Coherence

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CHAPTER 1

Introduction

Coherence or connectivity is a property of complex organized systems. On the face of it, such systems may be either biological or pre-biological. That is, an atom, a molecule or a mineral crystal certainly have a coherent complex structure. As I will suggest throughout this book, however, coherence is fundamentally a property of **biologically-based systems**. It is what makes their parts work together as a whole and what, in turn, makes the whole capable of evolving and adapting to novel contexts. Coherence is what makes information accessible to evolved minds-brains; it is what makes social groups cooperative and empathic, and what makes language accessible to other minds. What makes physical or chemical entities *appear* coherent, I suspect, is *who* they appear to – the mind of biologically evolved organisms.

Coherence has been traditionally discussed as a property of text, be it spoken or written, fiction or non-fiction, narrative, procedural or conversation, perhaps even poetry. A text is said to be coherent if a listener or reader can easily follow, recall, paraphrase or explain it: What is it *trying to say*? What does it *mean?*

But how does a listener or reader do this? What is it in the text itself, or in the mind that produces or interprets the text, that makes understanding, paraphrasing or explanation possible? And why do some texts seem coherent, accessible, enjoyable, while others seem opaque, garbled and incoherent? What I would like to suggest is that coherence is a much broader, more general property of complex biologically-based systems, complex in the simple-minded sense that they are made out of many parts – or at the very least more than one. And further, that more often than not, complex systems are hierarchically organized; and that their hierarchic design is a big part of what makes them coherent.

In the evolving structural complexity of biological organisms (Chapter 2), coherent, oft-hierarchic organization is what makes the parts *do their work* or *function* properly and efficiently, the way they are *meant to*. Coherent design and execution is what makes the parts of an organism collaborate with each other well, what makes them integral parts of a whole rather than disparate entities thrown together haphazardly, each doing its own thing. What is more, the coherent design of bio-organisms is not evident only in their extant structure. It is an evolved, selected feature, and is there for some **adaptive purpose**, emerging slowly in both evolution and ontogeny. In whatever domain, coherent design and coherent execution is what makes complex biological systems tick.

Quite early in the evolution of bio-organism, not too long after the first multi-cellular beings were assembled, their cells began to differentiate into distinct cell-types or tissue type. Soon, several tissue types combined into distinct organs, designed to perform disparate functions. Whereby arose the problem of **central control** and coordination. A rather mundane problem if one were an engineer – how to make sure that the parts collaborated and supported each other, rather than conflicted, interfered with and sabotaged each other's purpose. This is when the early differentiation of one crucial cell type occurred – nerve cells.

The function of nerve-cells and soon of a primitive **central nervous system** was from the start two-fold. First to receive sensory input from two types of adaptive context – the external environment and the organism's innards. And second, to command and direct the organism's response to both contexts.

Our second investigation (Chapter 3) concerns the structural and functional coherence of the evolved human brain-mind; how this incredible organ system makes it possible for the complex human organism, with its multiple tissue-types and organs, to perform its various life-sustaining functions. Not only how the extant system does its coherent magic, but how it came to be what it is through protracted evolution. For as complexity of the body grows and organs-cum-functions proliferate, coherent design of and coherent execution by the central controller must catch up.

Our next investigation (Chapter 4) concerns the rise of **complex social organizations**, leading eventually to what we have been proud, perhaps inordinately so, to call *cultures*. We meet first the old Society of Intimates, small groups of hunters-gatherers, the direct descendants of our social primate kin. We try to understand how coherent social structure and its functional double, coherent social interaction, sustained our ancestral *hominid* society for 6 million years. We note then how this durable adaptation has also characterized our own genus, *Homo*, for the last 3 million years, culminating in repeatedly waves of centrifugal migration out of Africa. We note then how the rise of complex bio-organisms and their complex central nervous system merely presaged the rise of complex, coherent socio-cultural organizations; first the small-scale Society of Intimates; then, beginning ca. 8,000 BC, the rise of the incredibly more complex Society of Strangers. In such complex mass societies, the adaptive role of coherent social organization and cooperation has gained added urgency.

We devote the next three chapters (5, 6, 7) to the coherence of **language**. First the coherence of the *process* of communication; then the coherence of the *product* – the text. We begin by noting how human language piggy-backed on amenable pre-linguistic neuro-cognitive capacities whose coherent design we surveyed earlier (Chapter 3). We describe the three hierarchic components of human communication – the lexicon, simple event-clauses and multi-propositional discourse – in terms of their structural coherence, both internal and contextual. We note how these three levels of organization map unto the neuro-cognitive capacities of long-term semantic memory and long-term episodic memory. We then survey how these two mental representation systems join with a third, attention and short-term working memory, and how these three systems interact coherently in language production, comprehension and memory.

In the last three chapters we investigate coherence in three complex off-shoots of cognition, socio-culture and communication. We look first (Chapter 8) at the role of coherence in **organized science**, noting how the gradual acquisition of knowledge by an organized community of scientists mirrors the acquisition of knowledge by the cognizing organism. That is, how philosophy of science, at its best, recapitulates epistemology.

We turn next to two vexing issues in the evolution of both bio-organisms and cultures. In Chapter 9 we consider the eternal seesaw between two conflicting views of **human nature**: Are we by nature selfish, aggressive and competitive, or are we empathic, pro-social and cooperative? We trace the argument first from antiquity to the Enlightenment (Hobbes vs. Rouseau). We then note how it was resolved in Darwinian and post-Darwinian theory of evolution, via the recognition of a dual adaptive impetus in social organisms – individual selection vs. group selection, respectively. We then note how this adaptive dichotomy controls the fine balance between social disruption and social coherence.

In Chapter 10, lastly, we probe the balance between the **homogeneity and diversity** of populations. First of biological population, where the balance between genetic/behavioral homogeneity vs. internal diversity defines biological species. At one extreme, excessive homogeneity may lead to adaptive stagnation and potential extinction. At the other, excessive diversity may lead to adaptive adventurism and potential speciation. The very same balance between homogeneity and diversity, it turns out, also applies to cultural populations, including our own. Our ancestral small-scale Society of Intimates used to deal deftly with this ever-shifting balance. But how is our current hyper-complex Society of Strangers doing as it struggles to manage its fraying cultural coherence? Some potential resolutions to our growing social incoherence seem worth exploring: Creative regression to the Society of Intimates of yore? Creative regression to the non-consensual social arrangements of the last 10,000 years? An algorithm-enforced virtual community of equal opportunity and winner-take-all merit? We stand at a bitter junction. Only time will tell.

CHAPTER 2

Complexity and coherence in biological design: An evolutionary-developmental account

Natural biological hierarchies are nested structures of functional entities that emerge when complex systems are organized.
J. W. Valentine (2004) *On the Origin of Phyla*

2.1 Systems: Complexity, hierarchy and coherence

2.1.1 Networks of matching structures and functions

In this chapter we survey the evolution of biological design from the point, ca. 4.3 billions years ago, when pre-cellular organelles, metabolizing and replicating haphazardly and inefficiently as ur-bacteria, first joined together symbiotically to make the protozoan cell. Each step in the evolution of bio-organisms from then onward, including that first step, involved the gradual growth of a **complex system**, whereby parts linked together **coherently** in a **hierarchic network** of nodes and connections.

From the very start, the structure of bio-organisms has not been a purely formal affair. Rather, it has been matched isomorphically, at every evolutionary step and at every hierarchic level, with an equally complex network of biological **functions**. In the emergent structural-functional network, each node performs a particular function, most often in collaboration with other connecting nodes in the network.

By saying that the two networks, the structural and the functional, are matched isomorphically we say three related things. First, that complex biological design involves a **division of labor**, whereby each structural part performs a particular function. Second, that the overall network of concrete structural parts corresponds to a matching network of invisible but just as real biological functions. And lastly, that the distinct functions of individual parts are **connected** and **coordinated** through the network pattern of the whole. Put another way, the very essence of this structural-functional network is that is its **coherently** rather than haphazardly organized.

Reductionist philosophers of science and radical biological gurus have on occasion challenged the notion of invisible 'functions' that are 'performed' by bio-organisms and their various parts as metaphysical, or worse, mentalistic.[1] But every adaptively-oriented biologist or medical practitioner ever since Aristotle has been an unabashed functionalist, asking themselves, at the very least, these simple-minded 'metaphysical' questions:

(1) All those intricately connected physical parts of the bio-organism,
 a. **What** exactly are they *doing* there?
 b. **Why** are they connected in this particular pattern?
 c. **How** did they come to be and work and connect *this* way?

The very essence of biology as a scientific discipline is packed into these questions, which invoke non-observable – or partly-observable – 'teleological', mentalistic and oft-abstract notions such as **doing, behavior, purpose, goal-orientation** or **causality**. It may thus be instructive to see how Aristotle, the first functionalist in Biology, developed his arguments against the two dominant structuralist schools of his day.[2]

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1. See extensive discussion of functional explanation in Chapters 8. S. J. Gould (1980), in his critique of Dawkins' reductionism in *The Selfish Gene* (1976), observes: "…the fascination generated by Dawkins' theory arises from some bad habits of Western scientific thought – from attitudes (pardon the jargon) that we call *atomism, reductionism*, and [genetic] *determinism*. The idea that wholes should be understood by decomposing into "basic" units; that [all] properties of microscopic units can generate and explain the behavior of macroscopic results; that all events and objects have definite, predictable, [fully-] determined causes. These ideas have been successful in our study of simple objects, made of few components, and uninfluenced by prior history.… But organisms are much more than amalgamations of genes. They have an [evolutionary] history that matters; their parts interact in complex ways. Organisms are built by genes acting in concert, influenced by environments, translated into parts that selection sees and parts invisible to selection. Molecules that determine the properties of water are poor analogues to genes and bodies…" (Gould 1980, pp. 77–78; bracketed material added)

2. It may be useful to remember that the notions of system, connections, pattern or organization are not purely physical/observable either, leaving considerable room for abstract, mentalistic invisibles such as interpretation, orientation, purpose or context. See Gould 's comment in fn. 1, directly above.

In *De Partibus Animalium*, Aristotle first argues against Empedocles' *elemental* (atomic) approach to biological structure, pointing out the relevance of larger bodily structures, such as tissues or organs:

> "…But if men and animals are natural phenomena, then natural philosophers must take into consideration not merely the ultimate substances of which they are made, but also flesh, bone, blood and all the other homogeneous parts; not only these but also the heterogenous parts, such as face, hand, foot…" (*De Partibus Animalium*, McKeon ed. 1941, p. 647)

Aristotle next notes the inadequacy of Democritan structuralism:

> "…Does, then, configuration and color constitute the essence of the various animals and their several parts?… No hand of bronze or wood or constituted in any but the appropriate way can possibly be a hand in more than a name. For like a physician in a painting, or like a flute in a sculpture, it will be unable to do the *office* [= function] which that name implies…" (*ibid*., p. 647; italics and bracketed material added)

Next, Aristotle offers his functionalist touchstone – the **teleological** interpretation of the design of living things, using the analogy of usable artifacts:

> "…What, however, I would ask, are the forces by which the hand or the body was fashioned into its shape? The woodcarver will perhaps say, by the axe and auger; the physiologist, by air and earth. Of these two answers, the artificer's is the better, but it is nevertheless insufficient. For it is not enough for him to say that by the stroke of his tool this part was formed into a concavity, that into a flat surface; but he must state the *reasons* why he struck his blow in such a way as to affect this, and what his final *object* [=purpose] was…" (*ibid*., pp. 647–648; italics and bracketed materials added)

Lastly, Aristotle outlines the governing principle of functionalism in biology and elsewhere – the isomorphic mapping of form and function:

> "…if a piece of wood is to be split with an axe, the axe must of necessity be hard; and, if hard, it must of necessity be made of bronze or iron. Now exactly in the same way the body, which like the axe is an *instrument* – for both the body as a whole and its several parts individually have definite operations [= functions] for which they are made; just in

the same way, I say, the body if it is to do its work [= function], must of necessity be of such and such character…" (*ibid*., p. 650; italics and bracketed translations added)

Ever since Aristotle, structuralism – the idea that structure is autonomous, arbitrary and requires no 'external' explanation; or worse, that structure somehow explains itself – has been a dead issue in biology, a discipline where common-sense functionalism is taken for granted, like mother's milk. Thus, from a contemporary introductory anatomy:

> "…anatomy is the science that deals with the structure of the body… physiology is defined as the science of function. Anatomy and physiology have more meaning when studied together…" (Crouch 1978, pp. 9–10)

Or from an introduction to animal physiology:

> "…The movement of an animal during locomotion depends on the structure of muscles and skeletal elements (e.g. bones). The movement produced by a contracting muscle depends on how it is attached to these elements and how they articulate with each other. In such a relatively familiar example, the relation between structure and function is obvious. The dependence of function on structure becomes more subtle, but no less real, as we direct our attention to the lower levels of organization – tissue, cell, organelle, and so on… The principle that structure is the basis of function applies to biochemical events as well. The interaction of an enzyme with its substrates, for example, depends on the configuration and electron distributions of the interacting molecules. Changing the shape of an enzyme molecule (i.e. denaturing it) by heating it above 40 C is generally sufficient to render it biologically nonfunctional by altering its shape…" (Eckert and Randall 1978, pp. 2–3)

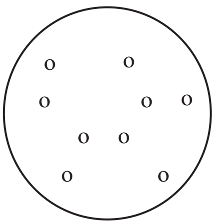
2.1.2 Complexity and hierarchic structure

The notion of *system* already suggests complex structural organization; that is, at the very least, having more than one entity (or part) to make up the whole. As a simple minded illustration, consider first the nine wholly unrelated entities in (2) below. They are independent of each other and have no association – no connection – to each other within an organized system:[3]

(2)
```
 o       o
o          o   o
    o   o
  o          o
```

Suppose now we enclose those nine entities in a circle that contains them all – together. What we have now is the simplest, most rudimentary system. It has a whole and it has nine parts. And further, each of the nine parts relates to – is contained by – the whole. But otherwise, the parts bear no relation to each other; that is:

(3)

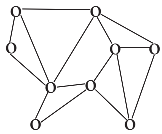


Suppose then we connect the nine entities in (3) in a **non-hierarchic network** pattern, where some of the nodes connect only to one other node, some to two, some to three, as in:

---

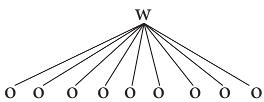
3. As sentient beings we are of course impelled to seek patterns of connectivity, and thus interpret random arrays of entities as systems, especially when the number of entities is small, and when they occupy contiguous space. It is thus night impossible to interpret two entities, say o – o, as independent of each other, since their pattern of relation is totally obvious – the shortest straight line between them.

(4)



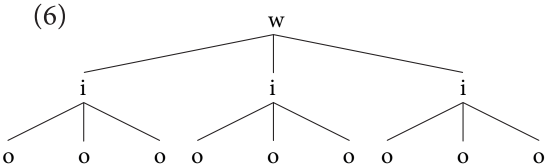
Next, we may be tempted, perhaps sorely tempted, to re-organize system (3), in which one whole includes 9 unordered parts, as a **one-level (flat) hierarchic network**, as in:

(5)



Lastly, the ordered entities in the rudimentary structured system (3), re-interpreted first as the flat-hierarchic (5), could also be organized as the **maximally hierarchic network** (6):

(6)



top node = the whole system

intermediate nodes = larger sub-parts

lowest nodes = smallest sub-parts

The first thing to note about the three-level hierarchic system (6) is something already alluded to earlier above – both its top node and the three intermediate nodes are *unobservable*. They are *abstract* organizational entities. Only the lowest nine nodes are real, observable entities. This philosophical conundrum should, of course, not disturb us in applying the notion of hierarchy to the structure of biological organisms. So that if a hand is made up of five fingers and a palm, aren't both the hands and its parts equally concrete and visible? Indeed; except that the 'hierarchy' itself is not really visible. All we see is five fingers and a palm. The notion of 'hand' – the whole – remains abstract. Or rather, it is a matter of *perspective*, or *framing*. For one purpose, I may describe fingers and a palm. For another, a hand.

One may as well note next that when Simon (1961) defined the essence of complexity as hierarchic structure, he was both inspired and a tad misleading. This is so because the network system in (4) is obviously a complex structure – but it is *non-hierarchic*. And both types of structure can be indeed found as parts of biologically-based systems. Thus, for example, the organization of lexical-semantic memory (see Chapters 3, 5 below) has hierarchies like (6) – say in the classification of plants and animals, or body parts, or human kinship terms – but also non-hierarchic networks like (4). What is more, the two network types can be embedded inside each other. Thus, for example, in the well-known experimental technique of *semantic priming*,[4] the word 'restaurant', if presented first, induces faster recall of semantically-related words such as 'food', 'table', 'kitchen', 'waiter', 'menu', 'cook', 'maitre de', 'customer', etc. But the resulting network of – clearly connected – nodes has both hierarchic and non-hierarchic components to its complex structure.

With all this in mind, it is still the case that biologically-based systems, including neuro-cognition, culture, and language, are extremely hierarchic. What is more, their hierarchic structure is not accidental, but is rather meaningful, functional, motivated. It is an evolved feature of the design of bodies and, by definition, of their functional organization; which may prompt a new cascade of 'hows' and 'whys'.[5]

2.1.3 Is pre-biological complex organization the same?

Having established a preliminary framework for the a more comprehensive discussion of structural complexity, hierarchy and coherence, three questions leap to mind concerning the nature of pre-biological entities:

(7) **The design of pre-biological entities**:
  a. Do pre-biological – physical or chemical – entities exhibit the same kind of structural organization as bio-organisms, with wholes made out of parts, with nodes connecting in networks, and with hierarchic organization?
  b. Does the isomorphic mapping of structures to functions found in bio-organisms exist in chemistry and physics?
  c. How did organized pre-biological systems, at the sub-atomic, atomic, molecular or cosmological levels, come into being? And is their evolution controlled by similar principles as bio-evolution?

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4. The experimental technique of semantic priming involves flashing on the screen before experimental subjects a word, then after a ca. 10 seconds another word, either semantically related (restaurant, food) or unrelated (restaurant, hammer). Immediately after flashing the second word, the subjects are asked to identify it as either a word or non-word in English (or any another test language). Consistently, the response time for related words is shorter than for unrelated words.

5. See discussion in Chapters 3 below about the processing efficiency advantage of hierarchic structures.

Question (7a) is easy enough to answer, in the affirmative. Consider first the building blocks of matter. Atoms are made of atomic particles, first the **electrons** spinning in multiple orbits around a **nucleus**; which in turn is made of tightly packed **protons** and **neutrons**. And each of the three atomic particles can be in turn decomposed into various **sub-atomic particles**. Taken together, the atom and its various parts and sub-parts make a complex hierarchic structure, with various types of **energy** 'holding' the parts in their 'proper' places, or 'controlling' their 'behavior'. Thus, protons and electrons are attracted to each other by **electro-magnetic** energy, while sub-atomic particles that are held together by **nuclear** energy. What is more, various types of atom may combine into **molecules**, held together by the same electro-magnetic energy as electrons to protons. And further, small molecules may combine into larger, more complex molecules. A clear hierarchic structure.

At the cosmological level too, a galaxy is made out of multiple stars, each of which may have several planets revolving around it, then each planet may have one or more moons revolving around it – all bound and moving by the interaction between gravity and inertia. Certainly another complex hierarchic structure.

At the geological level too, one can find examples of hierarchic structure. Consider, for example, how several small mountain streams combine into a larger brook; then several brooks combine into a river; then several rivers combine into a larger river. A classical hierarchic structure, this time the product of the interaction between gravity, erosion and sedimentation.

Question (7b) is much harder to parse. The negative-charged electrons spin around the atom's nucleus, held at a certain distance from the nucleus – in well-defined orbits – by an interaction between their centrifugal inertial force and the electro-magnetic positive charge – 'attraction' – of the protons. Is the electrons' speed-of-light spin around the nucleus their 'function'? Their 'purpose'? Or is their 'function' to be 'attracted' to positively-charged protons in the nucleus? Or is their 'function' to be 'attracted' to positively-charged protons in the nucleus of *another* atom, and thus partake in the next hierarchic level – combining two or more atoms into a molecule? And is the proton's 'function' to 'attract' the negatively-charged electrons to its positive charge and thus keep them spinning in orbits around *its* nucleus? And is this notion of 'function' the same as the one, say, when we note that the function of feet is walking, of teeth chewing, of the heart pumping blood, of the stomach digesting food, of the eye seeing, or of the brain thinking?

Willy nilly, it seems, the *teleological* bogeyman of *function* or *purposive behavior*, so natural in the discussion of both the structure and evolution of bio-organism, keeps rearing its ugly head, leastwise as a metaphysical, mentalistic *metaphor*. What is more, we even have the apparent *isomorphism* here between types of particles and the types of energy that powers them, moves them, attracts or repels them. But are those really the same teleological notions as bio-adaptive functions?

Question (7c), lastly, separates the sheep from the goats. The very foundation of biological evolution is the **adaptive behavior** of individuals and population; where successful survival and reproduction strategies are favored by **natural selection** and eventually encoded in the **genome**; and where genes and environment interact with the gestation, development and maturation of newborn organisms; that is, **epigenesis** (West-Eberhard 2003). So while the physical universe may be said to have metaphorically 'evolved' following the big bang, nothing remotely like the principles and mechanisms that control bio-evolution can be observed in the cosmological drift, nor in the gradual chemical 'evolution' that gave us first energy and/or sub-atomic particles, then larger particles, then eventually more complex atoms, molecules and rocks.

Some tendencies in the 'evolution' of the physical universe indeed involved the same general drift from simple to complex-hierarchic structures, as the universe slowly cooled off. But another guiding principle, **entropy**, drags matter and energy relentlessly downhill, into **dispersal** and **less complex** organization and **lower energy levels**.

True, entropy also controls the environment within which bio-organisms evolve, adapt and thrive. But it affects them mostly after death. Indeed, in a clear sense, biological organisms are small islands of **rebellion** against the relentless pull of entropy in the surrounding pre-biological environment. This feat of defiance is achieved, in the small islands that bio-organisms occupy and manage, by sucking energy out of the surrounding environment, thus increasing its entropy or disorder – while at the same time creating their own more complex, counter-entropic local organization, increasing its order.[6]

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6. I beg the reader's indulgence for a slight digression concerning the difference between pre-biological and biological entities. In 2007, when I was trying to put together a symposium on the Genesis of Syntactic Complexity (Givón and Shibatani eds 2009; Givón 2009), I called Murray Gell-Man to see if he would like to host our symposium. I had known Murray through my old mentor, Joseph Greenberg, and knew his Santa Fe Institute had a focus group on Complexity. After listening to my pitch, he said: "Of course you know, Tomás, it would be superfluous for you to try and solve the problems of syntactic complexity. Why don't you take a look at my work on complexity in physics and cosmology. I have already solved it".

2.2 The rise of complex coherence in biological design

In the main body of this chapter we will survey the evolutionary rise of complexity in biological organisms. What we will see is the repeated hierarchic embedding of earlier stages of evolved structure-and-function into progressively more complex, higher level of structural-functional organization.

2.2.1 From parasitic bacteria to symbiotic organelles in the protozoan cell

This section is a much-simplified version of the late Lynn Margulis' (1981) magnificent account of the evolution of the eukaryote living cell of both protozoan (mono-cellular) and metazoan (multi-cellular) organisms. That is, the evolution of the basic building block of all higher organisms. As Margulis herself documented rather conscientiously, her evolutionary account had been around a while, and had been ridiculed often by more conservative biologists (see the somewhat grudging account in Sleigh 1989, Chapters 1, 2).

As noted earlier above, the structure of chemical – let alone biochemical – compounds, the building blocks of the large polymers that support life, is already highly complex and hierarchic. The four major biochemical systems of the living cell may be described in terms of increased hierarchic complexity:[7]

7. My early academic career in biology and biochemistry (1956–1964) may have helped just a tad here. But it is truly mind-blowing how the field has grown and gained in knowledge and complexity. An anecdote may again illustrate this explosive growth of biology. The MS thesis I submitted in 1962 involved a simple-minded piggy-backing on Wendell Stanley's work, the resolution of the exact sequence of amino acids in the protein-chain that enveloped the Tobacco Mosaic Virus (TMV). With a well-known enzyme, supplied by Prof. Stanley's lab, we shaved off the last amino acid in the protein chain (*Thrionine*), then showed that the resulting virus lost its virulence vis-a-vis the tobacco-plant host. In spite of my protestations that the work was trivial, my thesis adviser insisted that I present the results to a conference at UC Berkeley, where Prof. Stanley was a prominent faculty member. At the end of my talk, my adviser introduced me to Prof. Stanley, who was most gracious in his comment: "Nice, how our first step in unfurling the chain should have such interesting consequences". At the time, I was not aware of the British code for "interesting". Prof. Stanley was not British, though, having been born in Ridgeville, Indiana.

(8) **Four major biochemical pathways to increased complexity in cell organization:**

a. **Carbohydrates**: Already-complex 6-carbon sugar molecules form more complex carbohydrates chains that store energy for short-term release.

b. **Fats**: Already-complex fatty acids and glycerine molecules form complex triple-chain fat molecules that store energy for longer-term release.

c. **Proteins**: Already-complex amino acid molecules form long and more complex protein chains that, in turn, make up the enzymes that catalyze all chemical reactions in the in the living cell, as well as many other life-supporting proteins in the cell.[8]

d. **Nucleic acids**: Already-complex nucleic acid molecules form the long chains of the genetic code (DNA) of biologically active proteins, or the copy chains (RNA) that transfer that code to enzymes that catalyze all metabolic reactions.[9]

About 4.5 billion years ago, some smaller precursors of the four complex polymers in (7a, b, c, d) already existed in the warm primordial aquatic soup on earth. The synthesis of those precursors from smaller and simpler inorganic compounds, all available in the atmosphere or the primordial soup – water (H2O), carbon dioxide (CO2), nitrogen (N2, NH3) and oxygen (O2) and some less common compounds – and their subsequent pre-biological polymerization, were presumably catalyzed by heat, atmospheric electricity, ultra-violet

8. By *catalysis* we mean the facilitation or speeding up of chemical reactions. The early inorganic catalysis by heat, electricity, ultra-violet radiation or other means simply pumped external energy into ur-systems in a haphazard, inefficient, ill-targeted fashion. In contrast, biological catalysis by enzymes is much more efficient, specific to particular building-blocks and products, and tied up to complex pathways in which the input chemicals of the desired reaction bind to the specially-structured enzyme protein, whereby they are brought close enough together in the proper configuration, so that the electro-magnetic attraction between the protons of one and the electrons of the other can 'click'.

9. By saying that enzymes perform a catalytic function we mean, much simplified, that they make possible biochemical reactions that under the relatively low body temperature of living organisms (below the ca. 45-degree Celsius temperature that would de-nature proteins) would not have occurred by themselves, for lack of sufficient energy input.

radiation, or external chemical energy (e.g. the oxidization of hydrogen sulfide (SH2)). But how exactly those small pre-biological polymers bonded together into longer self-replicating polymers; and how those, in turn, joined together in organelles inside the **procaryote** – bacteria – cell, is yet to be resolved.

The gist of Margulis' (1981) account is as follows:

Stage I. **Parasitism**

Three types of small bacteria, each containing one of the **organelles** that are now integral parts of eukaryote cells first became *parasitic* on the external cell-membrane of a fourth type, a much larger *host* bacterium. To wit:

(9) a. energy-producing **mitochondria**-like bacteria that digested organic debris
b. motion-inducing **flagelae**-carrying bacteria, like extant *spirochets*
c. photo-synthesizing **plastids**-carrying bacteria, like extant *cyanobacteria* (only in plants and algae cells)

The host bacterium, probably *amoeba*-like (Valentine 2004), brought into the symbiotic mix the protein-rich protoplasm with its catalytic enzymes for more efficient bio-synthesis, and its nucleic acid pre-chains, for a more efficient code-preserving replication (DNA) and instruction (RNA).

Stage II. **Symbiosis**

The three types of external parasites eventually penetrated inside the host bacterium and became *symbiotic* with it. In the process, they gradually lost their metabolic and genetic independence, with all four bacteria now pooling their specialized synthesizing, energy-deriving, metabolizing and replicating resources together into an integrated protozoan cell, one that could now manage all those disparate biochemical processes much more efficiently – in a complex interactive manner. In this connection, Margulis (1981) cites Thomas (1974):

> "…There is a tendency for living things to join up, to establish linkages, live inside each other, return to earlier arrangements, get along, whenever possible. This is the way of the world…" (Margulis 1981, p. 222)

The multi-step evolution of the full-fledged protozoan cell involved a progressive growth in hierarchic complexity, with pre-biological complexity of structure transforming into biological complexity of *both* structure and function. Which brings to mind an ontological question that has bedeviled Neo-Darwinian evolutionary biology for over a century now:

(10) At what point did pre-biological systems cross the line between short organic polymers outside the organism to long **metabolizing** and **self-replicating** polymers inside the now-living cell?

The answer to this question is still pending. Margulis (1981) seems to peg the boundary at self-replication:

> "…The crucial unsolved problem is how organic compounds became organized into self-perpetuating systems…" (1981, p. 7)

But self-replication is hardly conceivable without self-sustaining metabolism. One way or another, it may be useful to view the answer from two perspectives. From the lower-level perspective of *mechanisms*, of how the eukaryote cell executes its biochemical life-supporting functions, one can distinguish four major intra-cellular biochemical functions – or processes, essentially following (7) above:

(11) **Biochemical life-functions of the eukaryote cell**:
  a. **Cell-replication** function (mitosis, meiosis) controlled by the **nuclear DNA**
  b. **Information-transfer** function of the **messenger RNA**, shuttling between the nuclear DNA and the mitochondria and protoplasm
  c. **Cell-maintenance (i):** the digestive function of the **mitochondria** to produce energy needed for (a), (b) and (d)
  d. **Cell-maintenance (ii):** bio-synthesis function of enzymes in the **protoplasm** to produce needed ingredients for (a),(b), (c), (d)

From a more elevated evolutionary perspective, one may fall back on the three Darwinian criteria cited by Margulis (1981, Chapters 1):

(12) **Darwinian criteria for evolved organisms**:
  a. **Conservation** of evolved adaptive traits – guaranteed by the DNA genetic code
  b. **Variation** that produces new adaptive traits – guaranteed by random ordering 'errors', substitution, loss or doubling in the DNA chain
  c. **Adaptive selection** – guaranteed by the context of life – the environment[10]

10. In current Neo-Darwinian evolutionary biology, the environment is not viewed as wholly independent of the organism's interpretive, interactive mechanisms that operate during both development (ontogeny) and evolution (phylogeny); see West-Eberhard (2003).

It is criterion (12c) that illuminates the evolutionary process. The complex whole arises out of already-complex parts via interaction between the organism's internal properties and processes (11) and the external **context**, the organism's biosphere. Criterion (12c) transforms our notion of coherence, extending it beyond the *internal* coherence of the organism's diverse parts to embrace *external* coherence – the adaptive interaction of the organism with its environment.

Above the complex emergence of life, it seems, hovers the invisible 'metaphysical' ingredient that illuminates the whole, the persistent silent partner, **teleology** – the purposive behavior of context-sensitive organisms striving to adapt to their context. This teleology is the ghost in the machine[10] of both self-maintenance and self-replication in (11), (12) above.

2.2.2 From protozoa to metazoa: The rise of multi-cellular organisms

Organisms are best understood as developmental systems.
Valentine (2004, p. 50)

It is fairly clear that the first step in the evolution of complex multi-cellular (Metazoan) organisms, eventually displaying multiple complex organs and tissues, involved the clustering, initially-temporary, of single-cell organisms (Protozoa). Here Valentine (2004, p. 19) suggests two possible modes of early cell-cluster formation:

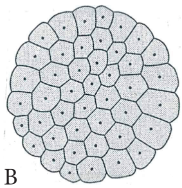
a. **Colony formation**: Erstwhile autonomous single-cell organisms joined together in a cluster. That is, daughter cells of mono-cellular organisms first dispersed upon cell division, then joined together in a cluster, or colony.
b. **Internal cell division**: A single-cell organism kept dividing, but the daughter cells continued to live next to each other in a cluster.

In both modes of cluster or colony formation, it is plausible to assume that a **temporary-cluster** stage preceded the stable colony in evolution. That is, the early colony was just a temporary stage in an **alternating life-cycle** between single cells and a cluster. Many variants of both modes are still attested in extant organisms, such as e.g. the choano-flagelate *Proterospongia* (Vallentine 2004, p. 44), or *slime molds* (Bonner 1988, p. 64), or the spherical algae *volvox* (*ibid*., p. 69).

In a way, the most obvious example of survival of the archaic alternating life cycle – mono-cellular to multi-cellular and back – is attested, abundantly, in most complex higher metazoic organisms of both the *Plantae* or *Animalia* kingdoms – the alternation between the large multi-cell vegetative body, made out of *diploid* (two chromosome sets) cells, and the single-cell reproductive *haploid* (one chromosome set) *gamets* – the sperm and ovum.

The second mode of clustering is most commonly observed in the embryology of most extant Metazoan organisms, an ontogeny that most likely *recapitulates* the phylogeny, whereby the early growing cell-cluster, before any differentiation to cell-types (tissues), forms a berry-like *Stereoblastula* (Valentine 2004, pp. 52–54; earlier called *morula* 'little berry'). Thus consider (Valentine 2004, p. 54; B):

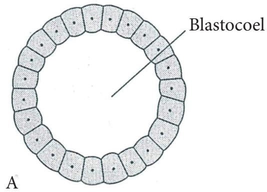
(13) **Berry like cell cluster (*Morula*)**

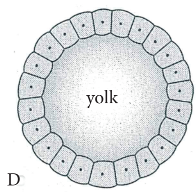


Such a histologically-uniform cell cluster eventually changes into a one-cell thick spherical envelope, the *Coleoblastula*, with either an empty middle (*Blastocoel*), or an enclosed yolk (*Periblastula*; *ibid*., p 54; A, D).

(14) **Empty sphere-like *Periblastula***:

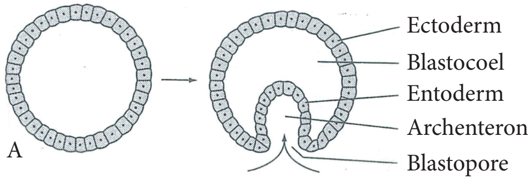
water-containing **yolk containing**





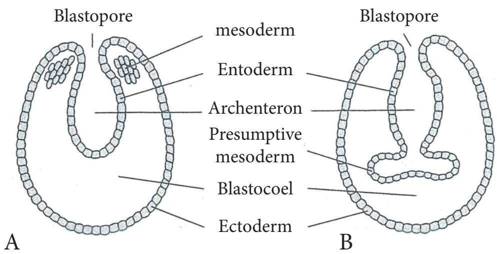
Next, again attested in early embryology, the *Coleoblastula* or *Periblastula* displays a gradually-deepening dent that soon becomes a larger and larger depression – the *Blastopore*. Whereby the next stage emerges, the *Gastrula* ('little stomach') or *Coleogastrula*. Thus (Valentine 2004, p. 56; A):

(15) **From spheric *Coleoblastula* to early *Gastrula***:



Next, the tissue inside the *blastopore* becomes the *endoderm*, the archaic stomach-lining tissue; while the tissue on the outside becomes the *ectoderm*, the eventual skin. Eventually, tissue inside the earlier sphere (*Blastocoel*) becomes the third archaic tissue type, the *mesoderm*, from which the many tissue types between the digestive tract and the skin develop. All tissue types of complex members of the *Animalia* kingdom can be traced to those three archaic types (*ibid*., p. 59; A, B).

(16) ***Gastrula* with all three archaic tissue types**:



The embryonic *gastrula* finds its evolutionary equivalents in, for example, the *hydra*, a tiny aquatic organism of the *cnidaria* phylum, with its single opening (*stoma*) surrounded by tentacles, a cup-like organism (see (16) above).

In the final archaic stage, an alternative evolutionary-embryonic development takes place. The outer 'lips' of the cup-like *gastrula* with its single opening (*blastopore*) fold toward each other till they link together, but only in the middle of the 'cup', leaving twin openings at the edges. This development eventually led to the evolution of the **alimentary canal** of complex *Animalia*, with two openings – a frontal one, eventually the feeding **mouth**, and a caudal one, eventually the eliminating **anus**. Many worms (*helmintes*), both aquatic and terrestrial, as well *anelides* and other small aquatic organisms, display this early post-*gastrula* design. This is the body plan that became, eventually, the general template for all higher organisms of the *Animalia* kingdom, including vertebrates. A front and side view of a hypothetical organism of this general design, with bilateral symmetry (see Section 2.4.4. below), is given in (17) below (Valentine 2004, p. 121; D, E).

(17) **Tubular organism design, with front-back differentiation and bilateral symmetry**

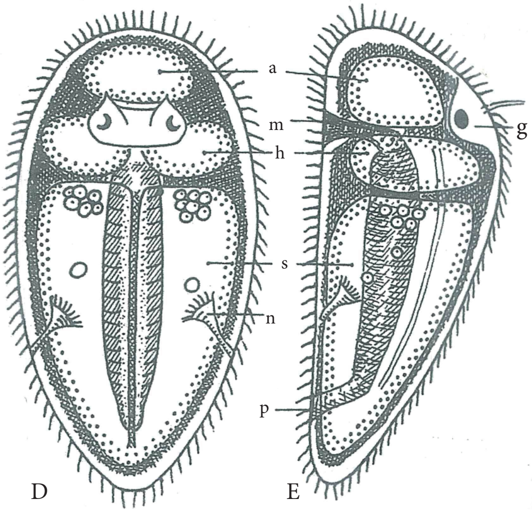


fig. 4.4 The origin of the coelom as suggested by Remane. (*A*) Cnidarian with tetraradiate enteron. (*B*) As mouth ans anus become separate openings, bilateral symmetry appears in the disposition of the enteric pouches. (*C*) Primitive bilaterian, with gut and three coelomic cavities (trimeric) as in some deuterostomes. (*D, E*) Dorsal and lateral views, respectively, of a hypothetical ancestral bilaterian. *a*, protocoel; *g*, brain; *b*, mesocoel; *m*, mouth; *n*, nephridium; *p*, anus: s, metacoel. From Remane 1954.

2.3 Intermezzo: Spatio-temporal experience and the advent of dimensions[11]

2.3.1 Preliminaries

We owe Immanuel Kant (1781; see Kemp 1968) the suggestion that the most primitive dimension used by sentient beings to construe their universe of experience – of both the external world and their internal body – must have been linear time. And that the three spatial dimensions must have followed later. It is thus of interest to see if the gradual evolution of bio-organisms points to anything remotely capable of supporting Kant's insight. We will begin by pointing out that the logic of time-space concepts suggests an asymmetrical one-way-conditional relation between space and time; so that time is independent of space but space presupposes time. That is:

11. A more complete version of this section appeared in Givón (1979/2019, Chapters 8)

(18) space ⊃ time (but not vice versa)

In plain words, no conceivable entity can exist in space unless it also exists in time. If Lucy is here, perforce she is also now. But some entities are more abstract, and thus exist only in time but not in space; that is, 'the celebration', 'last Tuesday', 'Christmas', 'my birthday', 'one minute ago', etc.

2.3.2 Experience in a one-dimensional universe of linear time

Consider first an *amoeba*-like mono-cellular organism that, given its small size, floats freely in the warm primordial aquatic soup. Such an organism has no capacity, let alone adaptive need, for controlled purposive motion, and its small size makes it indifferent to gravity, thus to the vertical dimension of space. In the dark deep, its sensory input is not spatially biased, but is distributed equally on all sides. So is its access to water-soluble chemicals or floating biological nutrients. Such an organism bears testimony to its indifference to spatial dimensions by having a full **spherical symmetry**, presumably because relevant input is distributed equally in all directions. The only primitive dimension it seems sensitive to and abide by is **linear time**. This is evident from the fact that its propagation, by cell division, is strictly timed by its metabolism, which in turn is also finely timed. It divides virtually on cue, every minute or so. The mechanism by which it 'reckons' time is strictly biochemical, a highly reliable metabolic clock. Reaching a certain protoplasm size, it splits, by the well-known process of *mitosis*.[12]

The external cell membrane of mono-cellular organisms affects a clear separation between the sentient organism and the external world. With that separation goes the tacit post-Socratic assumption that sentient beings have **no direct access** to information about the external world, unlike their access to their internal states and changes. Rather, they must rely on some *perceptual apparatus*.

12. In this process of vegetative cell division, first the double-strand (diploid) chromosomes separate into their single strands, which then migrate to the opposite nuclear poles, where they replicate, each strand reproducing its matching double. Each nuclear pole now has a full set of double-stranded (diploid) chromosomes. The nuclear membrane then pinches itself in the middle, dividing into two nuclei, each with a full set of diploid chromosomes. Then the cell membrane does the same, yielding two daughter cells, each with its own nucleus and an equal portion of the protoplasm. In multi-cellular organisms like ourselves, asexual cell division for growth, repair, differentiation and maturation proceeds essentially the same way as in, say, the mono-cellular amoeba.

Time is a linearly ordered dimension of successive adjacent points, governed by a strict logic of *precedence*, which may be given as:

(19) a. **Transitivity**: If point *a* precedes point *b*, and *b* precedes *c*, then *a* also precedes *c*.
b. **Non-reflexivity**: Point *a* cannot precede itself.
c. **Non-reciprocity**: If point *a* precedes point *b*, then *b* cannot precede *a*.
d. **Exclusivity**: If point *a* directly precedes point *b* and *b* directly precedes *c*, then there could be no point other than *b* that both follows *a* and precedes *c*.

Entities like the mono-cellular organism described above exist, as far as their cognition is concerned, in a uni-dimensional temporal universe. Their experience of unique entities in their cognized universe must be assumed to abide by the following criteria of time-stability:

(20) **Time-stability criteria for experience of unique entities**
a. Entity *x* is unique if at any point *a* in time it is identical to itself and only to itself, but not to any other entity *y, z*, etc.; and further,
b. If at any point *b* in time that directly follows *a*, it still identical to itself and only to itself.

2.3.3 Experience in a universe of time plus one spatial dimension: Early upright organisms

In order to describe entities that experience not only time but also of space, and then guarantee the uniqueness of *other* entities that they experience, one needs to consider another criterion, that of spatial exclusivity:

(21) **Spatial exclusivity and uniqueness of entities at any given time**:

An individual entity *a* is always identical to itself, and never to any other entity *b, c, d*, etc., if at any given time it occupies a position in space that cannot, at the same time, be occupied by any other entity.

Criterion (21) needs of course to allow for common apparent exceptions such as *enclosure* or *part-whole* relations; that is, allow for complex entities, as in:

(22) a. She has baby in her womb.
b. Trees are made of roots, trunk and leafy branches.
c. Salt can be dissolved in water.

Presumably, such cases can be handled by recognizing that complex entities, including bio-organisms, are hierarchically structured, with nested sub-parts and a cyclic bottom-up application of criterion (21) of spatial exclusivity.[13]

Consider now the life experience of an early multi-cellular organism, say a stationary member of the *cnidaria* phylum, or a stationary *mollusk* such as a Sea Anemone. Such an organism, devoid of spatial mobility, is heavy enough to be subjected to **gravity**, and thus sinks down at the larva stage till it lands on, and attaches itself to, a rock on the ocean floor. The sensitivity of such organisms to one spatial dimension, the **vertical**, is evident from their body's strong **vertical differentiation**: Their bottom is fashioned to be attached to the rock, and their top, around the single opening in a *gastrula* design, is occupied by flexible food-grabbing tentacles, as well as by sensory organs sensitive to light, touch and chemical input (smell/taste).

The reason for the vertical differentiation of these stationary organisms is obvious – attached to the ocean floor, all the relevant sensory and alimentary input comes from above. In contrast, their horizontal **radial symmetry** suggests utter indifference to further front-back or left-right differentiation on the horizontal dimension. Further body-design or cognitive differentiation beyond the vertical dimension is irrelevant to their adaptive needs.

Our *gastrula*-like organism, with the opening of its digestive cup facing upward, appears to have the same adaptively-determined orientation as shrubs and trees: A marked vertical differentiation, in the case of *Flora* dividing the nutrient-absorbing roots from the sunlight-demanding leaves; but relative indifference to the horizontal dimensions, whose input is roughly equal from all four winds.

2.3.4 Motion and the advent of a three-dimensional universe

Suppose now you took our stationary cup-like organism, detached its base from the rock, topple it on its side, and then endowed it with motility – by either wiggling its body, flapping its tentacles, or crawling on the ocean floor (or other arrangements; see Valentine 2004, pp. 64–65). If it now moves towards food, it is the former top, with its digestive-cavity opening, flexible grabbing tentacles and sensory organs, that will – naturally – become the new **front**. But with the body now prone, the former vertical axis is the new front-back axis – given

13. For the definition of complexity as hierarchic structure, see Simon (1961). See also discussion in Givón (2009, Chapters 1).

the organism's coherent motion towards potential food-source or away from predators. This forward-moving organism now has, perforce, two added spatial dimensions to cognize and cope with: The new vertical dimension of up/down, **back vs. belly**; and – unless it moves by corkscrew wiggle – the added third spatial dimension of **left vs. right**.

The organism we just described is well known, e.g. aquatic flat worms (*plati-helmintes*), among others. Their second spatial dimension, the new vertical, may become adaptively significant, since more input of either light or gravity-affected nutrients, or predators may come from above than from below. What is more, if they move by crawling on the ocean floor, their up-down differentiation is even more significant. Their third spatial dimension, on the other hand, while being a necessary consequence of their prone orientation and front-ward motion, is adaptively superfluous. This is evident from their left-right **bilateral symmetry** (Valentine 2004, p. 66, 121).[14] This bi-lateral symmetry has become a major evolutionary classificatory node, grouping together all complex *Bilateria* – from the lowly flat worm all the way to the *cordata* with their ur-spinal cord and onto our very own *vertebrates* (*ibid*. p. 120)

2.3.5 Purposive motion and the advent of agency

With the rise of forward-moving organisms like aquatic flat worms, the general spatial design of higher organisms of the *Animalia* kingdom, including vertebrates and mammals, has been set, seemingly for eternity. Their feeding aperture and perceptual capacities – the latter soon giving rise to a controlling central nervous system, first the spinal chord and then the brain – are increasingly centered in their motion-defined front. And while their motion towards nutrients may have at first been random, it soon becomes governed by the direction of perceived food. Which eventually brings about **controlled purposive motion** – toward food, moving prey or potential mates, and away from potential predators and other dangerous contexts.

Purposive motion, as well as a growing capacity for grabbing either free-floating food or self-propelled prey, has now rendered our front-moving organism a **volitional agent**. Its prior cognitive universe of dumb nouns ('this is a rock') and stative adjectives ('it is green') has now become a universe of active-agentive verbs, of intransitive motion ('move toward the light'), of action

14. The advent of the *left-right asymmetry* of the higher-vertebrate brain is still aeons away.

upon dumb objects ('eat the kelp'), or of interaction with other wilful agents ('catch the fish', 'mate with this male').

Without implicating humans and their sophisticated cognition, action and language, we nonetheless now have organisms whose sensory, motor and cognitive capacities are sophisticated enough for life and survival in a full-fledged spatio-temporal universe. In such a universe, they must be able to differentiate between a growing variety of dumb objects, some adaptively irrelevant, others potential food, breeding or hiding sites; others moving randomly, harmless and unthreatening; others moving purposefully, perhaps potential prey striving to escape; others potential predators bent on devouring you, or potential mates. It remains to be determined what cognitive capacities are required for differentiating between random and purposive motion. Put more narrowly, how does one spatio-temporally moving sentient being make judgements about the volition and agency of another?[15]

2.4 From early multi-cell simplicity to tissues, organs and system complexity

> The English language and genomes both
> have combinatorial, hierarchic structures.
> Valentine (2004, p. 77)

The evolutionary history of multi-cellular organisms is a continuation of the same story on a larger and larger scale. That is, already complex parts combine into more complex meta-parts in an ever-growing hierarchic organization. Bio-evolution seems to be the most conspicuous vindication of Simon's (1961) insight about *complexity as hierarchy*. This is true, first, of the evolutionary growth of complex body design and its matching functional organization. It is true of the evolving **genomic code** that licenses such body design, its functional organization and the ontogenetic development of both. And it is equally true of the evolving **neurological control system** that processes input and initiates signals or responses that makes the complex whole work. In addition to hierarchic organization, an important theme in the growth of metazoan complex design is *repetition*, which leads to *segmentation* of higher metazoan organisms along their front-back ('long') dimension (Valentine 2004, pp. 68–69). The entire story is rather complex, and the much-simplified summary given here is due, almost entirely, to the admirably coherent and detailed account in Valentine (2004).

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15. For further consideration of these issues, see Givón (1979/2019, Chapters 8).

The main theme in the growth of hierarchic complexity of the metazoan body involves, first, the combination of several **tissue types** (cell types) to make an organ; then of several **organs** to make an **organ system**; and then of several organ systems to make the whole **organism** (*ibid*., p. 80). But this growth of hierarchic organization involves multiple other factors that make the process more complex yet (*ibid*, p. 72). Not unexpectedly, the degree of complexity of an organism – thus roughly its position up the evolutionary tree – is closely correlated to the number of cell types (tissue types) it has (*ibid*., pp. 74–75).

It is a matter of curiosity, perhaps, that Valenine (*ibid*., p. 77–79) chose to cite the complex hierarchic organization of language (see Chapters 5, 6, 7 below) as a fitting analogue for the complex hierarchic organization of metazoan organisms. In this connection, he list the combinatorial progression from letters to words, then to 'phrases or sentences', paragraphs, chapters etc.,[16] noting that at any level of this combinatorial progression, the unit has to "produce a message that makes sense" (*ibid*. p. 78). This 'making sense' is, of course, a full equivalent to our notion of **functional coherence** that, in the main, is isomorphic to the **structural coherence** of the complex, hierarchic body-structure that evolves under adaptive-selectional pressures. The fundamental unity of all biologically-based systems is again underscored here by the teleological notion of *function*, as well as by the ever-present isomorphism of structure and function.

2.5 Body design, molecular classification and evolutionary hierarchies

As Valentine (2004, Chapters 4) notes, building a classificatory tree that matches the presumed course of evolution is not a simple endeavor. Ideally, body-design and molecular (genomic) criteria should yield the same branching classificatory-evolutionary tree. Alas, such an ideal is not yet fully attainable. The fact that from their early inception (Darwin 1959; Haeckel 1866; *inter alia*) to this day, all attempts to represent the evolution of biological taxa should wind up as hierarchic **branching tree structures** is striking. In this connection, Margulis (1981) observes:

16. The citation of letters – rather than semantic features – as the building blocks of words is an unfortunate if forgivable slip, given that Valentine's source was S. Pinker (1995), at that time an acolyte of his structuralist guru, N. Chomsky.

> "…classification as a whole is a hierarchy, a system of units that increase in inclusiveness and decreases in number from each level to the next higher one…many now strive to devise systematic classifications that reflect evolutionary history…" (*ibid.*) (1981, p. 17)

And likewise, Valentine (2004):

> "Genealogical histories can be traces in trees, which are positional structures" (Valentine 2004, p. 13)

And:

> "Natural biological hierarchies are nested structures of *functional entities* that emerge when complex systems are organized" (*ibid.*, p. 16; italics added)

Much like in biology and its evolution-relevant classification, the historical rise and diversification of languages and language families was rendered, from the early dawn of comparative-historical linguistics in the 1800s, in similar branching tree diagrams. The obvious question to ask then is this: Given the two hierarchically organized domains in biology and language:

(23) a. the evolved **structural-functional design** of individual organisms (or texts)
b. the evolved **classificatory organization** of biological (or linguistic) taxa

Do the same – or similar – general principles and mechanisms govern the two types of evolved, complex-hierarchic organization?

In the case of the classificatory organization of taxa (23b), be they biological or linguistic, the mechanisms that produce hierarchic organization are relatively transparent, for the most part elucidated by Margulis (1981) and adapted from (12) above:

(24) **Principles governing tree-diagram pattern of evolutionary taxa**:
a. **Conservation of adaptive traits**: maintained in biology by the genetic code, and in language by lexical-semantic and procedural-grammatical long-term memory, as well as by social pressure and communicative needs (see chs 4,5 below, respectively).
b. **Variation** that produces new potentially-adaptive traits; produced in biology by random 'errors' in the nucleotide chain; produced in language by inventive communicative experimentation by speakers.

c. **Self-replication of the extant organism**, guaranteed in biology by asexual or sexual reproduction, and in language by cross-generational transmission.
d. **Adaptive selection**: guaranteed in biology largely by interaction with the external environment; guaranteed in language by interaction with the social and communicative environment.[17]
e. **Reproductive/communicative isolation**: guaranteed in both biology and language by the geographic drifting apart of variant populations.

The principles and mechanisms that motivate the hierarchic organization of complex bio-organisms, of neuro-cognitive processing and control, and of live communication and the text it produces, are probably different. Given the structural-functional design of bio-organisms, the most likely explanation of their hierarchic organization has to do with the efficient organization and performance of complex multiple tasks by multiple organs that need to cooperate and coordinate. In neuro-cognition and language, a similar efficiency-driven explanation is probably involved (see Chapters 3, 5 below).

2.6 Final reflections

2.6.1 Coherence and context in biological design

2.6.1.1 Internal coherence

In the design of biological organisms, coherently-organized structural networks perform coherently-organized adaptive functions, with the two mapping isomorphically onto each other. Whatever the reasons may be that impelled the growth of complex hierarchic systems over the course of bio-evolution, the imperative of coherence in the organization of biological structure-cum-function is two fold. First, complex organisms require **internal coherence**, the coherent interaction and collaboration among the various parts vis-a-vis each other and thus vis-a-vis the whole. Division of labor at almost any level of complexity requires coordination. And coordination of a complex system requires **central**

17. In both bio-evolution and language change, the environment responsible for selection is not purely external. In biological evolution, there is a healthy interaction between the external environment, the genome, and development (West-Eberhard 2003). In language change, the *perceived* communicative context depends on the speaker's interpretation of it, on her/his communicative goals, and on her/his assessment of the hearer's current mental states of knowledge and intention (see Chapters 5).

control. In biological organisms, this central control is undertaken by the nervous system, a specialized information-processing and signal directing system that evolved surprisingly early in multi-cellular organisms.

General considerations suggest that there should be a correlation between the organisms **size** and: (a) its body complexity; (b) the size and complexity of its genome; and (c) the size and complexity of its central nervous system. Bonner (1988, Chapters 6) has made a valiant attempt to evaluate these assumptions, noting the difficulty of quantifying the internal body complexity of organisms – number of distinct organs vs. tissues/cell types – eventually settling on the latter.

Within bounds, a correlation does seem to exist between body size and internal complexity (Bonner 1988, p. 123; see also Bonner 2006, p. 82), although the size of equally-complex groups varies widely. The correlation between internal body complexity and genome size (thus presumably genomic complexity) appears less striking (Bonner 1988, p. 137). Lastly, the correlation between body size (thus presumably complexity) and brain size (thus presumably brain complexity) in vertebrates seems reasonable if not perfect (*ibid*., p. 199).

2.6.1.2 External coherence

In addition to their internal coherence, complex organism (much like simple ones) also require external coherence. That is, they must interact coherently with their adaptive-selective context – their **environment** – be it inanimate, animate or socio-cultural. Such external coherence involves once again nebulous 'mentalistic' notions such as **goal, purposive behavior**, or **activity**, be they about feeding, mating, defense, cooperation or socialization. Whatever the level of complexity of such behaviors, they must be coherent. That is, organisms must – given extant selectional pressures – behave in ways that should lead to achieving their adaptive goals. External coherence is thus not purely external, but must involve interaction with the organism's internal goals.

This is another area where Bonner (2004, Chapters 7) attempts to evaluate the correlation between size and complexity, this time in human societies. He reports a correlation between population size and social complexity – as measured by either the number of designated occupations or the number of 'organizational traits' (*ibid*. p. 103).[18]

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18. In the complex large-scale societies of hyper-social organisms such as ants or bees, this correlation obviously doesn't hold. Thus, with millions of members in an ant colony, there are only four adult occupations, or body types: breeding queen, breeding males, workers and warriors (Wilson 1971).

2.6.2 The seesaw of size aggregation

As noted above, the evolutionary growth in sized and complexity of organisms proceeded in several distinct steps. First, several primitive prokaryotic bacteria became parasitic on a larger bacterium, in effect creating a **social arrangement**. Eventually they merged together, first in a symbiotic quasi-social arrangement, then in a fully-integrated single-cell organism, the eukaryote protozoan cell.

The next step involved another social arrangement, the temporary association of single cells in seasonal colonies. Eventually such temporary associations became permanent, yielding the multi-cellular metazoan organism.

Given this repeated seesaw between individual organisms and their social aggregations, the rise of **social organisms** seems but another variation on an old theme. The complex aggregation of individual organisms may yield stable colonies like coral reefs, with only the breeding *gamets* breaking free, temporarily. Or it may yield the hyper-social arrangement of free-moving individuals, such as ants and bees (Wilson 1971). Or it may yield the 'mere-social' arrangements of many metazoans species at various evolutionary levels, including our own; where the coordination of cooperation in multiple tasks – feeding, reproduction, rearing of the young, defense, predation, sociality and communication – may demand complex reciprocal arrangements that, sooner or later, require a hierarchic social organization – and communication. But at whatever level, the *leitmotif* remains the same – the seesawing alternation between individual and group, with the distinction between the biological and the cultural repeatedly blurred (Wilson 1975). And at whatever evolutionary and complexity level, the imperative of **coherence** – be it of structural design, of functional organization, or of social interaction and communication – remains paramount. To again cite Thomas (1974), courtesy of Margulis (1981):

> "…There is a tendency for living things to join up, to establish linkages, live inside each other, return to earlier arrangements, get along, whenever possible. This is the way of the world…" (*ibid*. p. 222)

CHAPTER 3

Complexity, hierarchy and coherence in neuro-cognition

3.1 Recapitulation

In the preceding chapter we surveyed the growth of biological complexity from pre-cellular to mono-cellular (protozoan) to multi-cellular (metazoan) organisms, noting that a recurrent *leitmotif* was the gradual rise of hierarchic organization. We further noted that in biologically-based systems, structural organization is broadly isomorphic to functional organization, an observation that harkens back to Aristotle's *De Partibus Animalium*.

When multi-cellular organisms became larger and eventually motile, the growth of their complexity involved first the differentiation of cell types – tissue types – and then on to higher hierarchic organization. That is:

- multiple tissues combined into an organ
- multiple organs combined into an organ system
- multiple organ systems combined into the whole organism

The process of tissue differentiation started at the archaic cup-like *gastrula* stage, where the erstwhile uniform cells of the spherical *blastula* differentiated into three archaic types:

- the *endoderm* that lined the digestive inside of the *gastrula* ('little stomach');
- the *ectoderm* that lined, skin-like, the outside; and
- the *mesoderm* that developed in the space between the endoderm and the ectoderm.

All the tissue-types in more complex organisms can be traced back to these three archaic types.

Since the opening of the *gastrula* became the food-intake venue, it developed feeding implements, such as tentacles, and eventually a concentration of an evolving **sensory** and **control** mechanisms – the early **nervous system** – to control sensory perception, both visual and tactile, as well as feeding behavior.

We next noted how the lip-like folding of the *gastrula*'s mid-mouth eventually led to the basic two-aperture tubular structure of all motile metazoan animals. In this new body design, the one end of the tube became the archaic feeding mouth, the other the archaic eliminative anus, while the tube between them became the digestive tract.

Next, with the advent of mobility, the mouth-anus axis became the **front-back** axis, respectively. With both foods and other adaptively-relevant input now coming increasingly from the feeding front, the concentration of sensory organs and the evolving nervous system in the front end of the tube is an adaptive foregone conclusion.

A duplicative mechanism, well known in the evolution of genomes, led to eventual **segmentation** of the body along its front-back axis, yielding the early segmental design of long worm-like organisms (*platihelmintes, anelida*). An ancient part of the central nervous system, the spinal chord and autonomous nervous system, was added first as a tube-like fold in the dorsal ectoderm. Lastly, the concentration of sensory organs at the front end evolved into an archaic brain, the controller and coordinator of sensory and motor behavior.

3.2 The primate brain

3.2.1 General architecture: The three brains

In the evolution of the vertebrate brain, the early concentration of nerve ganglia at the feeding front of tubular worm-like organisms eventually evolved into the old **lower brain**, the current mammalian **brain-stem**. As in the embryology of primates (Tucker and Luu 2012, Chapters 1), the old brain was eventually divided to yield a new frontal part, the **mid-brain**. And the mid-brain in turn divided again to yield the **fore-brain** or **cortex**. The resulting tripartite general design remains fundamental to the vertebrate, mammalian and primate central nervous system.

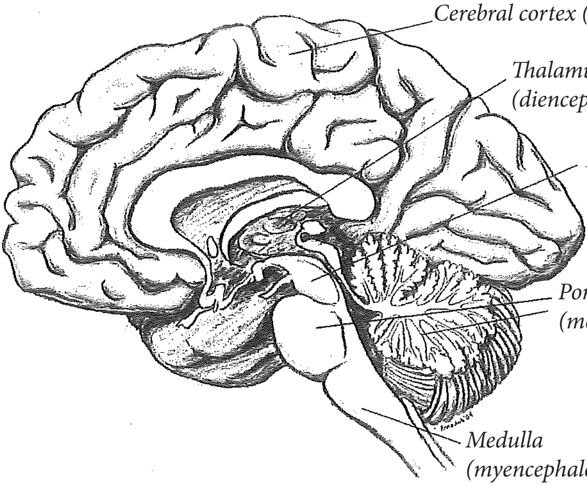
The **brain stem** of mammals is fully automated at birth. It controls the old, sub-conscious functions of the autonomous nervous system that stretches along the spinal chord, controlling heart beat, blood circulation, digestion, lung, liver and renal functions, etc. It is also responsible for maintaining the somatic *homeostasis* (steady state) of internal organs – temperature, blood pressure, etc. Lastly, it is responsible for transmitting internally-generated visceral, emotional, and somatic-state input upward to the mid-brain and, eventually, the cortex.

The **mid-brain** of mammals, comprising of the limbic system, thalamus and hypothalamus, the cingulate cortex and other sub-cortical structures, is not fully automated at birth, but becomes automated during the early months of life, a maturation process that depends on interaction with external sensory input. It processes the early stages of visual, auditory and olfactory perception, transferring them onward for further processing in the relevant primary sensory areas of the cortex. In addition, the limbic-thalamic core transmits visceral-emotional information from the brain stem to relevant cortical areas, including the conscious executive attention. And further, the mid-brain also serves as the terminal memory-storage of input from multiple cortical pathways. As such, it is responsible for modulating cortical input with top-down feedback from the various memory systems.

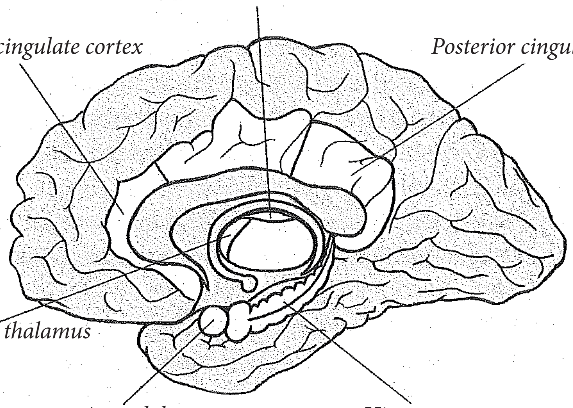
The **cortex**, new brain or *telencephalon*, is the last brain division to evolve. In primates, the cortex is wrapped like an envelope around the mid-brain and brain stem. Its various parts mature differentially over months or even years of post-natal development in mammals and primates, roughly with the *posterior* (back) parts maturing first and becoming fully automated, the *medial* parts maturing and automating later, and *anterior* (front) parts maturing last and automating latest or not at all.[1] The cortex is charged, first, with higher-level processing of **sensory** input coming from the primary sensory organs, often via the mid-brain. It is also charged with **motor** commands and their coordination with sensory input. It comprises of several modality-specific pathways and networks, feeding into integrative cross-modal intermediate regions and beyond. The mid and anterior regions of the cortex also accommodate the **attentional system**, a network comprising of modality-specific pathways as well as cross-modal integrative regions, including the conscious executive attention. Not surprisingly, the cortex also accommodates the processing of later-evolved faculties such as language, reading and math. The many cortical pathways and networks eventually project onto the sub-cortical mid-brain regions for both bottom-up **memory** storage and top-down feedback. Two pictorial representations of the tri-partite organization of the human brain are given in figures (1) and (2) below (Tucker and Luu 2012, p. 9).

1. This order of maturation or automation – from back to front – recapitulates broadly the evolutionary order, as did the maturation and automation order of the three main parts of the brain.

(1) **The tri-partite organization of the human brain**



(2) **Some details of mid-brain organization**



3.2.2 Perception, cognition and coherence control

Several interlinked general themes need to be touched upon here, however briefly, themes that may serve to frame the more structure-specific survey further below. The first involves the distinction between *perception* and *cognition*. In the brief mention of the early stages of the evolution of the nervous system of the *gastrula*-like *cnidaria* organisms (Chapters 2), we noted that these cup-like organisms often have prehensile food-grabbing tentacles around their feeding aperture, as well as other types of motion organs. With the evolution of forward-moving tube-like organisms such as *platihelintes* and *anelides*, a higher concentration of nerve-cell ganglia established itself at the feeding front aperture. This ganglia concentration is the early precursor of the **central nervous system**, located in what later became the head. The function of this early central controls system is, at the onset, two-fold:

- **process sensory input**, be it external or body-internal;
- **generate appropriate responses** by external or internal organs.

It is clear, however, that this disarmingly simple ur-nervous system is already a full-fledged cognitive processing-and-control system. To begin with, it already has to **make choices**, leastwise of two types. First, it has to make **interpretive choices** about incoming sensory data:

- Is it salient enough?
- Does it surpass requisite thresholds?
- Can it be assigned to any particular adaptive category, such as:
  - small food particles?
  - large moving predator?
  - small moving pray?
  - same-size potential mate or ally?

Next, our ur-nervous system must also make **behavioral choices** about possible responses to categorized input, however automated those responses may be:

- Does the input merit a response?
- If so, which one:
  - active-feeding response?
  - forward mating response?
  - turn-away flight response?
  - body-internal response?

All of which calls into focus another major component of any cognitive system, however rudimentary. In order to make adaptive classificatory decisions of the most rudimentary kind suggested above, the organism must already have in place a classificatory schema of adaptively-relevant **categories**. And that schema must be sufficiently ordered or structured – be it as a criss-crossing network or a hierarchy – to allow efficient accessing and retrieval. What is more, the classificatory schema must be accompanied by an **access procedure**, however rudimentary, whereby the organism can compare tokens of sensory input to the schema's categories for matches or mismatches. Put another way, our ur-cognitive system cannot function, even at the most primitive level, without a **memory system**.

Which brings us back to our main theme – coherence. Even at the most rudimentary level, a cognitive system must maintain coherence in multiple ways. First, incoming external signals must cohere with available sensory capacities. Second, sensory input must also cohere with the memory-stored classificatory schema. Third, chosen response must cohere with – be appropriate to – incoming sensory input. Fourth, chosen response must also cohere with available adaptive choices. And lastly, the categorization schema itself must be organized in a coherent way in order to facilitate efficient search and retrieval. As we shall see below as well as in subsequent chapters, similar **coherence imperatives** crop up at various regions of complex neuro-cognitive systems.

3.3 General architecture: Periphery to core – and back

In this section I will outline a general framework for the structural-functional organization of the human cortex and connected mid-brain regions. Being a non-expert, I will lean heavily at the onset on the best overview I know, that of Marcel Mesulam (2012). There are several reason why I find Mesulam's framework – indeed vision – attractive. First, it presents the highly complex cortical-cum-limbic organization as an overall **hierarchic network**, into which many less hierarchic sub-networks are embedded. Second, it accommodates rather well the work of many others on the major function-specific sub-networks that combine to make the whole – visual and auditory processing, sensory-motor coordination, memory, attention and language. Third, the framework suggests a coherent **multi-directionality** of traffic in the network, highlighting the complex role of the sub-cortical core.[2] That core is first the top node in the hierarchy, and as such the recipient of multiple bottom-up feeds from the cortical sub-networks. It is also as the dispenser of **top-down feedback**. This makes the core, in a rather obvious way, the **coherence monitor** or **integrator** of the overall network. Lastly, Mesulam is rather candid about the methodological complexities that make any integrative framework, however inspired, forever tentative.[3]

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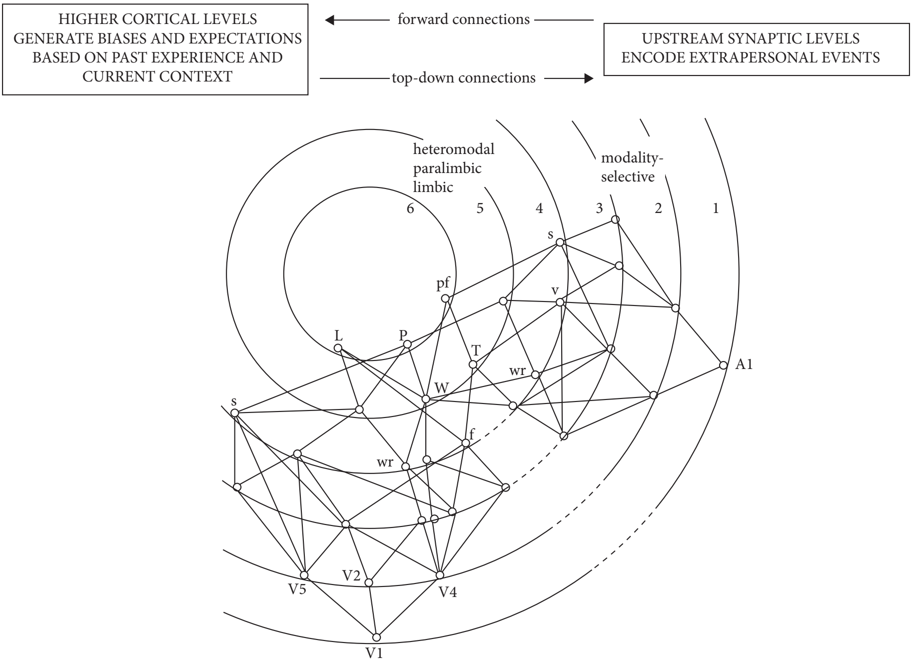
2. I owe the term 'core' (vs. 'shell') to Don Tucker (2001; in preparation; see also Tucker *et al*. 1986). My preference for 'periphery' over 'shell' follows Mesulam (2012).

3. See Chapters 8 for the residual tentativeness of empirical science.

Mesulam's schematic summary of the cortico-limbic network's overall organization is reproduced in figure (3) below (Mesulam 2012, p. 2184).

(3) **Human Cortical Connectivity**



The concentric circular zones 1–6 in (3) above represent a gradual transition from the most peripheral and uni-modal (modality-specific) sensory regions 1–2 to the sometime uni-modal but often hetero-modal integrative zones 3–4, then onward to the more integrative yet hetero-modal zones 5–6, with 6 representing the core. Thus, the visual regions *V1, V2, V4, V5* in zones 1–2 are points along a forward progression – toward the forebrain – of the *primary visual cortex*, beginning at the tip of the occipital lobe (see Section 3.4. below). Likewise, region *A1* in zone 1 is the *primary auditory cortex*.

Further into the concentric design, in zones 3–4–5, one finds various regions that specialize in mid-level integration. Thus for example, the two *wr* regions in zone 4 are still mono-modal, but integrative. One of them, with input from V4, is on the **ventral visual trend**, originally dedicated to visual object-recognition (Mishkin 1982; Ungerleider and Mishkin 1982; Kaas 1989; see Section 3.4. below). This visual channel integrates individual visual features – color, shape, size – into unified visual object concepts. What is more, it has been also adapted for visual word recognition (Posner and Carr 1991;

McCandliss *et al.* 1999). In the same vein, the other *wr* region gets input from the auditory channel *A1*, the primary auditory cortex. Its later conversion into auditory-word recognition now involves the integration of lower-level phonetic features into auditory words. Lastly, region *f* in zone 4 specializes in visual face-recognition, again integrating multiple features into a visual whole. It is still a uni-modal processor – but highly integrative.

Further toward the core, region *T* in zone 5, located in the *lateral-temporal lobe*, is a hetero-modal integrator, receiving input, however indirectly, from both visual region *V4* and auditory region *A1*. Likewise region *v* in zone 4, with input indirectly from the uni-modal auditory region *A1*, is involved in the integrative task of individual voice recognition. Next, region *S* in zone 4, on the **dorsal visual trend** (Mishkin 1982; Ungerleider and Mishkin 1982; Kaas 1989), is involved in spatial cognition. That is, it integrates stationary objects vis-a-vis their spatial ground, or moving objects vis-a-vis each other *and* the stationary ground. And region *W* in zone 5, adjacent to the ventral visual object-recognition stream in the temporal lobe, is the language-relevant Wernicke's area, involved in the integration of the meaning of word combinations – event-clause.

At the core, lastly, we find region *L* in zone 6, the hippocampus-entorhynal-amygdala in the **limbic system**, a central memory storage area. Mishkin (1982) considered it the site of 'explicit memory' in monkeys, thus of the integrated hetero-modal **episodic memory** in humans (Squire 1987, 1992; Squire and Zola-Morgan 1991). Next, region *P* in core zone 6, is the *posterior-parietal cortex*, a highly integrative hetero-modal region and part of the **attentional network** (see further below). Finally, region *Pf* in the core zone 6, the *dorsolateral prefrontal cortex* (DLPFC), is a core component of the hetero-modal, conscious **executive attention** system. This component of the attentional network connects to the sub-cortical *Anterior Cingulate Cortex* (ACC), to the *limbic system*, to the *posterior-parietal attention region*, and more (Schneider and Chein 2003; Fan 2014; Posner and Rothbart 2007, 2020).

In sum, while at or near the limbic core the overall network resembles a hierarchy, or a group of hierarchic networks, further towards the periphery it encompasses several cris-crossing less hierarchic networks.

Two global features of Mesulam's framework deserve special note. The first involves the skewed distribution of cross-modal connectivity:

- **Non-hierarchic cross-modal connections**: Such connections are more dense at the uni-modal perceptual periphery, and taper off gradually toward the core. This reduction is only natural: as one gets closer to the core, uni-modal information from the periphery has already been integrated in the intermediate hetero-modal regions. Further cross-modal connectivity would therefore be superfluous. Put another way, the closer one gets to the core, the more hierarchic the network appears.

- **Top-down feedback**: In both the core and the periphery, indeed at any hierarchic level of the system, higher regions with already-organized coherent structure send top-down feedback downstream. Such feedback helps the mid-level integrative regions sort out, or make sense of, incoming bottom-up information. Put another way, the top-down feedback at any hierarchic level insures the **coherence** of the overall network. Rather than being an exception to the hierarchic organization of the network, it *guarantees* its overall coherence.[4]

At the top of the hierarchy in particular, the limbic core processes incoming information along two parameters of coherence:

- How the new input coheres with the **already-organized information** in long-term episodic and semantic memory.
- How the new input coheres with the **current context**, the ever-shifting working memory.

Mesulam himself emphasizes the central role of the top-down feedback in establishing the coherence of the bottom-up streams of information at all hierarchical levels of the network:

> "…the role of heteromodal, paralimbic and limbic areas (i.e. transmodal cortices) is not only to promote convergent multimodal synthesis through forward [bottom-up] connections, but also to bind distributed modality-specific fragments into *coherent experiences, memories and thoughts* through top-down connections…" (2012, p. 2185; bracketed material and italics added)[5]

4. I owe this discussion to an exchange with Mike Posner. As will be seen in Chapters 5, 6, 7 below, the coherence structure of language and communication recapitulates this framework of top-down feedback as a guarantor of hierarchic network coherence.

5. M. Gazzaniga (2005, pp. 137, 148) has suggested, citing no evidence, that the site of this coherence-promoting integrative capacity, which he terms "the left hemisphere interpreter", is in an L-cortical (temporal?) region, a language-related site (Wernicke's semantic area?). Mesulam's framework and the supporting evidence are more compelling.

In anticipating the integration of modality-specific sub-networks into the overall hierarchic structure, Mesulam notes:

> "…Transmodal nodes at levels 5 and 6…provide multimodal integration sites, and therefore hubs or epicenters, for multi-modal domains such as spatial attention, episodic memory, executive attention and language…" (2012, p. 2186)

In a final assessment of the prospects for integrating lower level sub-network into his hierarchic core-periphery schema, Mesulam observes:

> "…Five major systems in the human brain fulfill the connectivistic criteria of large-scale distributed networks: the fronto-parietal spatial network described above, the left hemisphere temporo-perisylvanian language network, the limbic/paralimbic network for explicit memory and motivational salience, the infero-temporal face and object recognition network, and the prefrontal executive function…" (*ibid.*, p. 2187)

One might as well note, lastly, that another function of the limbic core has also been proposed, this one involving its connections to lower-brain visceral, emotional and motivational systems. Thus, Tucker (2001; in prep.) argues that the limbic core also has an **anticipatory** or **expectancy** function, preparing the brain subconsciously for incoming bottom-up information. Some support for this suggestion may come from the experimental work of Libet (1991, 1999), showing that in some conscious decision or choice-making tasks, the limbic core activates several msecs earlier than the pre-frontal executive attention, venue of choice-making and conflict resolution. This has been interpreted by some to mean that our sense of conscious decision-making may be a post-hock rationalization.[6]

In the next section we will review, however briefly, three specific sub-networks that appear to integrate rather well into Mesulam's general framework.

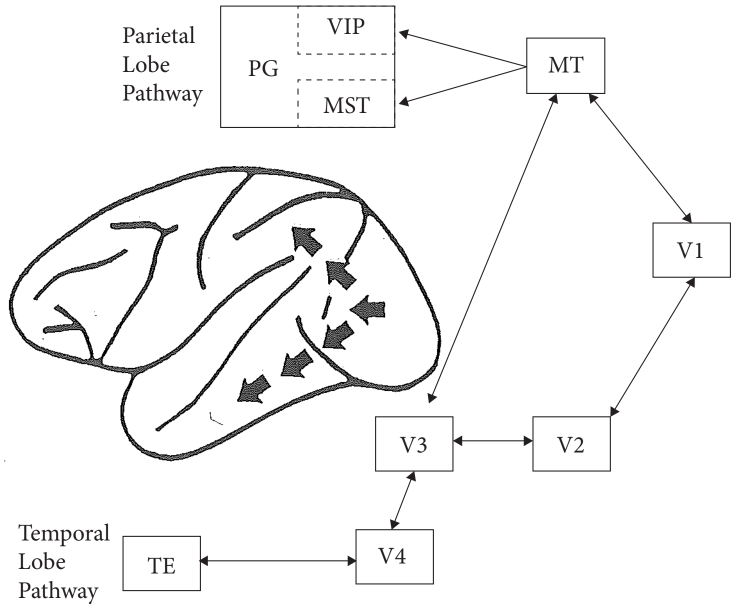
6. See e.g. Gazzaniga's (2005, Chapters 6) discussion of the implication of Libet's finding to our notion of free will. Michael Posner (i.p.c.) notes that Libet's research may be applicable only narrowly to the initiation of motor behavior, and has not been replicated in other areas of conscious decision making.

3.4 Three function-specific cortical networks

3.4.1 The visual information network

In a series of studies, Mishkin (1982); Ungerleider and Mishkin (1982); Kaas (1989) and others outlined the connectivity of the two-pronged cortical visual network. A schematic representation is given in (4) below (Kaas 1989):

(4) **Two cortical trends of visual information processing**



From V1 at the tip of the *occipital lobe*, seat of the primary visual cortex, the network splits into a ventral (lower) and a dorsal (upper) trend. The **ventral visual trend** proceeds through V2, V3, V4 and onward to a site in the temporal lobe (TE), adjacent to and perhaps not distinct from Wernicke's area. This ventral trend processes **visual object recognition**, but was later re-adapted to also process visual word recognition. From the temporal-lobe site (TE), the ventral trend projects down – still bottom-up – to the *paleo cortex* and *amygdala* in the limbic core (Tucker 1991). However, a top-down projection goes back to a pre-frontal cortical site – area 47/12 below Brocca's area (44/45). This pre-frontal cortical site was identified by Snyder *et al.* (1995) as the terminal point of the visual word recognition pathway.

Later studies using ERP to assess the precise timing (Posner and Pavese 1997; Abdulaev and Posner 1997) show that the pre-frontal site (47/12) is activated by single noun stimuli at 200 msecs. In contrast, the temporal-lobe site (TE) activates by noun-verb combinations at 800 msecs. These are, respectively, the processing times for the resolution of word meaning and verbal clause meaning (Swinney 1979). Further support for the combinatorial role of Wernicke's area comes from more recent studies by Badre and Wagner (2007); Friederici and Frisch (2000); Bahlmann *et al.* (2008) and Friederici (2008).

The **dorsal visual trend** splits from V1 and projects to area MT in parietal lobe and onward towards the mid-parietal visual-attention site PG (*parietal gyrus*). This pathway is involved in processing spatial information, i.e. information that integrates **objects in their spatial context**. That is, the objects' position vis-a-vis each other (spatial states); or objects' motion vis-a-vis other objects or vis-a-vis the ground (movement events); or objects interacting with each other (actions). The connection of the MT region to V3 on the *ventral* visual trend is significant, given the need to identify the *types* of objects that distribute, move or interact in space – information that is processed in the ventral trend.

A most intriguing experimental work with single-cell electrode recordings in monkeys, by Perret *et al*. (1989), has shown that specific locations on or near the dorsal visual trend encode specific **visual events**, the visual equivalent of **verbs**. This opens the door to a tantalizing conjecture (Givón 2009) – that while the *ventral* visual object-recognition trend had been re-adapted to the linguistic use of noun processing, the *dorsal* trend may have been likewise re-adapted to the processing of verbs or clauses – thus language-coded events or actions – and their concatenation in multi-clausal discourse. In terms of evolutionary change, this conjecture conforms well with the known pattern of the early evolution of new functions. That is, that an old structure may first be re-configured to process *both* its old function and a new – closely related – function, before the latter goes on to acquire its own dedicated structure. Thus (Mayr 1997):

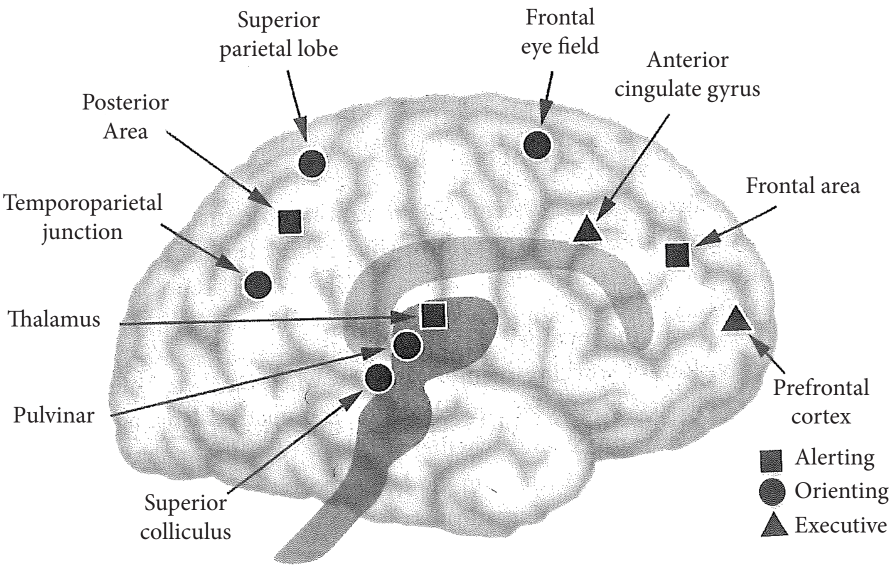
> "…Another entirely different and much more dramatic way by which evolutionary novelties can be acquired is a change in the function of a structure. Here an existing structure, let us say the [sensory] antenae of a *Daphnia*, acquires the additional function of a swimming paddle… During a succession of functions, a structure always passes through a stage when it can simultaneously perform both jobs…" (1997, p. 194–195; bracketed material added)

This pattern of change, by the way, is well known in the diachrony of grammar (Givón 2015; see also Chapter 7, below).

3.4.2 The attentional network

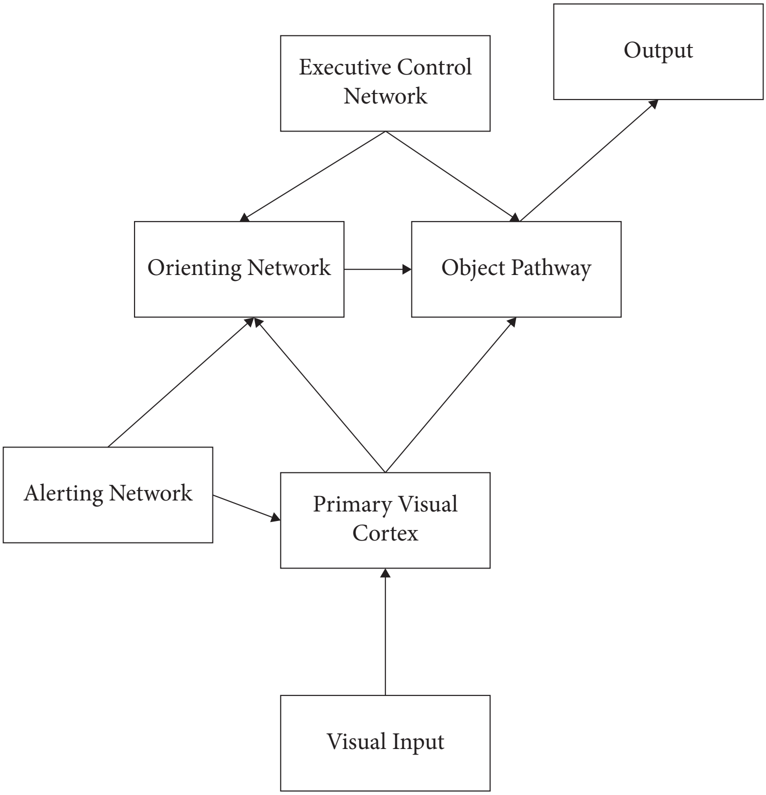
There are several depictions of the cortical and sub-cortical connectivity of attentional networks in the human brain, and the directionality of the traffic within them. Thus, Posner and Rothbart (2007) propose first the distribution of three attentional functions – alerting, orienting and executive – in the right hemisphere and the limbic core. The multiple sites of each function are distributed between the cortical regions of the *temporo-parietal junction* and the *pre-frontal cortex*, as well as in sub-cortical *limbic* regions and the *anterior cingulate gyrus* (ACG; also called *anterior cincgulate cortex*, ACC). The connections and directionality of traffic are not specified in the graphic representation below (Posner and Rothbart 2007, p. 6):

(5) **Distribution of attentional network sites**



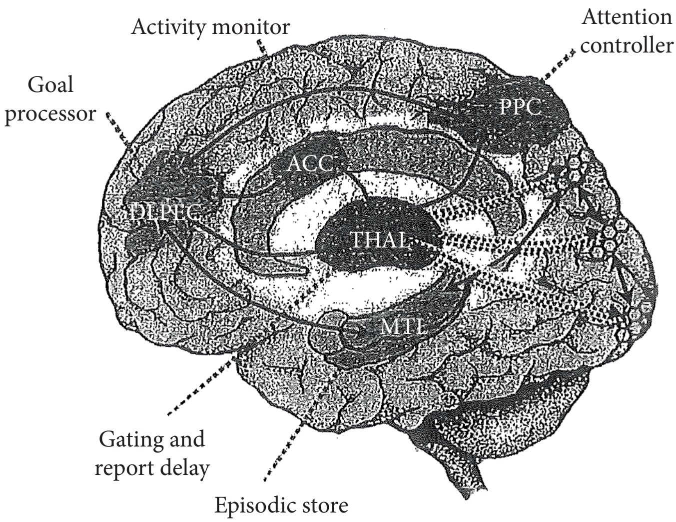
In a subsequent chart, however, Posner and Rothbart (2007, p. 10) give a fairly explicit functional flow diagram for the cortical parts of the network, with connectivity and direction of flow indicated:

(6) **Flow diagram for cortical attentional functions:**
(Posner and Rothbart 2007, p. 10)



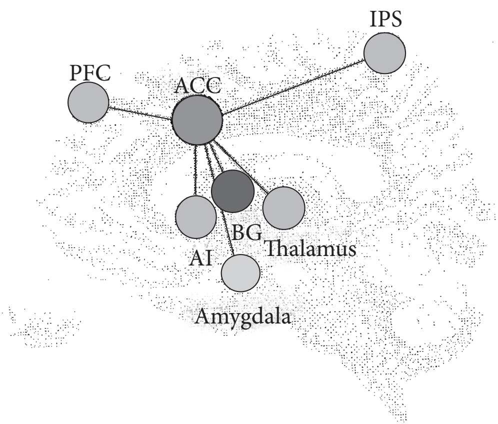
Schneider and Chan (2003), focusing on the executive attention network, note the connectivity of cortical – *parietal* and *occipital* – sites and the *dorso-lateral prefrontal cortex* (DLPFC), as well as several subcortical regions – the *anterior cyngulate cortex* (ACC), the *thalamus* (THAL), and the *hippocampus* and associated limbic structures (MTL). All the connections in their model are bi-directional, and the proposed connectivity pattern is non-hierarchic. Their semi-diagramatic representation is given in figure (7) below (Schneider and Chein 2003):

(7) **The executive attention network**



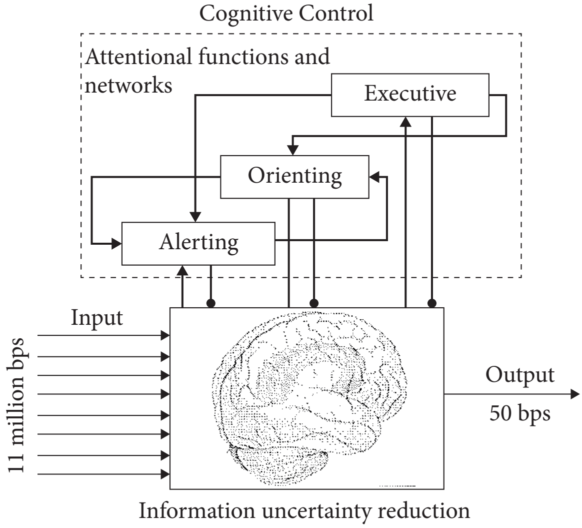
Lastly, Fan (2014) gives two diagramatic representations. The first one is hierarchic, placing the sub-cortical *anterior cingulate cortex* (ACC) at the core, from which two cortical connection lead to the *pre-frontal cortex* (DLPFC) and a *parietal* site (IPS). Four other connections lead to the *limbic-thalamic* core – the *anterior insular cortex* (AIC), the *basal ganglia* (BG), the *thalamus*, and the *amygdala*. No directionality of traffic is given. Thus (Fan 2014) :

(8) **The fronto-parietal network and the pivotal role of the ACC in information processing and responses across domains**



In his second, more functional, diagram of cognitive control, Fan indicates the direction of traffic, with some bi-directional connections and some uni-directional ones. The executive network appears at the top of a hierarchy, above the orienting and alerting functions. Thus (Fan 2014, p. 10):

(9) **Cognitive control implemented via attentional functions of alerting, orienting and the executive**

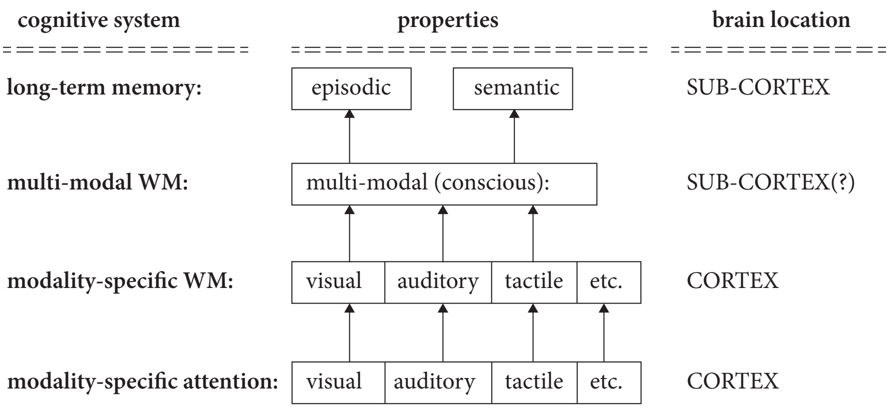


If one can draw any conclusions about the way the attentional networks fit into Mesulam's (2012) core-periphery framework, one may say first that they involve both hierarchic and non-hierarchic network connectivity, as does Mesulam's overall framework. Second, that they exhibit bi-directional connections to the sub-cortical core, thus both bottom-up input and top-down feedback, as does Mesulam's framework. Lastly, one clearly hierarchic feature of the attentional system is that multiple modality-specific attentional modules (visual, auditory, olfactory, tactile, etc.) receive their bottom-up input from respective modality-specific sensory channels, then feed into the single integrative, conscious executive attention. In this way, the attentional network parallels working memory, with which it is closely integrated.

3.4.3 The working memory network

Working memory is a short-term buffer capacity between the attentional system and long-term memory storage, be it episodic or semantic. The modality-specific attention channels, which feed into respective modality-specific working memory channels, receive input from downstream sensory channels.[7] Much like the attentional system, working memory involves first sub-conscious – automated – modality-specific channels that receive their input from respective sensory channels. Those sites in turn feed into a conscious cross-modal capacity, which then feeds into the two long-term memory systems – episodic and semantic – in the limbic core. A diagrammatic representation of this system, adapted from Gathercole and Baddely (1993),[8] is given in figure (10) below.

(10) **Connectivity of the working memory system**



7. See also Baddeley (1986); Shallice (1988); Squire and Zola-Morgan (1991). Michael Posner (i.p.c) notes that the attentional channels than interact with working memory are not necessarily specific to sensory or motor input channels, but rather to higher *cognitive* capacities, e.g. spatial or linguistic. The first interacts with the 'orienting' attentional system, the second with the executive attention.

8. The attentional system, certainly the conscious executive, can also get top-down input from episodic and semantic long-term memory. Thus, one can attend to a recalled episodic visual scene, a chunk of recalled episodic verbal discourse, or a word in semantic memory. In addition, modality-specific attentional modules also send bottom-up input to the cross-modal conscious attention.

In the main, this schema conforms well with Mesulam's (2012) framework. First, the general trend from the cortical periphery to the sub-cortical core. Second, the partially hierarchic structure, from multiple modality-specific sub-conscious modules to an integrative cross-modal site. Lastly, the depiction of bi-directional traffic between working memory and long-term episodic and semantic memory in the limbic core again conforms to Mesulam's grand design of top-down feedback.

3.4.4 What of language?

I have elected to forego discussing here the highly complex, multi-network representation of language in the human brain. Beginning its gradual evolution perhaps 2.1 million years ago with *Homo erectus*, language as we know it today – with its auditory-oral lexical code, an alternative writing code, verbal clauses, multi-clause discourse and grammar – is a relatively new human-specific addition to the pre-existing primate cognitive arsenal that dates back at least 10 million years. The various components of human language seem to have piggy-backed on amenable pre-existing cognitive capacities, reconfiguring them whenever possible for dual use. This is as true of the dual-trend visual information system (Section 3.4.1. above) as it is of episodic memory, semantic memory, auditory voice recognition and other pre-linguistic capacities.

The most complex domain of human language, grammar, remains to this day the most challenging to both linguists and neuro-psychologists. Part of the difficulty may be attributed to grammar's complex multiple connectivity. A bigger part is the monumental confusion of Linguistics itself, where warring ideological factions have been indulging for decades in *erzatz* 'theories' that are largely unconstrained by live data of communicative behavior, cognition, neurology, or evolutionary biology. In this morass, cognitive neuro-linguists, even the best of them, often test unrepresentative stimuli in vain attempt to substantiate dubious hypotheses derived from equally-dubious 'theories'.

Not altogether surprising, my own previous attempt to make sense of the oft-contradictory literature on the neurology of language (Givón 2009) has, I suspect, added to the confusion. Still, a number of substantive issues concerning coherence in language-coded communication will be discussed in three subsequent Chapters (5, 6, 7).

3.5 Other major mental representational systems

3.5.1 Overview

As noted above, cognitive psychologists have long recognized three major – distinct but oft-interacting – systems of metal representation in the human mind/brain – episodic memory, semantic memory and working memory (Atkinson and Shiffrin 1968; Tulvig and Donaldson eds. 1972; Squire 1987; *inter alia*). It is not surprising, then, that these cognitive capacities are closely matched by three language-coded representational domains:

(11) **Table 1.**

cognitive capacities	**linguistic equivalents**
(a) long-term semantic memory	the generic lexicon/dictionary
(b) long-term episodic memory	the current discourse/text
(c) working memory or attention	the current speech situation

Not only are these three systems of mental representation recognized for their specific cognitive-behavioral properties, but also for their specific brain locations. In the three sections directly below I will briefly recapitulate our earlier discussion of these cognitive systems.

3.5.2 Long-term semantic memory

The concepts or word-senses found in long-term semantic memory are not an unordered set of atomic items. Rather, they are an organized **network** of **nodes** and **connections** (Spitzer 1999). In cognitive psychology, this network organization has long been known from phenomena such as **semantic priming** (Collins and Quillian 1969; Neely 1977, 1990; Swinney 1979; Spitzer 1999; *inter alia*) and **spreading activation** (Collins and Quillian 1972; Collins and Loftus 1975; Neely 1977, 1990; Swinney 1979; *inter alia*).

In language, the network-like organization of the lexicon, intermingled with some hierarchic structures, has long been known from the study of semantic fields, derivational morphology, semantic change and grammaticalization.[9] This network organization of lexical-semantic memory makes the meaning of

9. See Givón (2001, 2015), *inter alia*.

words/concepts dependent, in large part, on their **connectivity** to other conceptual nodes in the network. So that when a concept node is activated, say by its sound-label or by a preceding semantically-related word, not only the central conceptual node itself 'lights up', but also, automatically and subconsciously, a whole cluster of connected nodes. Whether this activated cluster is compact or spread out, and in what direction, depends in large part on the **context** in which the word is used. One may thus say that the **coherence** of concepts/words may be expresses in two distinct ways:

- **generically**: by their connectivity in the semantic network
- **specifically**: by the discourse context in which they are used

Two simple-minded examples will illustrate this two-way coherence of words/concepts. Consider first:

(12) a. Get me a **knife** and make sure its **edge** is **sharp**
b. ?Get me a **knife** and make sure its **pillow** is **spastic**

Example (12a) is semantically coherent because 'edge' and 'sharp' are generic network connections of 'knife', necessary parts of its meaning, and automatically activated by it. In contrast, (12b) is lexically incoherent, because 'pillow' and 'spastic' are not generic connections of 'knife.

Consider next (13a, b) below:

(13) a. The **woman sat** at the **table**, but the **waiter** never **came** to **take** her **order**.
b. ?The **woman sat** at the **table**, but the **camel** never **finished chewing** his **cud**.

In (13a), the two concatenated event clauses are totally coherent vis-a-vis each other – in the well-known *restaurant* cultural context, or 'script'. In (13b), the second clause, if taken alone, is perfectly coherent. In the restaurant context, however, established by the first clause, the words of the second clause – and with them the entire clause – are incongruous and incoherent.

As noted in Section 3.4.1. above, the site of one component of the lexical-semantic network has been located, albeit still tentatively, in the left-inferior pre-frontal cortex (Snyder *et al.* 1995; Posner and Pavese 1997; Abdulaev and Posner 1997; Badre and Wagner 2007; see also Pulvermüller 1999, 2003; Pulvermüller and Hauk 2006; Pulvermüller and Shtyrov 2003; Pulvermüller *et al.* 2008). This important node in the network has multiple connections. It connects first to modality-specific sensory-motor cortical regions (vision, auditory, tactile, motor), from which concrete words gain their 'wet' senses. But it also connects to the main site of semantic memory in the limbic core. And that memory site provides top-down feedback during word processing, feedback that may also involve visceral, affective, emotional associations, such as fear, love, joy, hate, approval and the like (Tucker 1991, 2001, 2002).

Lastly, experimental evidence also suggests that sensory (pre-linguistic) and verbal (linguistic) concepts are represented in semantic memory in a single, integrated, cross-modal network (Humphreys and Riddoch 1987, 1988; ed. 1987; Riddoch and Humphreys 1987a, 1987b; Riddoch *et al.* 1988). This, of course, makes perfect sense from an evolutionary perspective (Givón 2002, Chapters 4, 5). It also parallels the cross-modal input into episodic memory.

3.5.3 Episodic and/or 'declarative' memory

Propositional declarative information about unique events, states, situations or lifetime experiences, including verbal or written discourse, are represented in episodic memory (Kintsch and van Dijk 1978; Gernsbacher 1990, ed. 1994; Kintsch 1982, 1992, 1994; Ericsson and Kintsch 1997, *inter alia*).

While the input to episodic memory comes from the various cortical channels, the site of long-term cross-modal episodic memory is in the limbic core, the *hippocampus* and *amygdala.* From there, relevant top-down feedback is projected back to the various cortical sites during on-going perception or communication, be it verbal or visual (Squire 1987; Squire and Zola-Morgan 1991; Ericsson and Kintch 1995; *inter alia*). And it is this limbic-based memory system, with its two-way interaction and top-down feedback, that is relevant to on-going language-coded communication.

Episodic memory, if items in it are to be searched and retrieved efficiently, must be **coherently structured**. At least as far as its language input is concerned, episodic-memory is organized as a **hierarchic network** of nodes and connections. And it is this coherent network organization that makes efficient search and retrieval possible (Spitzer 1999; Kintsch and van Dijk 1978; Kintsch 1994; see Chapters 5, 6, 7 below).

One facet of the coherence constraints on episodic memory has been highlighted recently in a number of studies that call into question the absolute separation between brain regions that code more generic-classificatory aspects of memory, best exemplified in semantic memory, and those that code more specific-episodic memory for individual objects, persons and events. As noted earlier above (sec. 3.4.1.), this distinction is already inherent in the two-trend division of visual information processing, between the generic-lexical ventral trend and the spatial-episodic dorsal trend.

In a study of the categorization of unique individuals, Bowman and Zeithamova (2018) showed that the anterior part of the hippocampus, the brain region representing episodic memory of unique individuals and events, also represents more abstract classificatory features that identify unique individuals as member of categories, or types. This contrasts with the posterior part of the hippocampus, where the actual episodic individuals are represented. What is more, the two representation occur simultaneously. That is, unique individuals – and presumably events – are represented in episodic memory – simultaneously – as *both* unique tokens and members of a type. Put another way, unique experiences finds at least part of its **coherence** in their type memberships.[10]

A just-announced study of maze-running mice suggested a similar simultaneous hippocampus representation of unique events. In this case, some hippocampus cells appear to specialize in the episodic representation of unique events, while others represent more abstract classificatory features of the event.[11]

3.5.4 Attention and working memory

The neuro-cognitive status of these two important systems, gateways to more lasting semantic and episodic representation, has been discussed in considerable detail in Sections 3.4.2. and 3.4.3. above. As noted there, the network and partly-hierarchic structural properties of both sub-systems, as well as the way they are connected with each other, conform in the main to Mesulam's (2012) framework.

3.6 Attended vs. automated processing

Both attention and working memory have either attended/conscious or automated/ subconscious components. The great bulk of human mental processing is done automatically and subconsciously. The two processing modes

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10. Bowman and Zeithamova (2018) also note that a pre-frontal cortical site, the *ventromedial prefrontal cortex* (VMPFC), collaborates with the hippocampus in the memory representation of generic-classificatory – but not specific-episodic – information about unique individuals.

11. Here the other region collaborating with the hippocampus in representing more abstract classificatory features of events was the *medial entorhinal cortex* (MEC), another sub-cortical brain region. The yet-to-be-published study is attributed by MIT Science News (online; 4–13–20) to Prof. Susunu Tonegawa and colleagues at the MIT Picower Institute for Learning and Memory.

are characterized by the following cluster of properties (Posner and Boies 1971; Posner and Klein 1971; Posner and Warren 1972; Kahnemann 1973; Posner and Snyder 1974; Schneider and Shiffrin 1977; Kahnemann an Treisman 1984; Petersen *et al.* 1988; Posner 1978; Schneider 1985; Scheneider and Chein 2003; Posner ed. 2017; *inter alia*):

(14) **Attended vs. automated processing**

a. **Attended processing**:
- **input**: novel, unique, important, unpredictable, low-frequency; *figure* information
- **mode**:
  - conscious/attended
  - slow processing rate
  - effortful, high energy demand
  - more error-prone
  - single channel
- **structure**: relatively flat, linear, non-hierarchic structure

b. **Automated processing**:
- **input**: repeated, predictable, less-important, high-frequency; *ground* information
- **mode**:
  - subconscious/unattended
  - rapid processing rate
  - effortless, low energy demand
  - more error-free
  - multiple parallel channels
- **structure**: complex hierarchic structures

In the course of learning, attended processing precedes automated processing. Newly-encountered, less frequent or more important information is process slowly with conscious attention. Upon repetition and habituation, processing becomes gradually faster,[12] automated and subconscious.

12. In the 1985 *Attention and Performane Conference* at the University of Oregon (Posner and Marin eds 1985), Walter Schneider presented a computationally-oriented paper arguing for a gradual shift from attended to automated processing. In the following discussion, I suggested that evidence from the acquisition, diachrony and (no doubt) evolution of grammar supported such graduality. That is, pre-grammatical language bears all the marks of attended processing. And

It is worth noting, lastly, that the gradual shift from attended to automated processing characterizes not only individual learning (development) and maturation (ontogenesis), but also evolution (phylogenesis). Thus, as noted earlier, the oldest mammalian brain structures – the brain-stem, vagus, pons/medula and spinal chord – control ancient physiological functions such as heart, lungs, digestive tract, low-level motor functions and bodily homeostasis. These oldest parts of the central nervous system are automated at birth. The later-evolved limbic and thalamic mid-brain, which processes early sub-conscious perceptual input such as smell, vision and hearing, (but eventually also multiple cortical inputs), is not fully automated at birth, but gains automation gradually during the first few months of life and interaction with input. Lastly, the last-to-evolve cortex is least-automated at birth, and involves cognitive capacities that mature and automate gradually over months or even years of learning and interaction with input – or never fully. These cortical capacities allow mammals, perhaps also birds, a modicum of life-long learning.

3.7 Automaticity, complexity, hierarchy and coherence

The association between automated processing, parallel processing, and complex hierarchic structure is hardly spurious. Rather, it goes to the very heart of the association between complexity, hierarchy and coherence. As Simon (1961) noted in his seminal paper, hierarchic structure is the hallmark of complexity. Indeed, in biology, cognition, culture and language, the larger an entity is, the more complex – and hierarchic – is its internal organization (see Chapter 2). In subsequent work, Chase and Simon (1973) showed that the memory of expert performers – habituated, faster and presumably more automated – involves **chunking** of smaller units of information into larger ones. This is just another way of saying hierarchic organization. Later on, Chase and Ericsson (1982) extended this work, showing that the working memory of

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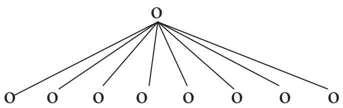
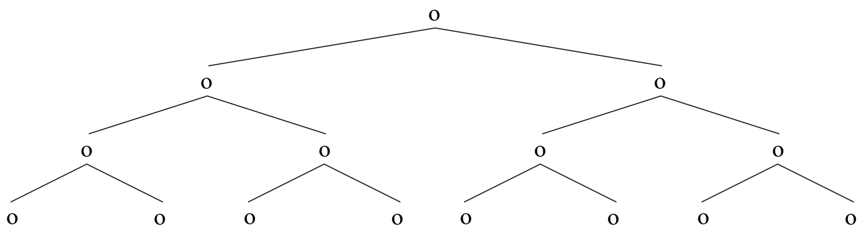
as grammar develops gradually over acquisitional, diachronic or evolutionary time, it acquires the marks of a more automated system, as summarized in (8) above (see also Chapters 5). Danny Kahnemann then rose up to reproach me for my apparent transgression, reminding me that attention vs. automaticity was an either-or distinction, with no gradation in-between. I pointed to Wally Schneider and asked for his comment. He said my suggestion of graduality in the development of grammar certainly conformed to his computational model.

skilled performers is more automated than that of novices.[13] The difference between flat vs. hierarchic organization of the very same number of individual items is illustrated schematically in (15) and (16) below.

(15) **Simple/flat linear structure:**



(16) **Complex hierarchic structure:**



The processing advantage of the hierarchic organization in (16) over the flat organization in (15) is considerable, in two respects. First and most obvious, to unambiguously identify an individual terminal node of the linearly-ordered population in (15), one would need to search, on the average, ca. 4 nodes (with luck, 1; without luck, all 8). To search with the same goal in mind through the hierarchic structure in (16), one would need only three moves, one per each (non-top) hierarchic level. This seems a slight advantage; however, it grows

13. In 1996 I attended a symposium on language change, development and processing, organized by Brian MacWhinney at CMU. Just before I gave my paper, Herbert Simon, already emeritus but still active and acute, came into the room and sat way up in the back. At one point during my presentation, I noted that grammar as a language processor combined automaticity, hierarchic structure, and thus chunking, citing Simon's, Chase's and Ericson's work as support. During the following discussion, Prof. Simon raised his hand and said, roughly: "I don't quite understand why you associate my early work on complexity and hierarchy with our subsequent work on chunking". A bit worried, I told him that chunking seemed to be a species of hierarchic organization, lumping several lower nodes together under a higher node; and that the association of chunking with expert/skilled performance, thus automaticity, suggested that much. Prof. Simon's response was gracious if somewhat noncommital.

rapidly as hierarchic structures become more complex and thus add levels. And second but perhaps more compelling, in an automated processing system, node searches at any level of the hierarchy can run in parallel. Whereas conscious attended searches through flat structures such as (15) proceed linearly, one at a time.

In sum, the efficient processing of large quantities of information, as well as the performance of complex motor and cognitive tasks – be they biological, neuro-cognitive, linguistic or cultural – benefits immensely from organizing their complex structures hierarchically, and thus more coherently.

Acknowledgements

I am indebted to my good friends and colleagues Mike Posner and Don Tucker for their patience and generosity in sharing with me both their own work and the works of others, as well as for their comments on an early version of this chapter. They are, naturally, absolved of any blame for the use I chose to make of their sage advice.

CHAPTER 4

Cultural coherence: The Society of Intimates

4.1 Introduction

4.1.1 The social context of inter-personal cooperation and communication

This chapter deals with the socio-cultural context within which humans interact, cooperate and communicate, and how this context has evolved and mutated. The traditional **Society of Intimates**[1] is small, consensual and non-hierarchic. But its seeming egalitarian anarchic structure often masks the fact that it regulates social interaction rigidly, by a binding social calculus of customs and conventions that are known to and observed by all adult members. Such conventions are binding and all-encompassing. Straying outside them is uncommon, and costly to the perceived violator.

Our species split from its nearest primate kin ca. 8 million years ago. Our cognitive capacities, including our so-called social brain, still bear the footprints of our ancient evolutionary roots. In contrast, the historical provenance of our current large-scale **Society of Strangers** date back to only ca. 8,000 BC, to the advent of agriculture. Most of our current cognitive capacities, habits and social expectations had been shaped as ingrained, automated patterns of mind and brain during the prior 8-million-odd years of the Society of Intimates.

Most germane to our discussion here is the hierarchically-organized **social coherence** – a gender-based nuclear union, extended family, clan, tribe and cultural-linguistic group. The rigid constraints of this social organization harken back to our hunting-and-gathering ancestry. The growing size and complexity of human societies since the rise of agriculture has largely failed to contravene long-set cognitive patterns and social habits. Indeed, much of the social upheavals, confusion, misery and violence that characterize our current societies of strangers are traceable to a relatively recent departure from our ancestral Society of Intimates. Some of the more striking ramification of this will be discussed in Chapters 9, 10 below.

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1. The term *Society of Intimates* was first used in Givón (1979/2019, Chapter 5).

In traditional societies of intimates, inter-personal manipulation among adult members tends to be indirect, implicit and subtle. It is more likely to be framed as solicitation of cooperation than direct manipulation. How the organization of cooperation and communication in such societies stacks up against our modern Society of Strangers is one of the implicit leitmotifs of this chapter. Not so much for itself, but because we may never understand the social and communicative calculus of mass urban nation-states unless we first come to terms with their evolutionary precursor, the durable product of our early bio-cultural evolution – the Society of Intimates.

4.1.2 Rational choice vs. implicit conventions

The bulk of this chapter will deal with how trust and cooperation are organized in small-scale societies of intimates. Broadly, I will suggest that:

- The patterns of trust and cooperation in small-scale societies of intimates arose over a protracted, adaptive bio-cultural evolution.
- These patterns persist in known contemporary societies of intimates.
- These patterns also remain highly relevant to the organization of trust and cooperation in contemporary societies of strangers.

When an earlier version of this chapter was first presented to a forum of *Decision Science* specialists, my collaborator Phil Young and I became aware of the **Rational Choice** literature that emerged earlier in Behavioral Economics, traditionally associated with Game Theory. Their literature reported on the behavior of utter strangers, assembled for a single session in an experimental lab and given various tasks in which they had the option of cooperating, defecting, or refusing to play (Dawes, McTavish and Shaklee 1977; Dawes, Orbell, Simmons and van de Kragt 1986; van de Kragt, Dawes and Orbell 1988; Orbell, van de Kragt and Dawes 1988; Caporeal, Dawes, Orbell and van de Kragt 1989; Orbell and Dawes 1991; *inter alia*). The behavioral options presented to subjects in these studies were couched in terms of *social dilemmas*, such as the *prisoner's dilemma* of yore. Various conditions were added or subtracted, and their effects on the subjects' cooperation or defection were noted. From the results, conclusions were drawn about the nature of human sociality, trust and cooperation.

Several assumptions underlying this experimental tradition were particularly worrisome to us, since they seemed to contradict what we thought we knew about cooperation under real-life conditions in societies of intimates. These implicit assumptions of the Rational Choice paradigm were:

- Cooperation was a matter of *choice*, rational or otherwise.
- The choice to cooperate or defect was motivated primarily by considerations of *individual* rather than *group* benefits.
- Cooperation was typically among *strangers*.

A few words are perhaps in order about why the very term Rational Choice is problematic. Our late colleague John Orbell (i.p.c.) suggested that there were at least two ways of interpreting the term Rational Choice within the tradition of *egoistic incentive* that underlay the paradigm; and that only the second interpretation was taken seriously by more sophisticated scholars.

(1) **Possible interpretations of 'Rational Choice'**:
  a. **Literally –** that people make self-serving decisions as conscious choices;
  b. **Metaphorically –** that the results of individual actions *turn out* to be self-serving; and that, regardless of conscious control, such results *seemed as if* they were rationally chosen.

Our own observations about cooperation in extant societies of intimates suggested, at the time, that the literal interpretation (1a) was unrealistic, since it fails to characterize the actual *mechanisms* of social cooperation. As for the metaphoric interpretation (1b), it seemed somewhat vacuous even *qua* metaphor, and was fairly guaranteed to foster intellectual misunderstandings.

The point to be made here is fairly transparent. Through protracted bio-cultural evolution, primate social species, including our own, have adopted well-entrenched mechanisms of cooperative social decision making. That such evolution has been adaptive is largely a matter of definition (Caporeal *et al*. 1989; Tooby and Cosmides 1992; Orbell *et al.* 1994). Being adaptive and group-serving, cooperative behavior is perforce also individual self-serving, again by definition. In this regard, Tomasello's (2009) account, comparing the empathic cooperative behavior of young apes and young humans, is instructive, intersecting as it does with the old argument about **individual vs. group selection** (Okasha 2006).

All this still does not make Rational Choice a useful descriptive name for the actual mechanisms of cooperation in social species, nor for the adaptive evolution that gave them rise. At the time, it seemed to us that the dismissal of the culturally-transmitted values suggested by Campbell (1975), or Boyd and Richerson (1985), opting instead for a more hard-wired 'biological' alternative, was at the very least premature. That is (Caporeal et al. 1989, p. 686):

> "…Campbell (1975) proposes that abstract cultural ideals such as fairness, equity, sharing etc. are instilled in individuals as "conscience", general rules and customs that guide interactions with others…In our view, it makes no difference whether a choice payoff is external (such as avoiding a sanction or obtaining rewards through reciprocity in the future) or internal (as in having a clear conscience, heightened self-esteem, or the avoidance of guilt). An individual whose decision can be traced to a positive psychological payoff is acting on the basis of egoistic incentive…"

Campbell's (1975) socially-mediated values are indeed a poor substitute for Rational Choice – if construed as *conscious* choices. But keen observers of extant Societies of Intimates have noted that the cultural calculus that governs behavior in such societies is most often than not implicit, subconscious and automated. While the actual behaviors may not be fully hard-wired and genetically-coded, they certainly display the unmistakable rigidity of **ritualization, habituation** and **automaticity** (see Chapters 3, 5), and should be perhaps best viewed as occupying a mid-range on a cognitive-behavioral-evolutionary continuum:[2]

(2) **Continuum of degree of conscious choice**:

least constrained

- individual conscious 'rational' choice
- culturally-constrained habituated choice
- genetically-coded automated choice

most constrained

As to the question of whether interpersonal behavioral choices are selfishly or socially motivated, the *balance* between self-serving and group-serving behavior in the Society of Intimates has been characterized succinctly by Stiles (1994):

2. Cross-cultural variation suggests that the actual patterns are not fully hard-wire. Considerable flexibility is also suggested by bi-culturalism, as well as by cultural-linguistic change over an individual's lifetime. Still, it has been argued that some universal constraints on possible diversity of cultural values are genetically coded (Tooby and Cosmides 1992).

> "…the evolutionary ecological paradigm [and, one must add, the Rational Choice paradigm] focuses on the individual as the unit of investigation and assumes that the individual is capable of free choice. It also assumes that all decisions must result in a positive outcome, as measured by reproductive fitness, for the individual. These assumptions would be incomprehensible to a traditional forager, and they contradict an enormous body of empirical ethnographic data. Individuals will certainly try to act in their own self-interest, but cultural rules, if followed, prevent them from being too selfish…Individuals are more or less forced to cooperate and share…" (1994, p. 439; bracketed material added)

Culturally-transmitted patterns of cooperation are central to our understanding of social decision making. But they do not necessarily contrast with genetically transmitted mechanisms. Rather, they complement and interact with them. Cultural and evolutionary mechanisms are not exclusive of each other, but rather mutually dependent. Indeed, the more recent perspective of evolutionary biology turns out to be rather similar – that phylogeny (nature, genes) and ontogeny (nurture, development) are not competing explanations, but rather collaborate in a merged mechanism – **epigenesis** (West-Eberhad 2003; Richerson and Boyd 2005).

Whichever way coherent cultural values are transmitted, what are the mechanisms that brought about their evolution? And if social behavior and higher-level cultural traits already have gene-coded components (Tooby and Cosmides 1992), what was the behavioral pattern that pioneered such an adaptation?

The latter question presupposes something that has become increasingly acceptable in evolutionary biology. To quote again Ernst Mayr, who pioneered some of these erstwhile-heretic observations:

> "…Many if not most acquisitions of new *structures* in the course of evolution can be ascribed to selectional forces exerted by newly acquired *behaviors*. Behavior, thus, plays an important role as the *pacemaker of evolutionary change*…." (1982: 612; italics added)

Or, as an anthropologist inspired by Mayr might suggest:

- Individual behaviors that yield an adaptive advantage become cultural norms.
- Cultural norms are the pace-makers of evolutionary change in social species.

Homo sapiens, and indeed our primate forebears long before us, evolved as social species. Self-interest and individual selection – Rational Choice's traditional great motivator and Adam Smith's (1776) *Invisible Hand* – have always operated within the constraints of culturally-habituated and genetically-encoded sociality and group selection – Adam Smith's (1759) *Moral Sentiment*. In societies of intimates, the interested 'self' is often the group rather than the individual.

4.2 The Society of Intimates

4.2.1 Preliminaries

Hominids and their primate kin evolved as a small-group social adaptation. These traditional foraging societies were our sole institutional framework till ca. 8,000 BC. With plant and animal domestication and the rise of sedentary agrarian life, the patterns of cooperation that developed during millions of years of hunting and gathering were continued. However, they were gradually elaborated upon by emerging societies of sedentary cultivators and nomadic pastoralists.

As increasingly complex institutional forms emerged, societies of intimates continued to co-exist with and within towns, cities, states and empires, those larger and more complex societies of strangers. Even within present-day industrial mega-states, clear vestiges of the Society of Intimates persist, most notably in small isolated rural communities. Likewise, in less developed countries, substantial populations of small-scale indigenous enclaves still exist, only partially integrated into the larger matrix of the nation-state, and often not at all. Such enclaves retain most of the old cultural norms, including patterns of trust and cooperation. It is from the many descriptions of such societies that the following sketch has been assembled.

4.2.2 General characteristics

The main salient characteristics of societies of intimates may be given as follows:

(a) **Small size of social group**
The size of hunter-and-gatherer tribal societies seldom exceeds 100. For foraging social primates, including early hominids, the size range of 50–150 has remained relatively stable over the last several million years (Dunbar 1992). Even villages of subsistence cultivators and camps of pastoral nomads seldom exceed 200 individuals. Such small size is conducive to familiarity, intimacy, and daily personal interaction among all members.

(b) **Foraging economy**
The Society of Intimates evolved in the context of hunting and gathering and flexible omnivorous feeding. The technological simplicity of such an economy most commonly also involved feast-or-famine cycles, since little food could be stored for later consumption. In such a context, within-group sharing of both food and foraging activities mitigates the feast-or-famine cycle, and thus has a great adaptive value for both the individual and the group.

(c) **Restricted territorial range**
The effective range of human foraging groups was traditionally within a 10–20 miles radius. These were thus societies with a relatively stable native range whose features were intimately familiar to all members, and where individuals developed a strong emotional attachment to the group's terrain (Schieffelin 1976). The overall population density of foraging societies is low, and social groups live in effective *communicative isolation* from each other, except for rare, mostly hostile contact at the boundaries.

(d) **Restricted gene pool**
The social organization of societies of intimates is invariably kinship- or descent-based, binding together individuals who acknowledge shared ancestry. Various provisions are made for exogamy, usually with a highly restricted set of other groups, as well as for splitting the group when its size exceeds the optimal range. The social group is thus the product of a much more restricted gene pool than in complex societies of strangers.

(e) **Social uniformity**
Status and role differentiation within societies of intimates are relatively low, and are based primarily on biologically defined parameters – gender, age, descent line – and personality. There is no rigid occupational specialization, and little social stratification. While not egalitarian in the absolute sense (Power 1991), the structure of societies of intimates – both human and pre-human – is flat and non-hierarchic, with the well-known exception of *dominance hierarchies*. Such hierarchies are, paradoxically, both rigid and fluid: rigid at any given time, so that group members always know their exact position vis-a-vis all others in the network, but fluid in that it depends largely on personal skills and charisma, and is thus always open to readjustment and change (de Waal 1982; Power 1991). However, this fluidity is itself governed by relatively rigid cultural norms.

(f) **Informational homogeneity and stability**
The world-view of group members, as encoded in long-term *semantic memory* (see chs 3,5), is highly uniform and universally shared. With the absence of occupational differentiation, with the small size of the descent-based

group, with the small and stable terrain and the relatively low rate of physical and cultural change, most *generic knowledge* is shared by all group members. New information spreads rapidly, and quickly becomes universal due to proximity, intensive daily contact and small group size. Individual behavior, motivation, propensities and caprices are well-known to all group members. The Society of Intimates is thus a society of high **informational predictability** in all three knowledge categories that form the context for both interaction and communication (see Chapters 3, 5):

(3) **Types of shared knowledge**:
 a. shared generic-cultural knowledge (semantic memory)
 b. shared current speech situation (attention and working memory)
 c. shared current discourse (episodic memory)

The high informational predictability of societies of intimates is due first to the fact that generic-cultural knowledge (3a) is restricted, non-specialized and shared by all group members. Second, these small groups more often than not forage together, and thus occupy the same speech situation (3b). And third, in sharing the current speech situation group members also share the current discourse (3c).[3]

(g) **Consensual leadership**

The Society of Intimates has always been profoundly consensual in the organization of action, cooperation and leadership. Leadership is seldom formalized by either volunteering, election or force. It emerges out socially recognized charisma leavened with attested competence, age and kinship status (Power 1991), with leadership remaining highly contingent. Groups and their leadership tend to be organized for the occasion, then quickly dissolve. Thus (Power 1991):

> "…The immediate-return foraging group is a consensus polity (Turnbull 1968; Silberbauer 1981). Nowhere in these societies do we find a secular authority backed by power (Turnbull 1968). There is no permanent leader. Indeed, the constant change of leaders gives the appearance of there being none (Woodburn 1982)…" (1991, p. 46)

3. The high informational predictability of early hominid societies of intimates, as well as its gradual dissolution, played an important role in the evolution of human language (Givón 2009, Chapter 12).

(h) **Kinship-based social cooperation**
The organization of societies of intimates is either descent-based (in the biological sense), as it is in social primates, or kin based (in the cultural sense), as it is with humans. The latter is a more elaborate transformation on the former, and may include association by marriage, adoption and ritualized kinship. But whatever the exact basis of kinship, all cooperation is predicted from it. Or, as Stiles (1994) notes:

> "…the principal objective is the survival of the group, not the individual…" (1994, p. 438)

All interaction in societies of intimates, if not based explicitly on ties of consanguinity or affinity, is modeled after them. That is, friendly relations among non-kin are functional analogues – or metaphors – of kin relations. In such societies, there are relatively few open choices. Or again, as Stiles (1994) puts it:

> "…people in traditional societies are constrained in their decisions by cultural rules…" (1994, p. 438)

Every member of the intimate social unit knows, by virtue of membership and precise locus in the social-network, what they owe in each social context – procreation, child-rearing, subsistence, warfare, construction, ceremonies. Such shared, largely-implicit knowledge is an important part of socialization of the young. This is part of the paradox of such consensual societies: Their structure is quite rigid, and available choices are limited and well circumscribed.[4] This is indeed an important ingredient in the high degree of informational and behavioral predictability of such societies. And this predictability is, in turn, a major factor in promoting of trust and cooperation among members, who can almost automatically rely on cooperation and reciprocation in any cultural context.

(i) **Non-cooperation with strangers**: There are few provisions in kin-based societies of intimates for knowing, meeting, interacting, communicating or cooperating with strangers. Almost by definition, lack of well-defined position in the rigid social network makes it impossible to carry on non-hostile interaction with non-members. From the perspective of **network coherence**, a *floating node* with no clear connections to other nodes cannot be

4. In this, primate and human societies of intimates closely resemble other social species, be they bees, birds, horses or wild dogs.

part of the network. The only consistent – if rarely undertaken – provision for dealing peacefully with strangers is *incorporation*, most commonly by marriage, adoption, kidnap or slavery. One may look at such provisions as mechanisms of *de-alienation* (see below).

4.3 Kinship-based cooperation: The Trobriand case[5]

I would like to illustrate the use of a kinship system as venue for cooperation in traditional societies of intimates by citing the intricate – nigh convoluted – Melanesian exchange system described by Malinowski (1932, 1935) in his work in the Trobriand Islands. While Malinowski referred to yam presentation as *urigubu*, the term in fact refers to exchanges of other types of goods. The description below also relies on amplification and clarification of the Trobriand exchange system by Leach (1958), Lounsbury (1965), and Weiner (1976).

4.3.1 Land ownership, land-use and residence

Land is the most important economic asset in Trobriand society. It is held in common by male members of the matrilineal sub-clan, and is usually controlled by only one or two men of the sub-clan, while others may establish use rights.

In order to receive the rights to use land, a young man must attach himself to an older male who has already established his own right to reside in a particular hamlet. The young man must then produce a yam-exchange garden to secure his own land-use rights. His first yam-exchange garden is usually made for his father or an older married brother. Most men continue to live in the hamlet of their father after marriage. Only the older sister's oldest son is likely to reside, after marriage, in the hamlet of his mother's brother, since it is only he who stands in direct line to inherit control of the sub-clan's land. Thus, one form of the Trobriand exchange is yams for land-use.

5. While the Trobriand descent system is matrilinial, their society is profoundly patriarchal, as can be seen from the description below. One way of interpreting such a – rather common – hybrid system is by considering it as a takeover by men of an earlier female-oriented social order.

4.3.2 Kinship and marriage

All social and economic obligations of a Trobriand male are defined by three potentially conflicting organizational principles:

- matrilinial birth clan membership
- residence and land use in one's father's clan
- exogamous marriage into another clan

Marriage must be exogamous, out of one's own clan and thus into a potential 'enemy' clan. Some specific marriage prohibitions also apply: All women of one's mother's clan (i.e., one's own matrilineal clan) are proscribed, as are some categories of women in one's father's clan.

The preferred marriage for a man is to a father's sister's daughter, or a woman in the same kin category within his father's matrilinial clan. Such women are referred to by the kin term *tabu*, and are considered by the Trobriand to be distant kin (or, in some cases, non-kin). Closeness versus distance of kin relations is culturally rather than biologically defined. Thus, a father's sub-clan is potentially an 'enemy' clan unless relations are established and renewed through repeated marriages over successive generations. *Tabu* as a general term, according to Leach (1958), refers to all potentially hostile outsiders.

4.3.3 The life-cycle of cooperation

In his early life, a boy works for his father, residing and eating at his father's matrilineal sub-clan hamlet. At puberty and until marriage, all boys ideally sleep together at the "bachelors" house. All through a boy's childhood and adolescence, one of his mother's brothers has been making yam gardens for the boy's mother, with the yams being presented to the boy's father. His father, in turn, has been making yam gardens for one or more of his own married sisters. When a boy's sister marries, his father will initially make yam presentations to her husband. The boy, at maturity, will take over this task, making yam presentations to his sister's husband.

A boy becomes a man upon marriage, and then establishes his own residence, usually remaining in his father's sub-clan hamlet, where he has already been working and eating. He continues to make yam gardens for his father. In exchange, he receives access to resources, including land use, of his father and father's sub-clan. In addition, the boy now begins to make yam gardens for one or more of his married sisters and make yam presentations to their husbands, thus relieving his father of that obligation.

4.3.4 Kinship and reciprocity

Yam presentations and women's wealth distribution in the Trobriand system are not, strictly speaking, an instance of *symmetrical direct exchange*. In a roundabout way, nonetheless, the system is one of reciprocal exchange. Transactions between any two individuals are temporarily asymmetrical. Thus, the direction of giving between two individuals – e.g., father and son – may reverse after a period of several years (Weiner 1976, pp. 125–126). Still, within the system as a whole, goods circulate among all group members, women and men. You receive from and give to different people, but both your cooperative obligations and your cooperative expectations are fully predictable from your position – your 'node' – within the kin-and-marriage-based network.

4.3.5 The adaptive logic of the Trobriand yam exchange

A boy marries, preferably, into his father's sub-clan, a potential 'enemy' group. This formal enmity is neutralized by cross-clan marriage, in this case the boy, a member of his mother's clan, marrying into his father's 'enemy' clan. One pays yams to 'outsiders' who married into one's own matrilineal sub-clan – the husband of one's mother (one's father) and the husbands of one's sisters. Yam payments can thus be seen as a ritualized mechanism for **de-alienating** strangers who have married into one's sub-clan. You give yams to your father and your sister's husband, and you receive yams from your sons and your wife's brother. Interestingly, as Weiner notes (1976. pp. 195–210), men who receive yams in the name of their wives – as is always the case in these presentations – are obligated to expend some of their own 'men's wealth' – pigs, valuables, Western trade goods – to obtain 'women's wealth' for their wives – banana leaf bundles, grass skirts. Such women's wealth is distributed at the women's mortuary ceremony. This purchase of women's wealth for one's wife is in fact the other half of the payment for the yams one has received from one's brother-in-law.

One may interpret this social system to mean that in the Trobriand scheme of things, one could be in only three fundamental social relations:

(4) **Trobriand social relations**:

a. **Consanguinity**:
kinship ==> similarity ==> solidarity

b. **Separateness**:
non-kinship ==> strangeness ==> enmity

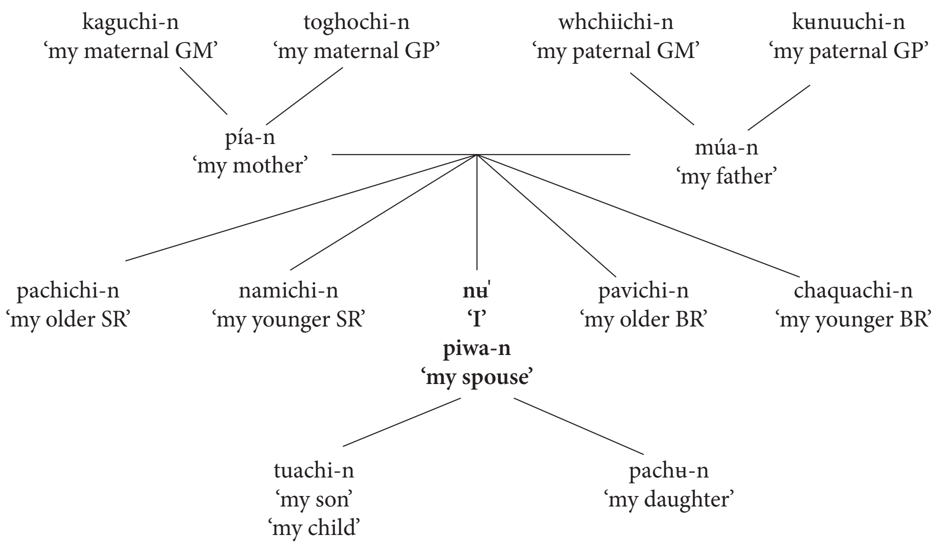
c. **Friendship through affinity (marriage)**:
proximity without kinship ==> dangerous grounds ==>
must neutralize

Marriage in the Trobriand world is thus the main mechanism for inducting outsiders – potential enemies – into a tenuous 'friendship', thus neutralizing their potential animosity. But such a tenuous association remains *dangerous grounds*. The exchange system is designed to constantly tend to, attenuate and neutralize this problematic relationship – with strangers who are nevertheless in close proximity.

4.4 Reciprocity and kinship hierarchies: Ute

The Ute kinship system, much simpler than that of the Trobriand, can be described as a hierarchic structure, within which the ego ('I') is the central point of reference. The kin terms thus shift in accordance to who is speaking. Kinship terms, like body parts, are *obligatorily possessed*, and thus must include the possessive pronoun suffix of the speaker. The core of the system may be given as in (5) below.

(5) **Ute kinship chart**[6]



6. See Givón *et al.* (2011).

The kin terms for 'grandson' and 'granddaughter' are reciprocal. That is, whatever name you call your grandmother or grandfather is the name they call you. Such **reciprocal naming** presumably stands for a close reciprocal relation with each of one's four grandparents. A similar reciprocal name-sharing convention also applies to one's aunts and uncles. The eight terms are:

(6) **Ute reciprocal terms for aunts and uncles**
  a. nawichi-n 'my mother's older sister'
  b. nʉpʉyaachi-n 'my mother's younger sister'
  c. 'aghoychi-n 'my mother's older brother'
  d. sʉnachi-n 'my mother's younger brother'
  e. paachi-n 'my father's older sister'
  f. namichi-n 'my father's younger sister'
  g. kúuchi-n 'my father's older brother'
  h. 'aachi-n 'my father's younger brother'

The Ute kinship system seems highly reciprocal in spite of natural age hierarchies, and involves no obvious gender skewing. It is of course true that heads of household were all men. But an unhappy woman was expected to take her children and go back to her parents' household. Likewise, while Ute chiefs were all men,[7] this does not imply much power, but only moral authority, temporary and contingent on mutual consent. When a man did not like the current chief, he pulled stakes and took his household out of the encampment, eventually joining another band. Lastly, a male cousin, from whatever side, is called by the age-appropriate term for 'older brother' or 'younger brother'. Likewise, a female cousin is called either 'older sister' or 'younger sister' (see (6) above).

4.5 Dealing with strangers

4.5.1 Estrangement and de-alienation: The Western Apache

At its prototypical core, the Society of Intimates has no provisions for cooperative interaction with strangers. The opportunities for meeting, interacting, getting to know, trusting or cooperating with strangers are scant. Whether

7. The term for 'chief', *ta'wa-vi̲*, is derived from *ta'wa-chi̲* 'man'. Another possible term is *'ava-tʉ̲ ta'wa-chi̲* 'big man'.

among primates or humans, small-scale intimate societies seem to observe, with various degrees of latitude, a hermetic social calculus:

(7) **Calculus of social cooperation**
  a. You cooperate only with those you trust.
  b. You trust only those you know intimately.
  c. Above all, never talk to strangers.

To illustrate how deeply ingrained this calculus is, consider Keith Basso's (1972) study of the Western Apaches, where the following contexts for *keeping silent* are counted.

(a) **Upon meeting a stranger**
The definition of 'stranger' in western Apache is roughly 'a person known or unknown but never before engaged in direct verbal contact'. Established prior intimacy is thus a prerequisite for meaningful interaction. The Western Apache do not introduce strangers to one another and do not engage in conversation with strangers until considerable time has passed (often days rather than hours). 'Strangers' who are quick to launch into conversation are eyed with undisguised suspicion.

(b) **Courting**
One marries exogamously outside one's own kin unit. As in Melanesia, one marries into an 'outsider clan'.[8] One's spouse, until de-alienated, is formally a stranger and potential enemy. Courting behavior is thus different from the joshing and horsing-around behavior among intimates. It begins with silence, and only gradually does the proximity engender intimacy, and eventually talk.

(c) **Children coming back home**
Long absence from intimate daily contact fosters alienation. The reunion of erstwhile intimates after a long absence is fraught with potential danger. The erstwhile intimate may have become alienated during long absence. One treads on delicate ground with a returning former intimate. One must remain on one's guard till the 'stranger' is de-alienated, by time spent at close proximity and silence. During such silent proximity, the 'stranger' is observed closely to ascertain that s/he has not become a dangerous alien.

8. In the Athabaskan descent system, both matrilineal and patrilineal clans are important, but incest taboos are stronger vis-a-vis one's mother's clan.

(d) **Getting cussed out**
When an intimate cusses one out, suddenly, out of the blue, one does not respond. Rather, one withdraws into silence. The logic of such silence is transparent: One does not expect an intemperate verbal assault from intimates. Such gratuitous hostility signals alienation. One is suddenly facing a kinsman who is, incongruously, acting like a stranger.

(e) **Being with those who are sad**
After mourners emerge from the purification ceremony that follows a death, one treats them with wary silence. Visiting is traditionally expected, but silence prevails. The purification ceremony is a protracted withdrawal, its participants go out of sight, and their potential contact with the spirit of the dead before de-contamination is extremely hazardous, and may convert the mourning person into a dangerous being – a stranger. Until successful decontamination has been accomplished, one remains on one's guard with 'those who are sad'.

(f) **Being with someone for whom they sing**
Curative singing for the sick is an ancient custom. But all sickness and death, except for the very young or the very old, is triggered by malevolent powers that invade and contaminate the sick, taking over them and converting them into aliens. The curing ceremony purports to expel such a power and de-alienate the victim. Traditional medicine contexts are thus extremely hazardous. One refrains from intimacy with the sick.

4.5.2 Other contexts of de-alienation

Provisions for de-alienating strangers are not exclusive to *Homo sapiens*, and most likely pre-date human cultures. Both primate and other mammal societies have some such provisions, as no doubt did early hominids; though seldom are the provisions quite as elaborate and ritualized as the Melanesian exchange system or the de-alienation rites of the Western Apache. I will cite here only two cases.

A most impressive documentation of de-alienation can be found in a film made by Jane Goodall on the life of a pack of hyenas in East Africa. The story focuses on the misadventures of a young male who had gotten detached from his original pack. His repeatedly rebuffed attempts to join another pack veer widely between the hilarious and the heart-rending. After nine months of abject failure, the dominant female of the family he targeted for incorporation relents one night, allowing him to sleep next to her in the den. This explicit act of the adoption transformed the poor stray overnight from alien to kin, acceptable to the family, thus to the pack. The gawky, needy teenager had been de-alienated.

Equine social interaction is controlled by a precise dominance hierarchy, ranking all mares linearly even in the absence of a stallion.[9] The adaptive payoff of dominance is better access to both food and the stallion. The equine pecking order is extremely stable and prevails for long periods without violent confrontations – as long as no stranger is introduced. But the minute a new mare joins a pre-existing herd, a series of violent confrontations erupt, and lasts till the new mare finds her precise slot in the pecking order. Superficially, the confrontations may have the appearance of a chaotic melee, but are in fact made out of distinct one-on-one challenges and responses, with the new mare both challenging and being challenged by various group members. The dominance displays used during the start of the process are the most extreme on the scale. They de-escalate gradually toward the more communicative (rather than 'secular') end of the scale.[10]

One conspicuous exception clause to this procedure is the status of the young. A filly born to a dominant mare can get away with claiming higher status, to the point of pushing even her own mother around. The high-ranking mother tolerates and sanctions such behavior vis-a-vis lower-ranking mares. But upon removal of the mother, the filly must readjust her status according to her own abilities. The sway of kinship has now ceased to matter. However, this adjustment, unlike the absorption of a total stranger, is done with considerably less violence, resorting to more communicative dominance signals.

Higher mammal societies can apparently make provisions for de-alienating and absorbing total strangers. Exogamous breeding among non-human primates creates another context for such provisions. But such contexts are relatively rare. And the provisions made to deal with them illuminate the norm: You don't cooperate with strangers unless you first de-alienate them and convert them into intimates.

Finally, one needs to recall that in social mammals, the extension of reciprocal cooperation from blood kin to other intimates has been well documented, as in the case of chimpanzees (de Waal 1982) and vampire bats (Wilkinson 1990). While blood kinship has always been the most solid foundation for intimacy, its extension to more 'cultural' contexts of friendships, alliances or coalitions predates human evolution.

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9. From my unpublished field notes.

10. Mare dominance signals, in terms of ascending aggression, rank roughly: lowered ears > lowered ears and head > lowered ears and head plus turning the back > hind-legs kicking (added to the above signals). See discussion in Givón (1991a).

4.6 Mitigating the hazards of communication

4.6.1 Preamble

From the preceding discussion it may appear that the Society of Intimates is an informational common pool where, through spatial proximity and daily contact, all information is universally shared. This is in a way true, but this facet of information sharing in societies of intimates is counterbalanced by two paradoxical caveats:

- Transacting new information is often costly; and
- Relevance is often irrelevant.

These paradoxes are well known to anyone familiar with the dynamics of small, isolated rural communities, where everybody knows everybody's business, where the proverbial *bush telegraph* is ever-active, and where gossip – both friendly and malicious – is rife. The example I have chosen to illustrate these paradoxes comes from observations made on a Native American reservation, complemented by my own observations of small rural towns in the West. In both cases, the seeming paradox turns out to revolve around the need to avoid, at all costs, alienating one's intimates.

4.6.2 Private discourse and the costs of new information

Philips (1974) has identified six rules of caution – circumspection, or avoidance – in transacting new information in a Native American reservation context:

(8) **Information one must avoid**
   a. explicit information about past events
   b. identifying participants by name
   c. being identified as source of information
   d. being identified as author of prediction
   e. citing the source of your information
   f. making explicit negative statements

These features of Amerindian – indeed of small-town – communication stand in sharp contrast to the presumed norms of communication described by academics (Grice 1968/1975; Gordon and Lakoff 1975; *inter alia*). The academic literature identifies, as norms or injunctions, truthfulness, explicitness, exhaustiveness, relevance and avoidance of redundancy. How then can the Society of Intimates get away with flaunting these presumably-universal norms? And how can new information about well-known intimates be so costly?

There is a compelling logic to the principles (8) noted by Philips, a logic emanating, in each case, from the **potential for alienation**. Respectively:

a. In societies of intimates, one's business is everybody's business. Information about any member is not neutral, but may – and often does – impinge on the well being of others. New information, whether correct or fallacious, may have unforeseeable consequences, for which one may get the blame, and pay in alienating intimates. By avoiding explicit commitment to transacted – oft solicited – information, one forestalls potential blame and alienation.
b. All members of the intimate group are related to all other members and know each other well. New information spreads quickly and will soon reach its subject. No information is lost by avoiding explicit mention of persons involved in events. These persons can be easily identified, even from the most oblique reference. By avoiding explicit identification, one reserves the right of *disclaimer*, avoiding potential alienation from the hearer or, soon enough, the subject.
c. Likewise, avoiding being identified as the source of information is vital, since the information may soon reach its subject, often gratuitously distorted, interpreted and embellished.
d. Predictions are chancy, and one may be held responsible whether they turn out to be right or wrong. Either way, the potential for alienation is vast and should be avoided.
e. Citing one's sources may embroil others, most likely intimates, in a web of unforeseeable consequences, which may in turn rebound back upon the speaker. However delicious the gossip, one's sources must thus be left out, obscured or fudged.
f. The negative speech-act is not merely informative, it is an act of denial, casting doubt on another person's veracity, good faith and character.[11] It is an alienating device *par excellence* even in the most neutral academic contexts.

Societies of intimates are ever wary of the potential for alienating intimates. The consequences of such alienation are enormous, since one remains in daily contact with alienated former intimates; since social cooperation is based on intimacy; and since the group's interest trumps self-interest. The oblique, hedging conversational style of such societies reflects these concerns.

11. See discussion in Chapter 5 about the presuppositions associated with negative speech acts.

4.7 Culture a mechanism for automated social action

The discussion thus far suggested that cooperation in societies of intimates is most commonly *not* a matter of choice, rational or otherwise. The great bulk of occasions for social interaction are processed through relatively rigid culturally shared mechanisms. Such mechanisms are *conventionalized, routinized, ritualized*, and leave relatively little leeway for individual choice. For as long as one is a member of the social group, one acts as one is expected. For membership is predicated, to begin with, on a high degree of commonality, affinity, empathy, and trust. Or as Stiles (1994) puts it:

> "…It doesn't matter…whether the individual does better or worse: Cultural rules force him to work for the benefit of the group. Besides, it is in every individual's interest for the group to benefit and survive; without it the individual would perish…" (1994, p. 439)

Like most of its cultural attributes, social cooperation in societies of intimates seems highly predictable. But this is not the entire story. There remain some social contexts in such societies for individual choice under uncertainty. The contrast between these two mechanisms for decision making – one rigid and culturally prescribed, the other open to individual choice – follows in the main what was noted earlier (Chapter 3) about automated vs. attended information processing. This contrast is recapitulated in (9) below.

(9) **Attended vs. automated processing**

feature	**attended processing**	**automated processing**
manner:	conscious, analytic	unconscious
speed:	slow, inefficient	fast, efficient
fidelity:	high error rate	low error rate
context dependence:	high	reduced
informational predictability:	low	high
frequency:	low (surprise)	high (norm)
cognitive status:	figure	ground

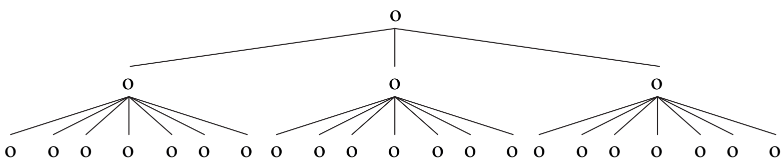
The creation of automated processing systems, with the attendant rigid neural pathways, is costly and requires repetition, habituation, reinforcement and protracted learning. Such high costs are only justified in the case of frequently encountered types of experience, ones that can be processed with high predictability – certainty – about their potential consequences. Attended processing, on the other hand, is analytic, conscious, slow and error-prone. It thus makes sense to reserve it for the minority of low-frequency, low-certainty but adaptively critical experiences.

4.8 The persistent relevance of the Society of Intimates

As far as can be ascertained, the Society of Intimates remained an amazingly stable primate and human adaptation for more than 10 million years, all the way till the late neolithic age ca. 8,000 BC. Complex societies of strangers began their ascent around that time, gradually developing agriculture, metallurgy, pottery – and literacy. The old hunting adaptation converted its intimate knowledge of the fauna into animal domestication and pastoralism, while the gathering adaptation converted its equally intimate knowledge of the flora into plant domestication and cultivation. Both changes precipitated – or made possible – sedentary settlements, surplus foodstuff and its storage, higher population density and larger social units. With lasting land improvements, cultivation, irrigation and durable shelter, the most precious property henceforth held in common by the foraging group – its terrain – became **private property**, soon leading to rising **social inequality**.

With the increased size of social units came the classical problems of management and coordination, as relatively amorphous and oft-leaderless societies of intimates turned into hierarchic societies of strangers. That is, schematically:

(10) **Hierarchic social organization**



The social and communicative consequences of hierarchic organization are profound, and may be expressed in terms of the interaction between vertically-adjacent vs. horizontally-adjacent nodes in (10) above:

- **Vertically**, an individual node interacts either with one governing node, or with its few governed nodes.
- **Horizontally**, a node interacts with its cohorts that are governed by the same higher node.

As everyone who has served in the military will tell you, the only social intimacy tolerated in this system is among members of a horizontal group, mostly at the lowest level where the like peons – with like social background – are thrown together.

Complex, hierarchic social organizations, once they attain the size of cities, states, kingdoms and empires, harbor a vast potential for alienation. Leaders – governing nodes – are alienated from their subordinates. Subordinates – governed nodes – maintain intimacy only within small, commonly governed units – clan, village, school, job, church, neighborhood, but are otherwise alienated from daily contact with other, similarly-isolated *nuclei of intimacy*. Social fragmentation and lack of intimacy breed mistrust. Wherever complex societies evolved over human history, **coercive governance** followed in their wake.

It is truly remarkable how little consensual government is recorded over the protracted history of complex societies of strangers, be they in Mesopotamia, Egypt, China, India, Europe or the Americas. Over recorded history, the few consensual governance experiments in complex societies of strangers amount to a frail 100 years in Athens, another 100 years in Rome, and the relatively precarious last 200 years of Western Europe and the Americas – out of the roughly 8,000-year lifetime of the Society of Strangers.

4.9 Closure

So far as can be ascertained, non-coercive societies of strangers have remained viable only when they succeeded, by hook or crook, in preserving some of the intimacy and solidarity of the old Society of Intimates. That is, to the extent that they succeeded in deploying some adaptive mechanisms of *de-alienation*. Let us consider three of those.

a. Cultural coherence

No society, however traditional, has ever been 100% homogeneous. All cultures maintain a balance between uniformity and diversity. In this, they closely resemble biological species, their normally-distributed variation curves, and the balance they maintain between genetic homogeneity around the mean and the genetic diversity at the margins (see Chapter 2). In biological populations, the price of excessive homogeneity has always been **adaptive stagnation**. The long-term survival of populations depends on novel solutions to challenging environmental puzzles. Stagnant bio-populations are relegated to the dust bin of evolution, or to remote corners of quaint relicdom. Conversely, the price of excessive diversity is **speciation**; that is, the separation of dynamic minorities from the gene pool (Bonner 1988).

Biological populations have always negotiated their survival between those two extremes, seeking an adaptive middle ground. The same may be said of cultures. To paraphrase A. F. Wallace (1961), a culture is an *organized diversity*, whereby a sufficiently high level of common perspective and shared knowledge are the prerequisites for trust, cooperation and communication.

All naturally-evolved communication systems, human and pre-human alike, are founded upon the rock of shared perspective, a common world-view and shared meaning. The much ballyhooed cliché of 'multi-culturalism' is, in an obvious way, utterly incompatible with a workable consensual society. It is an invitation for cultural incoherence, chaos and soon mayhem.[12]

The central adaptive injunction of the Society of Intimates – thou shall not cooperate with strangers – remains supremely relevant to large-scale societies of strangers. In the absence of cultural coherence, only two alternatives have ever been documented:

- chaos and violence
- coercive governance

b. Public intimacy

Public intimacy may sound like an oxymoron, yet it remains a major adaptive mechanism in complex would-be-consensual societies of strangers. Until the advent of universal media, geographic isolation meant eventual cultural-linguistic speciation. In the absence of spatial proximity and face-to-face intimacy, large-scale societies have often resorted to remote communication. This began innocently enough with literacy and eventually public education. Next came the ubiquitous media, re-homogenizing language, knowledge and world-view. With the emergence of a public consumer culture, external manifestations of

12. The original meaning of 'consensus' was *shared meaning*. See the further discussion in Chapter 10.

shared identity were reinforced, with food, dwelling, dress, hairstyle, art, sports, leisure, humor and more. Such media-driven commonalities can outflank spatial isolation and re-establishing, to varying degrees, the core prerequisites for trust and cooperation – familiarity and shared perspective.

The most intriguing and paradoxical universal medium turns out to be the Internet. It allows intimates to maintain their familiarity across vast geographic chasms. It lets us gain new bosom buddies, however illusory, without ever having met them in person. But it also lets impersonators, pranksters, scammers and sociopaths abuse our desperate need for intimacy.

c. Residual spheres of intimacy

Within the complex Society of Strangers, intimacy, trust and cooperation have never died out, but rather became confined to **islands of intimacy** whose denizens maintain frequent contact – family, friends, congregation, work-place, school, sports team, neighborhood bar, musical band – whatever will do the trick. Almost any frequent association based on shared interests can rekindle the old magic of intimacy, loyalty and trust. Within the complex Society of Strangers, such islands are created and re-created for the occasion, as havens in a raging sea. They grease the social skids, make cooperation possible, and furnish the emotional support that all social beings crave.

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CHAPTER 5

Language, coherence and other minds

5.1 Context as other minds

A long tradition in philosophy, psychology and linguistics, reaching back to Epicure and Aristotle, has take it for granted that mental representation reflects, or at least approximates, 'objective' reality. In philosophy, this tradition culminated in Logical Positivism (Frege 1884, 1892, 1893; Russell 1905, 1956; Carnap 1956, 1959, 1963). It is well expressed in the opening paragraph of Aristotle's *De Interpretatione*:

> "Now spoken sounds ['words'] are symbols of affections of the soul ['concepts'], and written marks ['letters'] are symbol of spoken sounds. And just as written marks are not the same for all men ['are not universal'], neither are spoken sounds. But what these are in the first place signs of – affections of the soul – are the same for all men ['are universal']. And what these affections are likenesses of – actual things – are also the same for all men ['are universal']." (bracketed material added)[1]

The fact that our perception of external reality is context-dependent, an observation going back to Plato, Aristotle, Kant and Peirce, could be presumably ignored by making context itself an 'objective' entity, the well-bounded surrounding portion of external reality, the ground vis-a-vis which we see the figure. It has been noted, however, that context is a selected mental construct, the product of **framing**. That is, one has to first decide which part of external reality is the figure and which is the ground – or context. Such a determination, while aided by some more-objective considerations such as perceptual saliency, compactness, boundedness, spatial and temporal distribution, also depends on non-objective value judgements such as relevance, importance, centrality and goals, all of which are subjective, malleable and rapidly-shifting mental constructs.[2] Indeed, context is most often construed on the fly, for the occasion.

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1. In addition to re-launching empiricism in philosophy, Aristotle's fateful paragraph also launched structuralism in Linguistics (Givón 1979/2019, Chapter 1).

2. Givón (2005, Chapter 1).

In spite of what we know about the maleability of context, tokens of mentally-represented experience – figures – are not adaptively useful to biological organisms unless they exhibit a high degree of **predictability**. And such predictability is due in large part to the fact that cognizing organisms classify all tokens of experience into general categories or **natural types**. In constructing such categories, organisms practice a certain measure of idealization, glossing over – or averaging out – much of the observable cross-token variation, or at least the portion of the variation that is deemed irrelevant.[3]

Since context is in principle a contingent framing operation, it would be of some interest to study it in a domain that constrains it at least to quite an extent, and in addition also divides it into recognizable sub-types. One such domain is the systematic use of context in language and communication.

5.2 Grammar and other minds

Let us begin by discussing three examples that illustrate the use of grammar in communication, and how it depends on assumptions that speakers make about what is in the hearer's mind during on-going communication. More extended examples will be brought up in Chapters 6, 7 below.

5.2.1 The grounding of definite referents

Consider first the three types of grounding that most commonly allow speakers/hearers to construct and interpret definite referents:

- grounding to the shared lexicon
- grounding to the current speech situation
- grounding to the current discourse

a. Grounding definite referents to the shared lexicon

As noted earlier (Chapters 3, 4), the culturally-shared lexicon is coextensive with the cognitive psychologist's **long-term semantic memory** (Atkinson and Shiffrin 1968). During on-going communication, different nodes in this network-like representation in the mind of the hearer are activated by the speaker's use of other words. Some of these words have *unique reference* that is *always* accessible to members of the relevant social unit. Part of knowing the meaning

3. Givón (2005, Chapter 2).

of such words is knowing that they are globally accessible to members of the relevant social unit. In using such words, speakers need only to mark them with a *definite* grammatical marker (e.g. 'the' in English for nouns, or the use of names). They can then take it for granted the hearer will search for them neither in the currently-attended speech situation, nor in episodic memory. As examples, consider:

(1) **Globally-accessible unique definite referents**:

referent	**relevant social unit**
a. **The sun** came out.	all humans
b. **The president** has just resigned.	a nation-state
c. They are at **the cemetery**.	a community
d. **The river** is frozen over.	a community
e. Call **the sheriff**!	a county
f. **The Gods** must be angry.	a religion
g. **Daddy** is home!	a family

The grounding of unique referents to the shared lexicon may also involve a mixed access system. In such a system, one referent is activated first via another type of shared context, then the definite referent is activated automatically because of its generic *network connection* to the first referent. This hybrid referential access is sometime called 'framed-based' or 'script-based' (Anderson, Garrod & Sanford 1983; Yekovich and Walker 1986; Walker and Yekovich 1987). Thus consider:

(2) **Double-grounded definite referents**:
a. My boy missed *school* today,
he was late for **the bus**.
b. She showed us *this gorgeous house*,
but **the living room** was too small.
c. We went into *a restaurant*
and asked **the waiter** for **the menu**.

The word 'school' in (2a) automatically activates its cluster of connected nodes, including – in our culture – 'bus'. The word 'house' (2b) automatically activates its cluster of connected nodes, among them 'living room'. The word 'restaurant' in (2c) automatically activates its cluster of connected nodes, including 'waiter' and 'menu'. The speaker uses the definite article in (2a, b, c) with the expectation that those referents are accessible to – thus activated in – the hearer's mind, given that the hearer is a member of the same culture, speaks the same language, and thus shares the same lexical-semantic network.

b. Grounding definite referents to the shared speech situation

When interlocutors share a current speech situation, referents within the shared space-time grid are assumed to be equally accessible to both speaker and hearer. In cognitive terms, the speaker assumes that situation-shared referents are available to – or activated in – the hearer's **attention** or **working memory**. Typical examples of situation-based access fall under the general label of *deixis* (pointing). The most common ones are:

(3) a. **The interlocutors**:
I am telling **you** that…
b. **Other referents**:
No, she doesn't own **this** hose, she owns **that** one.
c. **The shared location**:
There was no room **there**, so they came **here** instead.
d. **The shared time**:
He wanted to come **right then**, but I told him to wait till **now**.

In both (3c) and (3d), the proximate referent ('here', 'now') is situationally shared. The distal 'there' and 'then', respectively, are derived by conventional inference from their respective proximate referents.

c. Grounding definite referents to the shared current discourse

By far the most common grounds for assuming that a definite referent is accessible to the interlocutor's mind involves our tacit expectation that the just-transacted chunk of discourse is still available to our hearer in their *long-term episodic memory* (Attkinson and Shiffrin 1968). Referents in the on-going discourse are thus expected to have a mental trace in the hearer's mind. When a new – *indefinite* – referent is introduced into the discourse for the first time, the speaker assumes no prior mental trace in the hearer's mind, and marks the referent grammatically as indefinite. In the subsequent discourse, if the referent is deemed to be still accessible to the hearer, various definite grammatical devices can be used, depending on the *discourse context*. As an illustration, consider the brief narrative in (4) below.[4]

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4. This topic is discussed in greater detail in Chapters 6, below.

(4) a. …Well, there was **this** man standing near **the bar**,
b. but we ignored **him** and went on across the room,
c. where **another man** was playing the pinball machine.
d. We sat down and ordered a beer.
e. **The bar tender** took his time,
f. I guess **he** was busy.
g. So we just sat there waiting,
h. when all of a sudden **the man standing next to the bar** got up and…

In marking 'man', introduced for the first time in (4a), with the *indefinite* article 'this', the speaker cued the hearer that they don't expect him/her to have a prior mental trace of the referent in their episodic memory, but also that the referent is *important*, and thus is likely to recur in the subsequent discourse. Next, in coding the same referent with the anaphoric pronoun 'him' in (4b), the speaker assumes that the referent is both accessible and *currently activated*.

Another referent – 'man' – is introduced for the first time in (4c), marked with the indefinite marker 'another'. 'The bar tender' is then introduced for the first time in (4e), but is marked as *definite*. This is so because the prior discourse (4a) had activated the frame 'the bar', which is assumed to remain activated in the subsequent narration. And 'bar tender' is automatically-activated by the frame 'bar' (see (2) above) and thus marked as definite.

The continued reference with the anaphoric pronoun 'he' in (4f) again indicates the assumption that the referent is currently activated. Finally, the man introduced first in (4a, b) and absent for five intervening clauses is re-introduced in (4h). The use of a definite article with the noun in (4h) suggests that the speaker assumes that the referent is *still accessible* in the hearer's episodic memory but *not currently activated*, and that it must be searched for in the hearer's episodic memory. Another 'man' had been mentioned in the intervening (4c) as 'playing the pinball machine'. Both referents are assumed to still be accessible in the hearer's episodic memory, and would thus compete with each other if the simple definite 'the man' was used. To differentiate between the two, a *restrictive relative clause* is used here, matching 'standing next to the bar' in (4h) with 'this man was standing near the bar' in (4a). In using the restrictive REL-clause, the speaker reveals his/her expectation that the hearer still has an episodic trace of both the referent and the proposition in (4a).

All these decisions by the speaker about the appropriate use of grammar – and what the hearer knows at any given point in the discourse – are made rapidly and subconsciously. In all instances in (4), the construed context in the mind of the speaker is not only the rapidly-shifting relevant portion of the text, but, more crucially, the speaker's rapidly-shifting mental model of the mind of the hearer.

5.2.2 Speech acts: Access to the interlocutor's epistemic and deontic states

The narrative in example (4) above reveals another important facet of our presumption of access to other minds. Our mental model of the mind of our interlocutor shifts constantly – from one clause to the next – during on-going communication. As the speaker releases more information, they constantly update what they assume the hearer knows. Speakers thus seem to possess a *shifting mental model* of their hearer's ever-shifting *epistemic* (knowledge) states. In this section we will see that speakers also seem to possess a shifting mental model of their hearer's constantly-shifting *deontic* (intention) states.

The epistemic and deontic states we will consider here can be cued by several grammatical sub-systems. The most conspicuous of those, and the easiest to illustrate, is the grammar of *speech-acts*. The study of speech-acts has traditionally centered on a set of *felicity conditions* associated with various speech-acts – declarative, imperative, interrogative, etc. These conventions have an illustrious history in post-Wittgensteinean philosophy of language, beginning with Austin (1962); Searle (1970); Grice (1968/1975); Levinson (2000), *inter alia*.

As an illustration, consider first the following – somewhat schematic but still plausible – dialogue between speakers A and B:

(5) A-i: So she got up and left.
B-i: You didn't stop her?
A-ii: Would you?
B-ii: I don't know. Where was she sitting?
A-iii: Why?
B-iii: Never mind, just tell me.

In the first conversational turn (5A-i), speaker A executes a *declarative* speech-act, which involves, roughly, the following presuppositions about hearer B's current epistemic and deontic mental states, in addition to the speaker's own epistemic and deontic mental states:

(6) a. **Speaker's belief about hearer's epistemic state**:
- Speaker believes hearer doesn't know proposition (5A-i).
- Speaker believes hearer believes that speaker speaks with authority about proposition (5A-i).

b. **Speaker's belief about hearer's deontic state**:
- Speaker believes hearer is well-disposed toward the speaker communicating to him/her proposition (5A-i).

c. **Speaker's own epistemic state**:
- Speaker believes he/she knows proposition (5A-i).

d. **Speaker's own deontic state**:
- Speaker intends to inform hearer of proposition (5-i).

In the next turn (5B-i), speaker B executes an *interrogative* speech-act (yes/no question), which involves, roughly, the following presuppositions about hearer A's current mental states (as well as the speaker B's own):

(7) a. **Speaker's belief about hearer's epistemic state**:
- Speaker believes hearer knows the declarative proposition underlying question (5B-i).
- Speaker believes hearer knows speaker does not know that proposition.

b. **Speaker's belief about hearer's deontic state**:
- Speaker believes hearer is willing to share his/her knowledge of that proposition.

c. **Speaker's own epistemic state**:
- Speaker is not certain of the epistemic status of the proposition underlying (5B-i).

d. **Speaker's own deontic state**:
- Speaker would like hearer to share his/her knowledge with him/her.

In turn (5B-iii), lastly, speaker B executes a *manipulative* speech-act, which involves, roughly, the following presuppositions about hearer A's current mental states (as well as the speaker's own):

(8) a. **Speaker's belief about hearer's epistemic state**:
- The hearer believes the hearer knows that the desired event ('You tell me') is yet unrealized.

b. **Speaker's belief about hearer's deontic state**:
- Speaker believes hearer is capable of acting so as to bring about the desired event.
- Speaker believes the hearer is well-disposed toward acting to bring about the desired event.

c. **Speaker's own epistemic state**:
- Speaker believes the desired event ('You tell me') is yet unrealized.

d. **Speaker's own deontic state**:
Speaker would like the event ('You tell me') to come about.

At every new turn in the conversation (5), not only do the speaker's own belief-and-intention states change, but also his/her mental representation of the hearer's belief-and-intention states. And one would assume that similar fast-paced adjustments also occurs in the hearer's mental model of the speaker's belief-and-intention states.

5.2.3 Negation and other minds

Consider, lastly, the contrast between the use of affirmative and negative propositions in the very same communicative/discourse context – the beginning of a conversation between two familiars (Givón 1979/2019, Chapter 3):

(9)	**(a) affirmative response**	**(b) negative response**
	A: Hi. What's new?	Hi. What's new?
	B: Well, my wife is pregnant.	Well, my wife is **not** pregnant.
	A: Wow, congratulations!	Oh, was she supposed to be?

Following the affirmative response by B in (9a), speaker A shows no surprise, since affirmative information is transacted in the context of the speaker's (B) default assumption of the hearer's (A) *ignorance*. In contrast, in confronting the negative response (9b), speaker A shows surprise, and also reveals the source of his surprise: speaker B has just violated the normative assumption about negative speech-acts – that they are transacted in the context where the corresponding affirmative has been mention earlier, or contemplated, or presupposed. But in (9b) speaker A indicates he *knew nothing* about the possibility that the corresponding affirmative – 'my wife is pregnant' – had been ever raised before. Affirmative and negative speech-acts, it seems, are used normatively in utterly different communicative context; that is, with profoundly different mental models that speakers have about what their interlocutors know or do not know.

5.3 Relevant social unit and shared cognition

In Chapters 6, 7 below, we will discuss more complex examples of the use of context – and assumptions about the interlocutor's mind – in grammar-coded communication. We will note again and again how the relevant discourse context translates, transparently and systematically, mental models about the interlocutor's mind. And we will note again the central role that assumptions about the interlocutor's mind plays in both the coherent *process* of communication and its coherent *product* – the text.

While the assumption of shared cognition is prerequisite to all social cooperation and communication, it does not always pertain to the mind of a *specific* interlocutor at a specific communicative situation. Thus, in the examples discussed in Section 4.2.1. (a) above, what the speaker assumes is **culturally-shared cognition**, pertaining to all members of the relevant social unit. But how could one assume that one's current interlocutor, in the current speech situation, shares one's generic-cultural universe of reference? A rather mundane inference must make such an assumption plausible:

(10) **Shared cognition as an inference from observed similarities**:
If this person looks like me, walks like me, talks like me, and otherwise displays all the physical and behavioral signs of being like me and belonging to my social unit, then they must surely also share my generic-cultural cognitive map of the universe.

Inference (10) is an *abductive* rather than deductive one, a matter of conjecture or plausible expectation. It is a mundane case of *reasoning by feature association*, an old, inexpensive adaptive strategy.[5] For, much like in other biological organisms, such an inference merely extends into a novel functional domain an old, entrenched, most likely automated and genetically wired-in cognitive mechanism. Bio-organisms have been using this adaptive strategy for eons to infer the membership of both physical and social categories, reasoning from accessible visibles to adaptively-relevant invisibles.

The mind of others – and its similarity to one's own mind (10) – is the most natural, adaptive inference a social organism can make. However, such an inference can only be made if natural mental categories are rich and multi-featured, showing strong **feature association**.[6] Thus for example, horses have a typical size, shape, color, behavior and cultural uses. If one of those are missing – say you encounter a three legged, or miniature, or orange-painted, or circus horse – the presence of the other strongly-associated features insures that it still is a horse.

5. If it looks like a duck, walks like a duck and quacks like a duck, then by golly…

6. See again Givón (2005, Chapter 2).

5.4 Reasoning by feature association – the wrong metaphor?

As noted above, reasoning by feature association is an ancient, entrenched concomitant of natural categorization, the very core of the adaptive rationale for the evolution of classificatory mental categories. But however convenient the metaphors of ‘reasoning’ or ‘inference’ may be, they are somewhat misleading. For they misrepresent the underlying neuro-cognitive mechanisms involved in such ‘reasoning’. Our habituated generic mental categories do not depend on rational conscious inferences such as (11) or (12) below. The first, (11), reasons that an individual member of a natural – multi-featured – category must exhibit feature association. That is, it is, most likely, *prototypical*:

(11) **Reasoning by feature association (i)**:
Category *A* has strongly-associated features *a, b, c, d*.
Individual *x* is a member of category *A*.
Individual *x* possesses feature *a*.
===
Therefore individual *x* must also possess features *b, c, d*.

The second inference, (12) below, reasons first that an individual of unknown category membership who possess *one* characteristic feature of a category must also possess the *other* – associated – features, and thus must be a member of the category:

(12) **Reasoning by feature association (ii)**:
Category *A* has strongly-associated features *a, b, c, d*.
Individual x possesses feature *a*
===
Therefore individual *x* must also possess features *b, c, d*.
===
Therefore individual *x* must be a member of category *A*.

Inference (12) suggests that biological organisms assume that non-prototypical members of natural categories are relatively rare. And it is this statistical *clustering around the mean* exhibited by members of natural categories that makes them so adaptive. Indeed, it is the high probability that natural categories exhibit *strong feature association* that makes this clustering-around-the-mean possible. Put another way, the normal distribution curve is not the invention of statisticians, but of adaptive biological populations.

5.5 Intermezzo: Other minds and 'Theory of Mind'

In cognitive psychology, a 40-year discussion of the mental representation of other minds has been taking place, often subsumed under the rubric of *Theory of Mind*. This discussion was launched with a prescient article by Premack and Woodruff (1978) "Does the chimpanzee have a theory of mind?" While largely programmatic, the article was brimming with theoretical and methodological insights. In a concluding line anticipating empiricist objections, Premack and Woodruff (1978) suggested, perhaps tongue in cheek:

> "…Moreover – and we add this with more than facetious intent – it would waste the behaviorist's time to recommend *parsimony* to the ape. The ape could only be a mentalist. Unless he is not intelligent enough to be a behaviorist…" (1978, p. 526; italics added)

The evolutionary intent of the 1978 article was clear from the start, be it for its cross-species or cross-developmental comparison; or for its unabashed invocation of "naturalness" or "primitiveness" as key element in a mentalistic account of *inferring other minds*:

> "…The important point here is that assigning mental states is not a sophisticated or advanced act but a primitive one…" (*ibid.*, p. 525)
>
> "…Having decided that behaviorism is *unnatural* because it requires suppressing *primitive inferences*, whereas theories of mind are *natural*…" (*ibid.*, p. 526; italics added)

The intensive discussion that followed, lasting to this day, left in its wake a vast body of literature, much too extensive for me to review here. This literature may be divided, roughly and with a generous allowance for overlaps, into six categories:

a. **Theory of mind in human adults**:
   Gopnik and Wellman (1994); Whiten (ed. 1991); Dunbar (1998); Malle *et al.* (eds 2000); Fussell and Kreutz (eds 1998); *inter alia*.
b. **Children's Theory of Mind**:
   Wellman (1990); Gopnik & Wellman (1992); Bartsch and Wellman (1995); Povinelli and deBlois (1992); Meltzoff (1999, 2000a, 2000b); *inter alia*.

c. **Autistic (children's) Theory of Mind**:
Baron-Cohen (1995); Leslie and Frith (1988); Penner *et al.* (1989); Morton *et al.* (1991); *inter alia.* [7]

d. **Non-human primates' Theory of Mind**:
Povinelli & Preuss (1995); Povinelli and Eddy (1996a, 1996b, 1996c); Povinelli *et al.* (1990, 1992) Tomasello (1996); Tomasello and Call (1997); *inter alia.*

e. **Theory of Mind and the brain**:
Dunbar (1998); Baron-Cohen (2000); Morton *et al.* (1991); Meltzoff (2002b); *inter alia.*

f. **Evolution of Theory of Mind**:
Byrne and Whiten (eds 1988); Povinelli & Preuss (1995); Mithen (1996); Dunbar (1998); Byrne (1998); Baron-Cohen (2000); Meltzoff 2000b; Meltzoff and Prinz (eds 2002); *inter alia.*

Two things stand out when one peruses through this vast, thought-provoking literature. First, in the cross-disciplinary discussion of Theory of Mind there is not a single contribution from the discipline that can furnish the best prima-facie evidence for mind-reading, the discipline that studies – or at least ought to study – the rapidly-shifting expectations that speakers have about the rapidly-shifting mental states of their interlocutors during on-going communication. This discipline, Linguistics, can easily demonstrate the central role of grammar in the mind-reading process during on-going communication.[8]

The second remarkable thing about the 40-odd years discussion of Theory of Mind is that none of the discussants seem to have noticed that 'theory' is a rather improper term. This is so because, to judge by the evidence on the role of grammar in communication, and of the speed of oral language processing,

7. Three recent papers, all of them from child clinicians, dissent from the near-universal attribution of autism to lack of Theory of Mind, presumably due to some neurological deficiency. Rather, they attribute it to deficiencies in some component of the attention system. The first, Landry and Bryson (2004) attributes autism to a deficiency in the "disengage" component of attention. The second, Halperin and Schulz (2006), is not quite clear on the specifics. The third, Johnson *et al.* (2008), attributes autism to the opposite impairment, an inability to stay focused, i.e. ADHD.

8. The systematic use of grammar in constructing a mental representation of the hearer's mind in the speaker's mind during on-going communication (Givón 1990, 2005) has not been discussed much in linguistics.

the process of mind-reading during communication must be thoroughly *automated*, thus unavailable to one's conscious executive attention. Since the use of grammar is centrally involved in the representation of other minds during on-going communication, it is perhaps in order at this juncture to describe a bit more fully the central role of grammar in human communication.

5.6 Grammar and communication

5.6.1 Developmental-evolutionary perspective

Grammar is the latest evolutionary addition to the arsenal of human communication (Lieberman 1984; Givón 1979/2019, 2002, 2005, 2009; Bickerton 1980, 1990, 2008; Bickerton and Givón 1976; Li 2002; *inter alia*), following the lexicon and phonology (sound system). While the evolutionary argument remains necessarily incomplete, it is supported by a coherent body of suggestive evidence.

In ontogenesis, to begin with, children acquire the lexicon and phonology first, using pre-grammatical pidgin communication a year or so before they begin to acquire grammar (Bloom 1973; Bowerman 1973; Scollon 1976; Givón 1979/2019, 1990, 2009; *inter alia*). Likewise, natural second language acquisition in adulthood follows the same course, though most often stopping short of grammaticalization and thus remaining at the stage of pre-grammatical pidgin (Bickerton 1981, 1990; Bickerton and Odo 1976; Selinker 1972; Schumann 1976, 1978, 1985; Andersen 1979; Givón 1979/2019, 1990, 2002, 2009; *inter alia*). This old recapitulationist reasoning (Haeckel 1874; Gould 1977) has gained considerable traction in recent evolutionary-developmental – or *epigenetic* – research, showing that development (ontogeny) and evolution (phylogeny) share similar mechanisms (West-Eberhard 2003).

A well-coded lexicon can be acquired by many non-human species (Premack 1971; Gardner and Gardner 1971; Fouts 1971; Terrace 1985; Savage-Rumbaugh *et al.* 1993, 1998; Savage-Rumbaugh and Lewin 1994; Pepperberg 1991, 1999; Tomasello 1996; Tomasello and Call 1997; Tomasello *et al.* 2005; *inter alia*). This reinforces the suggestion that semantic memory is an old pre-human and pre-linguistic mental capacity (see Chapters 2, 3 above). In contrast, the communicative use of grammar in non-human species remains unattested. Nor has any success been reported in teaching grammar to non-human species (Premack 1971; Terrace 1985, 1979; Pepperberg 1991, 1999; Tomasello and Call 1997; *inter alia*). Grammar thus seems to be a uniquely human communicative device.

5.6.2 Grammar as structure

As a structural code, grammar is much more complex and abstract than either the sensory-motor code of phonology or the lexical-semantic network. At its most basic, the primary grammatical signal involves four major coding devices:[9]

(13) **Primary grammar-coding devices**:
  a. Morphology
  b. Intonation:
    - clause-level melodic contours
    - word-level stress or tone
  c. Rhythmics:
    - pace or length
    - pauses
  d. Sequential order of words and morphemes

Some of the primary coding devices in (13) (morphology, intonation) are more concrete, involving the same sensory-motor channels that code the lexicon. But these concrete devices are integrated into a complex whole with the more abstract coding devices (rhythmics, sequential order) that are, in all likelihood, second- or third-order computations, involving temporality.

The most concrete element of the grammatical code, grammatical morphology, is a diachronic (historical) derivative of lexical words (Givón 1971, 1979/2019, 2009; Traugott and Heine eds 1991; Heine *et al.* 1991; Heine and Kuteva 2007; Hopper and Traugott 1994; Bybee *et al.* 1994; *inter alia*).

The primary grammar-coding devices listed in (13) are, in turn, used to signal more abstract levels of grammatical organization:

(14) **Abstract levels of the grammatical organization**:
  a. Hierarchic constituency ('phrase structure')
  b. Semantic roles (agent, patient, dative, etc.)
  c. Grammatical relations (subject, object, indirect object, oblique)
  d. Lexical categories (noun, verb, adjective, adverb)
  e. Syntactic categories (noun phrase, verb phrase, clause, clause-chain)
  f. Scope and relevance relations (operator-operand, noun-modifier, subject-predicate)
  g. Government and control relations (agreement, co-reference, subordination, finiteness)

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9. For considerably more detail see Givón (2001).

Given that biological structures and functions are closely interlaced and reveal a pattern of isomorphic mapping (see Chapter 2),[10] one should not be surprised if grammatical structures and functions turned out to be equally complex and isomorphic.

5.6.3 Grammar as adaptive function

The great complexity and considerable abstractness of grammatical structures is due in large part to the complexity of grammar-coded communicative functions, as well as to grammar's interaction with many language-relevant neuro-cognitive processors. Grammar interacts intimately with, at least:[11]

(15)
- lexical-semantic memory (ventral trend, hippocampus)
- event-clause processor and episodic memory (dorsal trend, hippocampus)
- multi-clause coherence and episodic memory (dorsal trend, hippocampus)
- attention and working memory (attention networks)
- clause and clause-chain integration (Brocca's area, Wernike's area)

Once grammar is studied in its natural adaptive context – the actual *process* of communication and its *product*, the text – the function of grammatical constructions can be identifed in highly specific ways.[12] Unfortunately, the systematic deployment of grammar to signal mental representation of other minds is often obscured by the structuralist terminology employed by linguists.[13] As a result, the communicative function of grammatical construction is often equated with their observable *discourse context* – the text – rather than with the *communicative goals* of the speaker/hearer.

The most common communicative domains coded by grammar are listed in (16), (17) and (18) below. While the list is not exhaustive, it ranges over the three central clusters of grammatical organization:

10. For iconicity in grammar see Haiman (1985; ed. 1985); Givón (1991b).

11. For an account of how attention and memory may be deployed in the grammar-coded domain of referential coherence, see Chapter 6, below.

12. For details see again Givón (2001)

13. For discussion see Givón (1995, Chapter 1).

- nouns and nominal phrases (NP)
- verbs and verbal phrases (VP)
- clauses and clause-chain

In listing functions below, the terms 'coherence' and 'grounding' are used interchangeably, both signifying connectivity.

(16) **Communicative functions of nominal grammar**

structure	**function**
a. semantic roles	event and participant types
b. grammatical relations	referential coherence
c. definite reference	referential coherence
d. anaphora, pronouns	referential coherence
e. deictics	referential coherence
f. pragmatic voice	referential coherence
g. topicalization	referential coherence
h. relativization	referential coherence
i. focus and contrast	referential coherence

(17) **Communicative functions of verbal grammar**

structure	**function**
a. tense	temporal event grounding
b. aspect	aspectual event grounding
c. modality	epistemic/deontic event grounding
d. speech acts & negation	epistemic/deontic event grounding

(18) **Communicative functions of cross-clausal grammar**

structure	**function**
a. inter-clausal connectives	clause or chain grounding
b. presentative devices	referential coherence
c. chain-initial adverbials	chain grounding
d. chain-medial SS/DS	referential coherence
e. chain final markers	chain grounding
f. finiteness marking	cross-clause or cross-chain coherence

In studying the communicative function of grammatical construction, their distribution in text is an indispensable methodological tool (Chapters 6, 7). However, the theoretical goal of the investigation is not the text but rather, the mind that produces and interprets the text.[14]

5.6.4 Communicating without grammar

The adaptive function of grammar comes into a sharper focus when one studies how humans can, in some developmental, social or neurological contexts, communicate without grammar. In such contexts, they get by with a sound-coded lexicon and a few rudimentary combinatorial rules, using **pre-grammatical pidgin** communication (Bloom 1973; Bowerman 1973; Scollon 1976; Bickerton 1981, 1990, 2008; Bickerton anf Givón 1976; Bickerton and Odo 1976; Selinker 1972; Schumann 1976, 1978, 1985; Andersen 1979; Givón 1979/2020, 1990, 2009). One such context is early child communication (ca. 18 months of age). Thus, Bowerman (1973) observes:

> "…early child speech is 'telegraphic' – that is consists of strings of content words like nouns, verbs, and adjectives, and lacks inflections, articles, conjunctions, copulas, prepositions and post-positions, and, in general, all functors or 'little words' with grammatical but no referential significance…" (Bowerman 1973, pp. 3–4)

As an example of coherent but largely pre-grammatical child pidgin, consider the following two passages of interaction between a 29-month-old Spanish-speaking boy and his father (Wise 1994). In (19) below, high-frequency verb inflections for first and second person already conform to the adult model:

(19) a. No sé.
NEG know-**1s**
'I don't know.

b. Ves?
see-**2s**
You see?

c. Mira, así dos!
look-IMPER/2s like.this two
Look, like this, two!

14. Givón (1995).

d. Sí, tuyo dos.
Yes, yours two
Yes, [there are] two [with] yours.
e. Aquí hay campo.
here have room
Here there's room
f. Así, Papi!'
like.this, Daddy
like this, Daddy!'

In (20) below, the same invariant high-frequency verb form (3rd person sg.) is used regardless of number (20b) and person (20c); an oblique form of 'you' is substituted for the nominative; and the plural noun suffix is dispensed with (20b):

(20) a. Mi pantalón está…
my pant be-**3s**
'My pants are…
b. Aquí está dos carro aquí.
Here be-**3s** two car here
Here there're two cars here.
c. Aquí está tí, Papi.
here be-**3s** you/OBL Daddy
Here you are, Daddy.
d. Aquí está Guiguis arriba!
here be-**3s** G. up
Here is Guiguis up there!'

As an example of adult second-language pidgin, consider (21) below, spoken by an 80-year-old Japanese-English pidgin speaker in Hawaii (Bickerton and Odo 1976; Bickerton and Givón 1976; Givón 1990):

(21) "…oh me?…oh me over there…
nineteen-twenty over there say come…
store me stop begin open… me sixty year…
little more sixty year… now me ninety…
nah ehm… little more… this man ninety-two…
yeah, this month over… me Hawaii come-*desu*…
nineteen seven come… me number first here…
me-*wa* tell… you sabe gurumeru?…
you no sabe gurumeru?…
yeah this place come…

this place been two-four-five year…
stop, ey… then me go home… Japan…
by-n-by… little boy… come…
by-n-by he been come here… ey…
by-n-by come…
by-n-by me before Hui-Hui stop…
Hui-Hui this… eh… he… this a…
Manuel… you sabe-*ka*…"

As an example of coherent narrative produced by an *agrammatic (Broca's) aphasia* patient, consider (22) below (Menn 1990, p. 165):

(22) "…I had stroke… blood pressure… low pressure…
period… Ah… pass out… Uh… Rosa and I, and…
friends… of mine… uh… uh… shore… uh drink,
talk, pass out…
…Hahnemann Hospital… uh, uh I… uh uh wife, Rosa…
uh… take… uh… love… ladies… uh Ocean uh Hospital
and transfer Hahnemann Hospital ambulance… uh…
half'n hour… uh… uh it's… uh… motion, motion…
uh… bad… patient… I uh… flat on the back…
um… it's… uh… shaved, shaved… nurse, shaved me…
uh… shaved me, nurse… [sigh]… wheel chair… uh…
Hahnemann Hospital… a week, a week… uh… then uh…
strength… uh… mood… uh… up… uh… legs and
arms, left side uh… weak… and… Moss Hospital…
two week… no, two months…"

The instances of pre-grammar discourse in (20), (21), (22) above are entirely coherent in their sequencing, vocabulary choices and communicative intent. In the absence of morpho-syntactic clues, however, the bulk of the clues that help the hearer establish the text coherence in such pre-grammatical communication are furnished by the lexicon, situational clues (Kintsch 1992), intonation and gestures, intimate speaker-hearer familiarity – and anything the hearer can further infer. Pidgin communication is, for these reasons, slow, full of pauses and repetitions, prone to misunderstanding, and thus requires frequent clarification. Nonetheless, a small set of cognitively-transparent ('iconic') regularities – rules of proto-grammar – characterize pidgin communication.[15]

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15. (Givón 1989 Chapter 3, 1990, 1991b, 2002 Chapter 4)

Neither the lexical clues nor contextual inferences nor the 'rules' of proto-grammar disappear in fluent grammatical communication of adults. Rather, such cues are deployed as a parallel language-processing channel alongside grammar. The major differences between pre-grammatical pidgin and grammatical communication are summed up in (23) below (Givón 1979/2020 Chapter 5, 1989, Chapter 3).

(23) **Pre-grammatical vs. grammatical communication**

properties	**grammatical**	**pre-grammatical**
STRUCTURAL:		
a. **morphology**	abundant	absent
b. **constructions**	complex, embedded	simple, conjoined
c. **word**-order	grammatical (subj/obj)	pragmatic (topic/comment)
d. **Pauses**:	fewer, shorter	copious, longer
FUNCTIONAL:		
e. **processing speed**	fast	slow
f. **mental effort**:	effortless	laborious
g. **error rate**:	lower	higher
h. **context dependence**:	lower	higher
i. **processing mode**:	automated	attended
j. **development**:	later	earlier
k. **consciousness**:	sub-conscious	more conscious

When one compares the functional properties of pre-grammatical pidgin with those of conscious attended processing (Chapter 3), it becomes clear that grammar is an automated language processing device. Its later development in acquisition, diachrony and no doubt evolution (Bickerton 1981; Givón 1979/2020, 1990, 2009; Heine and Kuteva 2007; *inter alia*) conforms to this observation.

Pre-grammatical children, adult Pidgin speakers and agrammatic aphasics comprehend and produce coherent multi-propositional discourse, albeit at slower speeds and higher error rates than those characteristic of grammatical communication. Fluent oral speech is processed at the rate of ca. 250 msec per word, ca. 1–3 secs per clause and ca. 10–15 secs per clause-chain (Neely 1977, 1990; Swiney 1979). The processing rate of pre-grammatical speech, with hesitations, repetitions, misunderstandings and corrections, is at least 3–5 times slower.

5.7 The whys of grammar: Context, automaticity and other minds

In evolving its highly-automated lexical phonology and grammar, human language liberated itself, albeit only partially, from the tyranny of paying constant attention to the context. This partial liberation came in two waves. First to evolve was lexical-phonology, yielding pidgin communication. Grammar followed later. As a result, the two language codes, taken together, now activate more automatically and reliably the three mental representation systems – or context types – discussed earlier above (see also Chapter 3):

(24) **Context types as cognitive representation systems**:

context type	representation system
• The shared generic world-view	permanent semantic memory
• The shared speech situation	attention and working memory
• The shared current text	episodic memory

The automatic nature of grammar is further underscored by experimental work suggesting that while people are fairly good at recalling the propositional contents of just-transacted discourse, they are notoriously bad at recalling the grammatical structure used in that discourse (Kintsch and van Dijk 1978; Kintsch 1994; Gernsbacher 1985; Dickinson and Givón 1997; Barker 2004; Barker and Givón 2002, 2003). Grammar, like other *skilled* performance executed by *experts*, appears to behave like an automated-processing system. Or, as Socrates has discovered to his chagrin and eventual sorrow, and reported in both the *Meno* and *Apology* dialogues, experts are too skilled to know how or why they do things. They just do them.

The subconscious nature of the use of grammar – ever present but seldom recalled[16] – contrasts sharply with lexical and propositional information, which speakers tend to attend to and retrieve consciously from semantic and episodic memory.

As noted earlier, grammatical constructions are associated systematically with the speaker's explicit mental models of their interlocutors' epistemic and deontic states. And further, these mental models are sub-conscious, so that access to them is automated. But why?

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16. When Xenophon went to Delphi to consult the oracle prior to departing for his ill-fated *Anabasis*, the Pythia is reputed to have said: "Invoked or uninvoked, the God will be there". Grammar seems to enjoy the same behind-the-scene ubiquity.

One possible explanation has to do with *relevance*: Much of the information about the speaker's *and* hearer's shifting mental states during communication is relevant *only* during the moment of processing a particular conversational turn, or a clause. Verbatim grammatical information is stored only in *working memory* for the 3–10 seconds when it is *relevan*t. Storing it in longer-term episodic memory, and then making it consciously accessible at any subsequent time when it is *irrelevant,* would serve no communicative purpose. In fact, it would interfere with the mental representations that are relevant at that later time.

The coherence structure of discourse is profoundly re-shuffled in episodic memory (Loftus 1980; Gernsbacher 1990; Ericsson and Kintsch 1997; Dickinson and Givón 1997; Barker and Givón 2003; Barker 2004). Recalling from episodic memory propositions that sport the same grammatical structure that coded them upon entry would be a cognitive distraction.

Grammar, it seems, is but a means to an end in language processing, an input/output translation code. What is stored in the hearer's episodic memory, in addition propositional information, is not grammatical structure, but what it stands for – multi-propositional coherence (Gernsbacher 1990). To echo Wittgenstein's (1953) ladder metaphor, once grammar has been used to get us where we need to go – to a coherent representation of discourse in episodic memory – it is discarded. Carrying it any further would have been an adaptive burden.

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CHAPTER 6

Discourse coherence

6.1 Re-orientation

The coherence of human discourse has been discussed most often in terms of the product of communication – the oral or written *text* (Grimes 1975; Halliday and Hassan 1976; Longacre 1976; *inter alia*). However, coherence is fundamentally a property of the mind that produces, stores, retrieves and interprets the text (Mandler 1978; Johnson and Mandler 1977; Kintsch 1982; Kintsch and van Dijk 1978; van Dijk and Kintsch 1983; Trabasso and van den Broeck 1985; *inter alia*). That is, discourse coherence is better viewed as a set of constraints on mental structures and operations that take place during ongoing communication. It is nonetheless a sound methodology to proceed from studying the structure of coherent texts to hypotheses, empirical studies, and theories about the mind behind the text (Kintsch and van Dijk 1978; Gernsbacher 1990; Kintsch 1982, 1992, 1994; Ericsson and Kintsch 1997; Givón 1992, 1995; *inter alia*).

As noted earlier (Chapter 5), the mental operations that take place during communication are best rendered in terms of the speaker's mental representation of the hearer's ever-shifting epistemic and deontic states. And grammar is a specific device designed to code those implicit assumptions the speaker makes about the hearer's mind during ongoing communication.

6.2 The coherence structure of discourse

Human discourse is typically multi-propositional. That is, we string together multiple event/state clauses in coherent, hierarchically organized sequences that maintain a high degree of *continuity* or *connectivity*. The sub-elements – *strands* – of discourse coherence tend to persist from one clause to the next across stretches of discourse, most commonly clause-chains; though the coherence of early childhood discourse, ca. age 1, is commonly mono-propositional.[1] The overall thematic coherence of human discourse is a tapestry-like product of those multiple strands, of which the most concrete and easier to track are:

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1. Multi-propositional coherence in early childhood is achieved first across adjacent adult-child turns (Ochs *et al.* 1979).

(1) **Main strands of discourse coherence**
 a. referents
 b. spatiality
 c. temporality
 d. tense-aspect-modality
 e. action routines

Most commonly, these individual strands of discourse coherence maintain their continuity together, breaking together at the end of discourse units. And those units are organized hierarchically; schematically:[2]

(2) **Hierarchic organization of discourse**

lower

---

clause
clause chain
paragraph
episode
story

---

higher

The most basic unit of discourse-coherence above the verbal clause level is the **clause-chain** (a.k.a. *sentence*), the arena in which the bulk of grammatical devices perform their communicative functions. The overall structure of clause-chains can be given as, schematically:

(3) **Structure of clause chain**
…# RD, CI, CM, CM, CM, CM, (…..), CF#…
RD = re-orientation device
CI = chain-initial clause
CM = chain-medial clause
CF = chain-final clause
# = chain boundary

2. The tradition of Conversational Analysis (CA), imported into linguistics from sociology, holds that the coherence structure of conversation, where the control of perspective shifts periodically from one speaker to another, is radically different from the coherence structure of narrative or procedural discourse. Several studies have suggested that this claim is not empirically supported (Chafe 1997; Coates 1997; Ervin-Tripp and Küntay 1997; Dickinson and Givón 1997; Linell and Koroiija 1997; Barker 2003).

Prosodically, a word and a clause tend to come under a unifying intonation contour. Within-clause (between-words) intonation breaks tend to be ca. 50mscs long. Between-clause – chain-medial – intonation breaks tend to be up to 100msecs long. And between-chain intonation breaks tend to be longer than 100msecs.[3] Inter-clausal intonation breaks correspond, roughly, to comma punctuation [,] in written discourse, and inter-chain breaks to period [.] or semi-colon [;].

6.3 Referential coherence as grounding

Of the multiple thematic strands of coherent discourse listed in (1), referential coherence is the most concrete, frequent in text, grammatically conspicuous and easy to measure. It will thus serves as the best initial example of discourse coherence. In this chapter we will also discuss temporal (tense-aspect) coherence. Other facets of discourse coherence will be deferred to Chapter 7, below.

6.3.1 Continuity, connectivity and grounding

Discourse coherence can be taken to mean – at the very least – continuity, connectivity or grounding. As noted earlier above (Chapters 3, 5), mental texts are represented in episodic memory in sequential-hierarchic *network* structures. The coherent structure of mental representation is the main guarantor of rapid access to and retrieval of episodic-memory nodes during on-going communication. Such access and retrieval depend, crucially, on the nodes' connectivity – or *grounding* – to other nodes in the network.

During on-going communication, both the speaker and the hearer are busy connecting – or grounding – incoming lexical and clausal nodes onto the pre-existing network structure of the current text in episodic memory. From the **hearer's perspective**, coherent grounding guarantees three core adaptive imperatives of discourse processing:

- coherent comprehension
- coherent episodic storage
- rapid access to and retrieval of the stored text

3. See Swinney (1989); Neely (1990); Givón (1991a, 2005 Chapter 5).

From the **speaker's perspective**, using grammar to cue the hearer into establishing well-structured – coherent – episodic storage of the current text guarantees the hearer's comprehension. That is, it guarantees that the hearer's episodic representation will approximate the speaker's. Successful communication thus depends crucially on the creation of well-structured – coherent – episodic representation during communication (Gernsbacher 1990).

6.3.2 Temporal axis: Anaphoric vs. cataphoric grounding

The use of grammar to cue the grounding of incoming lexical and propositional information into episodic memory involves two temporal directions relative to the ever-shifting time of speech:

- **anaphoric** or retrospective grounding to nodes in the prior discourse;
- **cataphoric** or anticipatory grounding to potential nodes in the subsequent discourse.

Anaphoric grounding, discussed briefly in Chapter 5 above, connects incoming referents that are assumed to be either *familiar* or *accessible* to the hearer ('definite') to nodes in the mentally-represented current text where the referents already have some *antecedent* presence.

Cataphoric grounding connects incoming referents that are assumed to be *unfamiliar* or *inaccessible* to the hearer ('indefinite') to nodes in the mental representation of the current text where they do not yet have antecedent presence, but where they are expected to cohere for other reasons. In both types of grounding, the speaker-hearer takes for granted the implicit, ever-shifting *time-axis* of communication – the time of speech ('now'). The example of grounding of definite referents given in Chapter 5, above, were all of the anaphoric kind.

The main referent-coding grammatical devices can be ranked in terms of their degree of **referential continuity**:[4]

4. Modifiers on both definite and indefinite nouns add many intermediate points on this scale, as do various pre-clausal or post-clausal 'dislocated' NPs, adverbial phrases, adverbial clauses.

(4) **Referent-coding grammatical devices**

lowest referential continuity

a. indefinite nouns (or NPs)
b. definite nouns (or NPs)
c. stressed independent pronouns
d. unstressed anaphoric pronouns
e. zero anaphora

highest referential continuity

Grammatical relations – subject vs. direct object vs. oblique – also play an important role in the coding of referential coherence, intersecting with and enriching the referent-coding devices in (4). All other things being equal, a referent marked as the clause's *subject* tends to be more continuous and more important; one marked as *direct object* tends to be less continuous and less important; and one marked as *oblique* tends to be less continuous and less important yet. In addition, word-order can play an important role in coding referential coherence, often signaling the referent's topicality (importance). Both grammatical relations and word-order will be discussed further below.

So far, we may have left the impression that referential **continuity** ('accessibility') is the only dimension of referential coherence. But an equally important, if less understood and harder to measure, dimension is that of referential **importance** ('topicality'),[5] which can pertain to both definite and indefinite referents. And while there is a seemingly-strong statistical association in text between the continuity and importance of referents, the two dimensions are distinct and can be dissociated. For example, an *indefinite* NP (4a) codes an anaphorically discontinuous – inaccessible – referent, which may nevertheless be highly important, as measured by e.g. cataphoric continuity. In the next section, we will survey briefly the traditional philosophical discussion of reference, existence, reality and definiteness.

5. See Givón (1988).

6.4 Intermezzo: The domain of reference

6.4.1 Truth and reference in the Real World

An illustrious tradition, culminating in Logical Positivism, considered reference to be a mapping between linguistic expressions and entities in the Real World (Russell 1905; Strawson 1950, 1964; Carnap 1956, 1959). From this objectivist perspective, the truth value of propositions that contain referring expressions depends in part on whether those referring expressions do or do not map onto entities that have reference ('denotation') in the real world. As an illustration, consider (5) and (6) below:

(5) a. **The present king of France** is not bald
    b. **The present queen of England** is not bald

(6) a. There is a king of France
    b. There is no one that is both king of France and bald
    c. There is a queen of England
    d. There is someone that is both queen of England and not bald

According to Russell's approach to reference ('denotation'), in asserting (5a) one asserts two contradictory propositions – the false (6a), and the true (6b). And further, the falsity of (6a) is due to the *failed denotation* of 'the present King of France' in (5a). In asserting (5b), on the other hand, one is not being contradictory. Rather, one asserts two propositions, the truth of one (6c) being due to *successful denotation* of 'the present Queen of England' in (5b), and the truth of the other (6d) being a matter of mere fact.

It is of course remarkable that human languages elect to code the referents in (5a, b) with exactly the same grammatical device (syntactic subject, the definite article 'the'), paying no heed to denotation in the RW or the truth value of the propositions. In the same vein, human languages ignore RW-grounded denotation and truth value in marking indefinite referents, as in:

(7) a. I rode **a unicorn** yesterday
    b. I rode **a horse** yesterday

In matters of reference, it seems, the grammar of human language, or rather the grammar-using mind behind it, marches to a different drum. Rather than grounding linguistic referents in the RW, we ground them in some verbally-constructed *Universe of Discourse*. Or, in the framework pursued here, we ground linguistic referents in the current discourse as represented in either (fleetingly) working memory/attention or (more lastingly) in episodic memory.

6.4.2 Referential intent in a universe of discourse

It is of course true that the Universe of Discourse and the proverbial RW enjoy a considerable overlap in human communication, which tends on the whole to deal with extant human individuals and their everyday affairs. But when the two worlds part company, the grammar of reference cheerfully disregards denotation in the RW, opting to align itself with denotation in the Universe of Discourse. In (5a) above, for example, the grammar first created a hypothetical referent in an imagined universe of discourse, then treated it as if it was real. In the same vein, consider:

(8) a. She's looking for *a horse*; **it** escaped last Friday.
 b. She's looking for *a horse*; **it** had better be white.

In both (8a) and (8b), the pronoun 'it' is equally grounded to an antecedent referent ('a horse') in the pre-established Universe of Discourse. And while the grammar of English in this case does not distinguish between the real horse that escaped last Friday (8a) and the potential white horse yet to be identified (8b), the speaker surely does. The speaker *intends* 'a horse' in (8a) to be interpreted as a specific *referring* entity in the universe of discourse, but 'a horse' in (8b) to remain imaginary, potential, *non-referring*. In other languages (or in other varieties of English), the speaker's *referential intent* is explicitly marked by grammar (see further below).

6.4.3 Reference and propositional modalities

The effect of propositional modalities on the referential properties of nominals under their scope was initially noted by Quine (1953). The logical tradition (e.g. Carnap 1956) recognized four propositional modalities – necessarily true, factually true, possibly true, not true, a division that goes back to Aristotle. The four logical modalities can be easily re-interpreted as the equivalent communicative modalities, as in (9) below, with the four propositional modalities now grouped into two mega-modalities, *fact* (true) and *non-fact* (not-true):

(9) **Propositional modalities**:

communicative	**logical**
fact	**true**
a. Presupposition	necessarily true (analytic)
b. Realis-assertion	factually true (synthetic)
non-fact	**non-true**
c. Irrealis-assertion	possibly true (has no truth value)
d. NEG-assertion (negation)	not-true (false)

The differential behavior of nominal referents under the scope of the four modalities is illustrated in (10) below with indefinite object nouns:

(10) a. **Fact, Realis**:
She **saw** a dog
(⊃ a particular dog; REF)
(*⊃ any dog; *NON-REF)
b. **Fact, Presupposition**:
Because she *saw* a dog,…
(⊃ a particular dog; REF)
(*⊃ any dog; *NON-REF)
c. **Non-fact, Irrealis**:
She **will** see a dog
(⊃ a particular dog; REF)
(⊃ any dog; NON-REF)
d. **Non-fact, Negation**:
She **didn't** see a dog
(⊃ any dog; NON-REF)
(*⊃ some dog; *REF)

6.4.4 Reference vs. topicality/importance

So far, if one tests isolated clauses detached from their discourse context, it may seem that the referring vs. non-referring contrast is about the speaker's *referential intent*. And one could easily then find languages (Turkish, Modern Hebrew, Mandarin Chinese, Krio, Sherpa) where special markers are accorded to indefinite nouns that are *intended* to refer, as against unmarked non-referring nominals. In Bemba (Bantu), the referring vs. non-referring contrast cuts across the definitive/indefinite contrast, which is grammaticality unmarked. Thus consider:[6]

(11) **Fact-realis**:
a. **Referring**:
a-a-somine **ichi**-tabo
s/he-PAST-read **REF**-book
'S/he read a book'
b. ***Non-referring**:
a-somine **chi**-tabo
s/he-read **N/REF**-book

(12) **Non-fact, irrealis**:
c. **Referring**:
a-ka-soma **ichi**-tabo
s/he-FUT-read **REF**-book
'S/he will read a particular book'
d. **Non-referring**:
a-ka-soma **chi**-tabo
s/he-FUT-read **N/REF**-book
'S/he will read a (some, unspecified) book'

(13) **Non-fact, negation**:
e. **Referring**:
ta-a-a-soma **ichi**-tabo
NEG-S/he-PAST-read **REF**-book
'She didn't read *the* book'
*'S/he didn't read *a/any* book'
f. **Non-referring**:
ta-a-a-soma **chi**-tabo
NEG-S/he-PAST-read **N/REF**-book
'S/he didn't read *a/any* book'

When the same morphological contrast is studied in its natural communicative context, i.e. in a text, a different picture emerge. The grammatical operator that is supposed to mark referring-indefinite nominals as '*intended* to refer' in fact marks them as *important/topical*. That is, such referents are intended to *persist* in the subsequent discourse, regardless of their logical referential status. In contrast, the grammatical operator that is supposed to mark non-referring

6. For more detail see Givón (1973a).

nominals as 'not-intended to refer' in fact marks them as *non-topical/ unimportant*. They are thus indefinite referents that are *not* intended to persist in the subsequent discourse. What we have here is a system of cuing *thematic importance* or *relevance* rather than logical referential status.

As a typical example of this contrast, consider the use of the referring-indefinite marker 'this' in spoken American English, as seen in an old Dear Abby letter (Wright and Givón 1987):

(14) **The indefinite articles *a(n)* vs. *this* in English discourse**:

"Dear Abby: There's *this guy* I've been going **with** for near
three years. Well, the problem is that **he** hits me. **He**
started last year. **He** has done it only four or five times,
but each time **it** was worse than before. Every time **he** hits
me it was because **he** thought I was flirting (I wasn't).
Last time **he** accused me of coming on to *a friend* of **his**.
First **he** called me a lot of dirty names, then **he** punched my
face so bad **it** left me with *a black eye* and black-and-blue
bruises over half of my face. It was very noticeable, so I
told my folks that the car I was riding in stopped suddenly
and my face hit the windshield.
Abby, **he**'s 19 and I'm 17, and already I feel like *an old
married lady* who lets her husband push her around. I
haven't spoken to **him** since this happened. **He** keeps bugging
me to give **him** one more chance. I think I've given **him**
enough chances. Should I keep avoiding **him** or what?
Black and Blue"

Of the four indefinite referents introduced for the first time into the discourse in (14) above, the one introduced by 'this' ('this guy') recurs again and again as the central character in the subsequent narrative (aside from the speaker herself). The indefinite referents introduced by 'a', two logically referring ('a friend of his', 'black eye') and the other non-referring ('an old married lady'), do not recur in the subsequent text.

The *cataphoric persistence* of 'a'-marked vs. 'this'-marked indefinite referents has been studied in oral narratives produced by 8-to-12-year-old native speakers of American English. The results are summarized in table (15) below (Wright and Givón 1987).

(15) **Mean cataphoric persistence (CP) of 'a'-marked vs. 'this'-marked indefinite subjects and objects in spoken English** (expressed as the number of times the referent recurred in the subsequent 10 clauses)

grammatical coding	mean CP value	N	%
'this'-subject	6.95	**28**	65%
'this'-object	2.40	15	35%
total 'this'		43	100%
'a'-subject	1.54	13	12%
'a'-object	0.56	**94**	88%
total 'a':		107	100%

A clear correlation can be seen in (15) between grammatical subjecthood and use of the indefinite article 'this': 65% of 'this'-marked referents also appear as subjects, while 88% of 'a(n)'-marked referents occur as non-subjects. Indeed, the contrast of grammatical roles – subject vs. direct object vs. others – is one of the most reliable cataphoric grammatical signals for both indefinite *and* definite referents.

Referring-indefinite – highly topical – subjects most commonly appear in a special *existential-presentative* construction. Thus, 100% of the 'this'-marked subjects in the data summarized in (15) above appeared first in such a construction, as in, e.g.:

(16) ....*There's this guy* who comes over to our house every night…

Lastly, in the diachronic evolution of indefinite markers, the early stage always marks important – cataphorically persistent – indefinites. This is just as true of the old indefinite 'one' ('a'/'an') in English, the '*ekhad/khad* 'one' in Hebrew or the *wan* 'one' of Krio as it is of the new indefinite 'this' in English (Wright and Givón 1987; Givón 2015, Chapter 12).

As an illustration of how grammatical roles are used to convey the difference between important (persisrent) vs. unimportant (non-persistent) referents, consider the cataphoric persistence of subject-marked vs. object-marked referents in a sample of 5 languages, given in table (17) below. The data are expressed as a contrast between low-persistence referents, those that persist only 0–1–2 times (0–2) in the subsequent 10 clauses, and high-persistence referents, those that persist more than twice (>2) in the subsequent 10 clauses. Both definite (the majority) and indefinite (a small minority) referents are included in the samples (Givón 1995, Chapter 6).

(17) **Cataphoric persistence of subjects and objects of transitive clauses in Sahaptin, Panare, Bella-Coola, Korean and Spanish**

persistence in the following 10 clauses

language	**0–2**		**>2**		**total**	
	N	**%**	**N**	**%**	**N**	**%**
Sahaptin						
subj	9	19.6%	37	**80.4%**	46	100.0%
obj	21	**61.8%**	13	38.4%	34	100.0%
Panare						
subj	9	31.0%	20	**69.0%**	29	100.0%
obj	19	**65.5%**	10	34.5%	29	100.0%
Bella Coola						
subj	27	21.4%	99	**78.6%**	126	100.0%
obj	82	**65.1%**	44	34.9%	126	100.0%
Korean						
subj	53	35.3%	97	**64.7%**	150	100.0%
obj	106	**72.0%**	44	28.0%	150	100.0%
Spanish						
subj	19	19.0%	81	**81.0%**	100	100.0%
obj	70	**70.0%**	30	30.0%	100	100.0%

6.5 The grammar of anaphoric continuity

Having noted the correlation between referential importance ('topicality') and cataphoric continuity in the subsequent discourse, we return now to flesh out the discussion of anaphoric continuity or accessibility, first broached in Chapter 5 as well as, briefly, in Section 6.2. above, where we left off with the referential continuity scale (4), reproduced below:

(4) **Referent-coding grammatical devices**

lowest referential continuity

a. indefinite NPs
b. definite NPs
c. stressed independent pronouns
d. unstressed anaphoric pronouns
e. zero anaphora

highest referential continuity

In the following sections we will flesh out the earlier discussion of anaphoric referential coherence, furnishing supporting empirical evidence.

6.5.1 High-continuity grammatical devices

Consider first the contrast between zero anaphora and unstressed anaphoric pronouns in English:

(18) **Unstressed anaphoric pronoun vs. zero**:
John went to the mirror, [Ø] examined his hair, [Ø] sighed and [Ø] turned.
a. Then **he** walked out.
b. *Then [Ø] walked out

Both the unstressed anaphoric pronoun in (18a) and the anaphoric zero in (18b) signal maximal referential continuity. Yet (18b) is an inappropriate continuation, because zero anaphora cannot be used in English across chain boundaries, only across chain-medial inter-clause boundaries.

Consider next the contrast between unstressed ('anaphoric') and stressed ('independent') pronouns:

(19) **Unstressed/anaphoric vs. stressed/independent pronouns**:
Mary talked to Marcie for a while.
a. Then **she** left. (⊃ Mary left)
b. Then **SHE** left. (⊃ Marcie left)

The unstressed anaphoric pronoun in (19a) signals referential continuity (SS). The stressed independent pronoun in (19b) signals referential discontinuity or **switch reference** (DS). This use of stressed independent pronouns also applies to objects. Thus, consider the complex subject-object switches in (20) below, all of them in chain-medial contexts:

(20) Marcie slapped John, then **HE** slapped **HER**, then **SHE** left in a huff and **HE** left too.

In Spanish, where subject pronominal agreement is obligatory, the two highest-continuity devices, anaphoric pronouns (4d) and zero anaphora (4e), have merged into a single device, subject pronominal agreement, which can be used at both chain-medial (cross-clause) and cross-chain boundaries. Thus, compare the Spanish continuation in (21a, b) below with the English in (19a, b) above:

(21) Juan volvi-**ó** a la casa y comi-**ó** su cena.
J. returned-**3s** to the house and ate-3s his dinner
'John went back to the house and ate his dinner.
a. Luego sali-**ó** de nuevo.
then got.out-**3s** of new
Then **he** went out again'.
b. *Luego **él** sali-**ó** de nuevo.
then **3s** got.out-**3s** of new
*Then **HE** went out again'.

The infelicity of (21b), in both Spanish and English, is due to the fact that it implies switch reference (and contrast) where none is warranted by the context. Such a contrast, now used appropriately, is seen in (22b) below, motivated there by the context and fully corresponding to the English usage in (19b) above:

(22) Maria habl-**ó** con Mercedes.
Mary talked-**3s** with Mercedes.
'Mary talked with Mercedes.
a. Luego volvi-**ó** a la casa.
Then return-**3s** to the house
'Then **she** went home' (she = Mary)
b. Luego **ella** volvi-**ó** a la casa.
Then **she** returned-**3s** to the house
Then **SHE** went home' (she = Mercedes)

A similar functional distribution, with obligatory grammatical agreement collapsing the function of zero anaphora and unstressed/anaphoric pronouns of English, can be seen in other languages with obligatory subject-agreement paradigms, such as Hebrew or Swahili.

In languages such as Japanese or Chinese, which have no unstressed anaphoric pronouns, zero anaphora codes *both* chain-medial (cross-clause) and cross-chain referential continuity, in this way corresponding to pronominal agreement in Spanish. Ute (No. Uto-Aztecan) is roughly in this typological ball-park, since its unstressed clitic pronouns are optional, and roughly 70% of continuous referents are still zero-coded. As an illustration, consider the following story-initial sequence:[7]

(23) a. yoghovʉchi̲ 'u, [Ø] pagha'ni-na-pʉga-'ura,
Coyote/s the/s walk.about-HAB-REM-be
'Coyote, **he** kept wandering about,

b. kach [Ø] 'ini-a-sapa̲ paqha-na-pʉ-a, [Ø] 'ɵɵ-'ay-kwa̲-pʉga,
NEG WH-O-MOD kill-HAB-REM-NEG bone-be-go-REM
he hadn't killed anything (for a long time), **he** became bone-skinny,

c. ka-'ini-aa-sapa̲ [Ø] paqha-na-pʉ-a,
NEG-WH-O-MOD kill-HAB-REM-NEG
he hadn't killed anything (for a long time),

d. [Ø] tʉgʉy-whqa-vɵrɵ-na-pʉga-'ura…
hungry-search-walk-HAB-REM-be
he was walking about searching hungry…'

A second participant is then introduced as the subject of a *presentative* construction, with a hedge in (24e) below, then as an *object* (24f). And a stressed independent pronoun is used in (24f) for *switch-subject* to the new referent, as in English or Spanish. Such switching is repeated several times in succession (24g, h). Thus, with Coyote still the topical referent:[8]

(24) e. …'ú-vway-aqh-'ura 'ú-vwaa-tʉ-'ura 'íni̲-kway 'ura-pʉga…
there-at-it-be there-at-DIR-be WH-MOD be-REM
'…Then, right there, there was what's-his-name…

f. mu̲kwapi [Ø] maay-pʉga, **'uwas**-kway pacha'ay-kyay-ku̲.
spider/O see-REM **3s/S**-TOP stick-ANT-SUB
he saw a spider, as **HE** (spider) was stuck (there).

7. "Hungry Coyote races Skunk for the prairie dogs", as told by Mollie B. Cloud (Givón ed. 2013).

8. *Ibid.*

g. 'ú-vway-aqh-'ura **'uwas** magʉni̲-pʉga, [Ø] tʉka-vaa-chi̲-'**u**.
there-at-it-be **3s/s** pounce-REM eat-IRR-NOM-**3s**
so right away **HE** (Coyote) pounced, intending to eat **it** (spider).

h. 'u-vyay-aqh-'ura **'uwas**-'ura 'áy-pʉga…
there-at-it-be **3s/s**-be say-REM
so then **HE** (Spider) said…'

6.5.2 Low-continuity devices

We have already seen how stressed independent pronouns function as switch-reference devices. Such use of these pronouns is most typically found in chain-medial contexts, where two participants alternate as the topical referent (see Chapter 7). By using the independent pronoun alone in such contexts, the speaker signals to the hearer: "Go back to the previous occurrence of a different referent and *reinstate* it", as in (24f, g, h) above. As a result, the *anaphoric distance* between the current and previous occurrence of the referent in such mid-chain switches tends to be 2–3 clauses.

Full NPs, in contrast to stressed independent pronouns, are used either to introduce brand new ('indefinite') referents into the discourse for the first time, or to re-introduce old ('definite') referents after a considerable gap of absence. When an indefinite NP is slated to be topical/important, and thus persist in the subsequent discourse, most commonly some *presentative device* is used in its first introduction. Such devices most typically mark the new topical referent as the *subject* of a presentative clause, as in English existential clauses. In Ute, an independent pronoun is used as such a presentative device, in combination with the full NP. Thus compare:

(25) a. **English:**
Once there was **a wizard**, he lived in Africa, he went to China to get a lamp….

b. **Ute:**
'uwas-'ura **yoghovʉchi̲** 'ura-pʉga; khura tʉgʉy-naru'a-puga…
3s/s-be **coyote/s** be-REM then hunger-buy-REM
'There was once **Coyote**; well he got hungry…'

But new referents are commonly introduced into discourse as indefinite *objects*, and only later upgraded into higher topicality – and re-introduced as *definite subjects*. This is the Ute strategy in (24f) above, where 'spider' is introduced first as an indefinite object and then immediately upgraded to definite subject in the following clause, coded now by a stressed independent subject pronoun:

(26) mukwapi [Ø] maay-pʉga, '**uwas**-kway pacha'ay-kyay-ku…
spider/O see-REM **3s/S**-TOP stick-ANT-SUB
'**he** saw a spider, as **HE** (spider) was stuck (there)…'

When old referents are re-introduced into the discourse after a gap of absence greater than 2–3 clauses, they are most commonly re-introduced as *definite NPs*. When the old referent is brought back across a chain or paragraph boundary, with a gap of absence – anaphoric distance – of 10–20 clauses, special chain-initial **reorientation devices** are used, most often with a pause that renders the construction **paratactic** rather than syntactic. Such a re-orientation device may be an L-dislocation construction, a long conjunction, and ADV-phrase or an ADV-clause. And these devices can be ranked in terms of the *anaphoric distance* (AD) to the previous mention of the referent, or the depth and complexity of the preceding context vis-a-vis which the re-orientation proceeds. That is:

(27) **Chain-initial re-orientation devices**:

Shorter-distance re-orientation

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a. **Subject L-dislocation**:
…Now **the other guy, he** quit, just took off and vanished…
b. **Object L-dislocation**:
…Now **the other guy**, we saw **him** just once, then he took off…
c. **Conjunction**:
…**But then** the other guy took off and vanished…
d. **Adverbial phrase**:
…**The next minute**, the other guy took off, just vanished…
e. **ADV-clause**:
…**After she finished talking**, the other guy took off…

Longer-distance re-orientation

6.6 Quantitative text-distribution of major referent-coding devices

6.6.1 Preliminaries

In the preceding section we identified several clusters of major referent-coding devices in terms of their anaphoric continuity. Table (28) below lists the typical ('average') anaphoric distance (AD) of the most common referent-coding grammatical devices (Givón ed. 1983, 1995 Chapter 8).

(28) **Comparison of mean anaphoric distance (AD) values and degree of categorial clustering of common anaphoric devices**

construction	mean AD (# of clauses)	degree of clustering around the mean
most continuous:		
a. zero anaphora	1.0	100% at mean
b. unstressed pronouns	1.0	95% at mean
c. stressed pronouns	2.5	90% bet. 2–3 cl.
d. Y-movement	2.5	90% bet. 2–3 cl.
e. cleft clauses	3.0	90% bet. 2–4 cl.
f. DEF-noun	7.0	25% at 1.0 cl.
		35% bet. 5.0–19 cl.
		40% at 20+
g. DEF-noun with	10.0	55% bet. 5.0–19.0
restrictive modifier		45% at >20+
h. L-dislocated	15.0	60% a >20+
DEF-noun		13% at 10–19
		25% at 4–9
least continuous:		

One must emphasize that anaphoric distance (AD), much like cataphoric persistence (CP) earlier, is only a *heuristic* measure. By itself, AD does not signal any mental operation. Rather, it is possible to *interpret* measured AD values as correlating to some mental entities – or operations. But the case for such correlations must be first established as credible hypothesis, then argued on firm theoretical grounds, and eventually supported by independent cognitive evidence. In the next section I will present quantitative distributional evidence, obtained from the study of written or oral discourse across a number of languages, to back up the generalizations given in (28) above.

6.6.2 Individual languages

a. English

English is a rigid SVO language using four major referent-coding anaphoric devices: zero, unstressed/anaphoric pronouns, stressed/independent pronouns and full definite NPs. In Table (34) below a comparison is given of the mean *anaphoric distance* (AD) values for these four devices in written English narrative, re-computed from Brown (1983).

(29) **Mean AD values of major referent coding devices in written English**

category	N	mean AD value
zero	314	1.00
unstressed PRO	1,162	1.72
stressed PRO	27	2.27
definite NP	1,023	16.66

The comparable values for spoken English narrative are given in Table (30) below, re-computed from Givón (1983b).

(30) **Mean AP values of major referent coding devices in spoken English**

category	N	mean AD value
zero	117	1.0
unstressed PRO	336	1.0
stressed PRO	75	3.75
definite NP	69	10.15*

* Indefinite NPs were not counted here, since they have no anaphoric antecedence.

Within bounds, both written and spoken English conform to the expected values in (28). What is more, the high text-frequency of zero and unstressed pronouns underscores their use as high-continuity devices.

b. Spoken Ute

Ute is a flexible-order ex-SOV language with a high text-frequency of anaphoric zeros. It also employs optional, low-frequency unstressed anaphoric pronouns, and those can cliticize on any word-type, commonly on the first word in the clause ('2nd position clitics'), and most commonly on the verb. Table (31) below, re-computed from Givón (1983c), summarizes the mean AD values of the major referent-coding devices in spoken Ute narrative.

(31) **Mean anaphoric distance values of major referent coding devices in spoken Ute**

category	**N**	**mean AD value**
zero	321	1.21
unstressed PRO	42	1.54
stressed PRO SV	75	2.80
VS	61	1.95
OV	12	2.41
VO	1	1.00
definite NP SV	39	10.84
VS	25	**1.48**
OV	34	9.67
VO	13	**4.46**

Within bounds, the AD figures for Ute conform to the predictions made in (28) above, but with one crucial exception – the low AD value for post-verbal (VS) subject NPs and, to a lesser extent, of post-verbal (VO) object NPs. This effect of **flexible word-order** will be discussed further below.

c. Biblical Hebrew

Early Biblical Hebrew (EBH) is a VO language with flexible subject position (VS vs. SV) and a strong statistical tendency to VSO. The two major verbal conjugations, the suffixal *perfect* and the prefixal *perfective/irrealis*, have obligatory subject pronominal agreement. Object pronominal agreement on the verb is optional, and alternates with unstressed object pronouns written as separate words (as in English). Since subject pronominal agreement is obligatory in the main conjugations (perfect, perfective, irrealis), zero anaphora is rare, found mostly in non-verbal (nominal/participial) clauses. Table (32) below, re-computed from Fox (1983), summarizes the anaphoric distance values for the major reference-coding devices in Early Biblical Hebrew.

(32) **Mean anaphoricv distance values of major referent coding devices in Biblical Hebrew**

category	**N**	**mean AD value**
pro-AGR S	295	1.10
pro-AGR O	57	1.10
stressed PRO-S	87	2.87
stressed PRO-O	52	1.17
definite NP SV	142	9.86
VS	357	**6.51**
OV	12	25.08
VO	267	**12.30**

The AD figures for pronominal agreement and stressed subject pronouns conform, in the main, to the predictions in (28), above. The effect of the pragmatically-controlled word-order on the AD values of definite NPs will be discussed further below.

d. Spoken Spanish

Spanish is a rigid VO language with a flexible subject position (SV vs. VS) and obligatory subject agreement in all verbal conjugations. It is thus typologically similar to Biblical Hebrew, above. Unstressed anaphoric object pronouns are cliticized to the verb, pre-verbally (OV) in most finite conjugations and post-verbally (VO) in the infinitive and imperative conjugations. The mean anaphoric distance values for the various referent-coding devices in spoken Venezuelan Spanish are given in Table (38) below, re-computed from Bentivoglio (1983).

(33) **Mean anaphoric distance values of major referent coding devices in spoken Spanish**

category	**N**	**mean AD value**
pro-AGR S	328	1.30
O	137	1.65
DAT	112	1.50
stressed PRO – SV	133	1.90
VS	11	**1.64**
stressed PRO-VO	6	1.50
definite NP SV	34	4.20
VS	10	**2.50**
VO	20	8.57

Within bounds, these results conform to the predictions given in (28), above. As in Biblical Hebrew, a word-order effect is also discernible in Spanish, with post-verbal subject (VS) coding more continuous referents – lower AD values – than pre-verbal subjects (SV).

e. Spoken Japanese

Japanese is a rigid SOV language with no unstressed anaphoric pronouns or verb pronominal agreement. The AD values reported below, re-computed from Hinds (1983), cover oral narrative, female-female conversation, and male-male conversation. Table (34) below, summarizes the results for spoken Japanese narrative.

(34) **Mean AP values of major referent-coding devices in Japanese spoken narrative**

category	**N**	**mean AD value**
zero	50	1.10
stressed PRO	/	/
definite NP	147	6.87

Table (35) below summarizes the results for the female-female conversation.

(35) **Mean AP values of major referent-coding devices in Japanese female-female conversation**

category	N	mean AD value
zero	108	1.55
stressed PRO	11	4.35
definite NP	25	13.5

Table (36) below summarizes the results for the male-male conversation.

(36) **Mean AP values of major referent-coding devices in Japanese male-male conversation**

category	N	mean AD value
zero	114	3.10
stressed PRO	27	5.27
definite NP	65	10.5

The results of the Japanese AD measures for narrative and female-to-female conversation conform, in the main, to the prediction in (28). The results for the male-male conversation stand out in two categories – zero anaphora and stressed pronouns. Both seem to be used in contexts of *much lower* referential continuity – higher AD values – than expected. Such usage may be due to the higher informational predictability in face-to-face conversation between intimate interlocutors in this particular diad. It may also be due to a more careless style of verbal interaction among males.

f. Spoken Mandarin Chinese

Mandarin Chinese is a rigid SVO language, with an extensive use of zero anaphora and no unstressed anaphoric pronouns, in this respect rather similar to Japanese. The correlation between grammatical role – subject vs. direct object – and the frequency of zero anaphora, stressed pronouns and full NPs in Mandarin was studied by Pu (1997). Her results are reproduced in Table (37) below.

(37) **Grammatical role and frequency of zero anaphora in Mandarin oral narrative**

	full NP		stressed PRO		ZERO		Total	
role	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
S	822	40.2	398	19.4	829	**40.4**	2046	100.0
DO	648	85.3	65	8.5	47	**6.2**	760	100.0
others	525	97.9	/	0.0	11	**2.1**	563	100.0
					887			

The bulk of zero anaphors in the Mandarin text – 829 out of 887 or **82.9%** – code the subject participant, the most topical and most continuous in discourse. Expressed differently, **40.4%** of all subjects are zero-coded, as compared to only 6.2% of direct object and 2.1% of other roles.

Pu (1997) also studied the *cataphoric persistence* of the referents occupying the subject vs. object grammatical role, expressed in terms of 0–2 occurrences in the subsequent 10 clauses (low persistence) vs. >2 occurrences (high persistence). The pooled results are reproduced in Table (38) below.

(38) **Grammatical role and the cataphoric persistence subjects vs. objects in Mandarin oral narrative**

	0–2 occur.		>2 occur.		Total	
role	**N**	**%**	**N**	**%**	**N**	**%**
subject	430	21.0	1616	**79.0**	2046	100.0
object	659	**86.7**	101	13.3	760	100.0

Subject referents in Mandarin, claiming **82.9%** of zero-anaphora in the text, exhibits higher cataphoric persistence – thus higher topicality – in **79.0%** of their occurrence in text. In contrast, direct objects, claiming only **6.2%** of zero anaphora in the text, exhibit lower cataphoric persis-tence – thus lower topicality – in **86.7%** of their occurrence in text.

6.6.3 Word order, topicality and referential continuity

As noted earlier, several of the languages considered above deploy some word-order variation – SV vs. VS or OV vs. VO – as part of the inventory of devices used to code referential continuity or topicality. In this section we will consider briefly three languages: spoken English (rigid SVO), spoken Ute (flexible word-order), and Early Biblical Hebrew (rigid VO, flexible VS-SV).

a. Word-order and referential continuity in spoken English

In table (39) below we re-capitulate the anaphoric distance figures listed in Table (29) above for written English narrative (Brown 1983), adding for comparison the values for L-dislocated (pre-posed) and R-dislocated (post-posed) definite NPs is spoken English (Givón 1983b).

(39) **Mean anaphoric distance values of major referent-coding devices in English**

category	**N**	**%**	**mean AD value**
zero	117	18.1	1.0
unstressed PRO	336	52.1	1.0
stressed PRO	75	11.6	3.75
definite NP (SVO)	69	10.7	**10.15**
Total:	597	100.0	
L-dislocated NP	44	6.80	**15.34**
R-dislocated NP	4	0.62	**1.00**

Several things are striking about these distributions of AD values. First the combined high-continuity devices – zero anaphora and unstressed pronouns – constitute **70.2%** of the total sample of nominal referents in the written narrative text. This underscores the fact that these two devices code maximally-continuous referents, conforming with their identical **1.0** – one clause back – AD values.

The average AD value for definite NPs in the most common SVO order of English, comprising 10.7% of the total referents in the written text, is **10.15** clauses back. L-dislocated NPs, at 6.8% of the total sample of the spoken English text, displays an even higher AD value – **15.34** clauses back. That is, L-dislocation is used in spoken English to code referents that are brought back into the discourse after the largest gap of absence, easily transcending the length of the current clause-chain, perhaps even the current paragraph.

Lastly, R-dislocated NPs, at a minuscule 0.62% of the total sample of the spoken English text, code referents with the same high referential continuity – **1.0 AD** – as zero anaphora and unstressed pronouns. Whatever the communicative function of R-dislocation may be, it appoears to have little to do with referential continuity.

b. Word order and referential continuity in spoken Ute

Table (40) below recapitulates the AD values of the various referent-coding devices in spoken Ute narrative, given in in (31) above. The re-capitulation highlights the contrast between pre-verbal (SV, OV) and post-verbal (VS, VO) referents. Thus (Givón 1983c):

(40) **Mean AP values of major referent coding devices in spoken Ute**

category		**N**	**%**	**mean AD value**
zero		321	51.5	1.21
unstressed PRO		42	6.7	1.54
stressed PRO	SV	75	12.0	2.80
	VS	61	9.8	**1.95**
	OV	12	1.9	2.41
	VO	1	0.16	**1.00**
definite NP	SV	39	6.2	10.84
	VS	**25**	4.0	**1.48**
	OV	34	5.4	9.67
	VO	**13**	2.1	**4.46**
Total:		623	100.0	

As in English, referents that are placed post-verbally (VS, VO) in Ute have a much lower AD value than those places pre-verbally (SV, OV). That is, post-verbal position marks referents with much higher referential continuity, with AD values – 1.95, 1.00, 1.48, 4.46 – approximating those of zero anaphora and unstressed clitic pronouns (1.21–1.54).

Table (41) below lits the distribution of various referent-marking devices in contexts of *high thematic continuity* (paragraph-medial) vs. low thematic continuity (paragraph-initial) in spoken Ute narrative, re-computed from Givón (1983c).

(41) **Distribution of the various referent-coding categories in contexts of high thematic continuity (paragraph-medial) vs. discontinuity (paragraph-initial) in spoken Ute**

	paragraph-initial		**paragraph-medial**		**Total**	
category	**N**	**%**	**N**	**%**	**N**	**%**
zero	1	0.4	320	**99.6**	321	100.0
clitic PRO	/	/	42	**100.0**	42	100.0
indep-PRO SV	26	34.0	49	66.0	83	100.0
VS	6	9.0	55	**91.0**	61	100.0
DEF-NP SV	15	38.0	24	62.0	39	100.0
VS	3	12.0	22	**88.0**	25	100.0

First, the overwhelming distribution of the high-continuity referent-coding devices (zero and unstressed clitic pronouns) in paragraph-medial contexts – **99%–100%** – demonstrates again how referential and thematic continuity march hand in hand.

Second, both independent subject pronouns and full subject NPs placed *post-verbally* (VS) appear much more frequently in the paragraph-medial contexts of high thematic continuity – **88%–91%** – than pre-verbal subject NPs (SV; 62%–66%). This again underscores the fact that referential and thematic continuity march in tandem.

C. Word-order, tense-aspect and referential continuity in Early Biblical Hebrew[9]

Early Biblical Hebrew (EBH) is a rigid VO language with the pre-verbal position (SV, OV) reserved for **discontinuous referents**. This word-order device interacts with the tense-aspect system, so that full-NP continuous referents, overwhelmingly post-verbal (VS, VO), tend to appear in clauses marked with the *perfective* or *irrealis* (prefixal) conjugation. In contrast, discontinuous referents, most commonly pre-verbal (SV, OV), tend to appear in clauses marked with either the *perfect* or the *nominal/imperfective* conjugations. As an example, consider the opening episode of *Genesis* in (42) below. The first 4 clauses (42a, b, c, d)

9. The description of Early Biblical Hebrew grammar here is taken from Givón (1977); see also Givón (2015a, Chapter 9).

introduce new referents in rapid succession, first in *perfect*-marked clauses (42a, b), then non-verbal (42c), then the *imperfective* (42d):[10]

(42) a. bɨ-re'shit bara' elohim 'et-ha-shamayin (ADV-V)
at-beginning create/PERF/3sm God ACC-the-heaven
we-'et-ha-'arets,
and-ACC-the-earth
'In the beginning God created the heaven(s) and the earth,'

b. we-ha-'arets hay-ta tohu va-vohu, (S-V)
and-the-earth be/PERF-3sf chaos and-confusion
'and the earth was all chaos and confusion,'

c. vɨ-ħoshekh ʕal pney ha-tɨ'om, (S-V)
and-darness on face/of the-precipice
'and darkness over the precipice,'

d. wɨ-ruaħ 'elohim mɨraħf-et ʕal pney ha-mayim;
and-spirit/of God hover/IMPFV-sf on face/of the-water
'and the spirit of God (was) hovering over the water;' (S-V)

Once the scene has been set, the continuous narrative with a recurring referent switches to the VS order and the *perfective* (prefixal) conjugation:

(43) e. wa-yo-'mar 'elohim: "yɨ-hi 'or!", (V-S)
and-3sm-say/PFV God 3sm-be/IRR light
'and God said: "Let there be light!",'

f. wa-yɨ-hi 'or; (V-S)
and-3sm-be/PFV light
'and there was light';'

g. wa-ya-r' 'elohim 'et-ha-'or ki-ţov (V-S)
and-3sm-see/PFV God ACC-light SUB-good
'and God saw that the light was good,'

h. wa-ya-vdel 'elohim beyn ha-'or u-veyn (V-S)
and-3sm-divide/PFV God between the-light and-between
ha-ħoshekh,
the-dark
'and God divided the light from the dark,'

i. wa-yi-qra' 'elohim l-a-'or yom, (V-S)
and-3sm-call/PFV God to-the-light day
'and God named the light day,'

---

10. The first clause here is a *presentative* device, fronting the time adverb 'in the beginning' and precipitating the post-posing of the subject, i.e. OVS order (TVX; Venneman 1973).

Next, a new object is contrasted with the preceding object, precipitating a switch to the OV order and the *perfect* tense-aspect:

(44)	j.	wɨ-l-a-ħoshekh	qara'	layla;	(O-V)
		and-to-the-dar	call/PERF/3sm	night	
		'and the dark he named night;'			

After which the episode closes with the continuous mode once again, with VS order and the *perfective* tense-aspect, even with the two subjects ('evening', 'morning') being new – though thematically unimportant:

(45)	k.	wa-yɨ-hi	ʕerev			(V-S)
		and-3sm-be/PFV	evening			
		'and there came the evening,'				
	l.	wa-yɨ-hi	boqer	yom	'eħad.	(V-S)
		and-3sm-be/PFV	morning	day	one	
		'and there came the morning of day one'.				(Genesis, 1:1–5)

Table (46) below summarizes the frequency distribution of the main tense-aspect conjugations in two EBH books (*Genesis, Kings-II)*. The prefixal conjugation, strongly associated with the VS word-order, is a merger of the *perfective* and *irrealis* tense-aspects, both used to carry the bulk of in-sequence new information, the **foregrounded backbone** of the narrative. The suffixal conjugation, strongly associated with the SV word-order, carries mostly the *perfect* tense-aspect function, with some *subjunctive* use (see further below). The nominal/participial conjugation, rather infrequent in the text, carries the *imperfective* tense-aspect function, and is also strongly associated with the discontinuous SV word-order.[11]

(46) **Overall frequency distribution of tense-aspects in EBH**

	Genesis		**Kings-II**	
tense-aspect	**N**	**%**	**N**	**%**
perfective (prefixal)	480	**69.7**	912	**74.8**
perfect (suffixal)	181	26.2	209	17.8
imperfective (nominal)	28	5.1	98	7.4
Total:	689	100.0	1,219	100.0

11. See Hopper (1979); Givón (1977, 2015, Chapter 9).

As is to be expected, the prefixal conjugation, associated with referential and thematic continuity and backbone of the narrative, comprises **70%–75%** of the total sample.

Consider now the statistical association, for the *Genesis* text, between the tense-aspect conjugations and word-order:[12]

(47) **Subject position and tense-aspect in Genesis main clauses**

	tense-aspect conjugation					
	prefixal		**suffixal**		**nominal**	
category	**VS**	**SV**	**VS**	**SV**	**VS**	**SV**
no fronted non-S	**168**	/	**1**	**21**	5	**76**
fronted non-S	/	/	**13**	/	2	**16**
PRO-obj	9	/	/	/	/	/
PRO-subj	/	5	/	4	3	**21**
negative	4	/	1	/	1	2
irrealis	8	7	3	/	/	/
total	**189**	12	18	**25**	11	**115**
%	**94.0%**			**58.1%**		**91.1%**

The association between tense-aspect and word-order in EBH may be summarized as follows:

- In main, in clauses marked by the *prefixal* (mostly *perfective*) conjugation, **94.0%** of the full-NP subjects come in the **VS** word order.
- In main, in clauses marked by the *suffixal* (mostly *perfect*) conjugation, **58.1%** of the full-NP subjects come in the **SV** order. The figure is even higher for the *nominal* (*imperfective*) conjugation – **91.1%** SV.

The strong association between *thematic* and *referential* continuity is natural and universal, given that referential coherence is one of the main strands of thematic coherence. This association also explains why in Biblical Hebrew word-order and tense-aspect are so strongly associated. The VS order in Hebrew, and indeed in any flexible-order language, signals subject referential continuity, while the SV order signals discontinuity (Givón 1988).

12. *Ibid*.

One must note, lastly, that the strong text-distributional correlation between anaphoric referential **continuity** and cataphoric referential **importance** also makes sense. Clause chains are ca. 5–10 clauses long in spoken language, and often longer in written text. Important/topical referents tend to persist through the chain and change at thematic boundaries. Thus, when an important referent is introduced for the first time at the chain-initial clause, it tends to recur in all the subsequent chain-medial clauses all the way to the chain-final, which thus makes it also *anaphorically* continuous, with a typical anaphoric distance (AD) value ca. 1 – in any but the chain-initial clause. Its cataphoric persistence (CP) value will be high, albeit descending gradually from the chain-initial toward the chain-final clause. We will revisit this issue in Chapter 7, below.

6.6.4 Interim summary

Whether during the initial introduction of referents (indefinite) or their subsequent reappearance (definite), the grammar of referential coherence, in coding the anaphoric continuity or cataphoric topicality of referents, seems to either anticipate or cue the mental states of the interlocutor. The system as a whole is complex and finely articulated. Referents may be grounded into – thus cohere with – the culturally shared lexicon (semantic memory), the current speech situation (attention and working memory), or the current text (episodic memory). Of the three, grounding into the shared lexicon seems less frequent and perhaps cognitively less central.

6.7 Grammar and cognition: The grammar of referential coherence as mental processing instructions

6.7.1 Preamble

Anaphoric distance (AD) and cataphoric persistence (CP) of referents in text are heuristic measures. But a measures of what? What is the cognitive status of these two core dimentions of referential coherence – referential continuity/accessibility and referential topicality/importance? The experimental literature on grammar as mental text-processing cues, however meager (e.g. Givón *et al.* 1985; Gernsbacher 1990; Tomlin 1995, 1997), suggests that the cognitive capacities most likely to be implicated here are **attentional activation, working memory**, and **episodic memory**.

In sketching out a cognitive interpretation of the grammar of referential coherence, I will take it for granted that the verbal event/state clause is the minimal processing unit for adding new language-coded information into episodic memory (Chafe 1994). In connected discourse, such clauses have one topical referent, most commonly their grammatical subject, and are part of a larger thematic unit, the *clause-chain* (a.k.a. 'sentence'), which is in turn part of a *paragraph*, which is in turn part of an *episode*, etc.[13]

6.7.2 Filing and storage conventions

In the accretion of new language-coded information into episodic memory, the following conventions are followed:

(48) **Filing and storage conventions for episodic memory**:

a. **Sequential-hierarchic organization**:
Text is stored mentally in episodic memory in a sequential-hierarchic structure, with words stored linearly under their proper clause node, clauses stored linearly under their proper chain node, chains under their proper paragraph node, paragraphs under their proper episode node. etc.

b. **Topical referent**:
Each clause has one topical referent, one that is most likely to recur as the topical referent of the entire clause-chain.

c. **Attentional activation of filing labels**:
The topical referent that persists across multiple clauses in the chain serves as the attentionally-activated *filing label* for the clause, insuring that it is filed under its proper chain node.

d. **Continued activation of clause files**:
As long as incoming clauses have the same activated topical referent, they continue to be filed under the same chain node. The clause filing label thus also serves as the chain filing label.

e. **Terminated activation of chain files**:
To *discontinue* filing incoming information into a chain-file, its filing label, the topical referent, must be de-activated.

---

13. Multi-participant conversations with alternating turns vary enormously in the degree, scope and complexity of their hierarchic structure, depending on collaboration (vs. competition) between interlocutors, length of individual turns, and overall thematic coherence. For details see Givón (ed. 1997a).

f. **Activation of a new chain file**:
To open a new chain for filing incoming new information, its filing label – the *new topical referent* of the first incoming clause, must first be activated.
g. **One open file at a time**:
Only one filing label at a time can be activated, so that only one chain at a time can receive incoming new information.
h. **Filing new information into a clause**:
New information coming into a clause is made out of words.
i. **Filing new information into a chain**:
New information coming into a chain is made out of clauses.

Conventions (48), inspired by the grammar of referential coherence and its text distribution, make strong claims about the central cognitive role of topical referents in processing language-coded information into episodic memory. It is thus perhaps in order to ask why it is *nominal referents* – rather than adjectives, adverbs or verbs – that are used as the filing labels for new information coming into episodic memory. Several cognitive, developmental and evolutionary factors make nominal referents the most natural choice here:

- Subject or object nominals are perceptually and cognitively more salient, being typically concrete, durable, individuated, spatially compact, and fast-moving. They are thus more likely to be the cognitive *figures* in states or events.
- Nominal referents are also culturally more salient, given that human culture is centered on moving/acting animates/humans and the objects they manipulate.
- Nominal referents are acquired earlier in language ontogeny (Bloom 1973).
- Nominal referents must have come earlier in language phylogeny (Givón 1979/2019, 2009)
- Subject and object nominal referents are much more frequent in discourse than oblique referents.

The last point may be illustrated by the frequency-distribution of various types of nominal referents in text. Table (49) below summarizes the text-requency of subjects, direct objects and oblique arguments (locative, dative, time, manner etc.) in Zacapultec oral discourse (DuBois 1987).

(49) **The distribution of grammatical roles in the zero-pronoun and full-NP categories in spoken Zacapultec**

	nominal referent type					
	zero/pronoun		**full-NP**		**total**	
grammatical role	**N**	**%**	**N**	**%**	**N**	**%**
transitive SUBJ	169	93.9%	11	6.1	180	100.0
intransitive SUBJ	136	51.9%	126	48.1	262	100.0
all subjects	305	**60.0%**	137	40.0	**442**	100.0
dir. objects	96	**54.3%**	81	45.7	**177**	100.0
others	24	13.4%	154	**86.6**	178	100.0
					797	

Two facts in table (49) are striking. First, **60%–54%** of all subjects and direct-object in the text, respectively, are marked grammatically as zero or anaphoric pronoun – the most continuous referent types in discourse. Conversely, of the total **797** referents in the text, **619** or **77%** are either subjcts or direct-objects.

Next, table (50) below summarizes the text frequency of clauses in spoken English with only a subject (intransitive), with a subject and direct object (transitive), and with a subject, direct object and oblique (Givón 1983b).

(50) **Nominal participants and their grammatical roles in spoken English narrative**

# of referents per clause	**N**	**%**
1 (subject)	39	**38.6%**
2 (subject & object)	54	**53.4%**
3 (subject, object, oblique)	8	8.0%
>3	/	/
total:	101	100.0%

Of the total clauses in the text, those that contain only a subject (intransitive), or a subject and a direct object (transitive), constitute 92% of all clauses. Only 8% of the clauses contain an oblique referent.

The data from the same text can be re-computed to yield the distribution in Table (51) below (Givón 1983b).

(51) **Frequency distribution of the various grammatical roles in spoken English narrative**

grammatical role	**N**	**%**
subject	101	59.0
object	62	36.0
others	8	5.0
total:	171	100.0

Subjects and direct objects combined make up **95%** of all nominal referents in the text. The obliques constitute only 5%.

Human communication seems to single out perceptually, cognitively and culturally salient nominal referents as the important entities about which new information is transacted. This information-processing system bears the unmistakable footprints of its pre-linguistic evolutionary precursors. Visual episodic information processing was no doubt organized along similar lines long before language evolution (Barker and Givón 2002). Salient, compact, durable, moving, live, culturally-salient entities, those that perform the roles of either active agent or impacted patient, have been serving since long ago as the **thematic guide-posts** around which events and states were organized. Once language-coded multi-propositional communication has developed (in ontogeny) or evolved (in phylogeny), these natural guide-posts are easily converted into its recurrent topical referents.

6.7.3 Cognitive operations

The grammar of referential coherence cues three major types of cognitive operations:

(52) **Grammar-cued cognitive operations**:
  a. **Attentional activation operations (cataphoric):** Nominal referents are activated, de-activated or re-activated in working memory.
  b. **Search and operations (anaphoric)**: The episodic memory of the current text is searched for the antecedent co-referent of the currently activated topical referent. When that trace is found, then
  c. **Grounding operations (anaphoric)**: a grounding connection is established between the referent's currently activated location in working memory and its antecedent location in episodic memory.

Under attentional activation (52a), three processing instructions are subsumed:

(53) **Attentional activation instructions**:
  a. **Continue activation** of the currently active topical referent (default); or
  b. **Terminate activation** of the currently active topical referent
  c. **Activate a currently inactive referent**, either
    i. **a new referent** (indefinite) with no episodic trace
    ii. **an existing referent** (definite) with an episodic trace; then

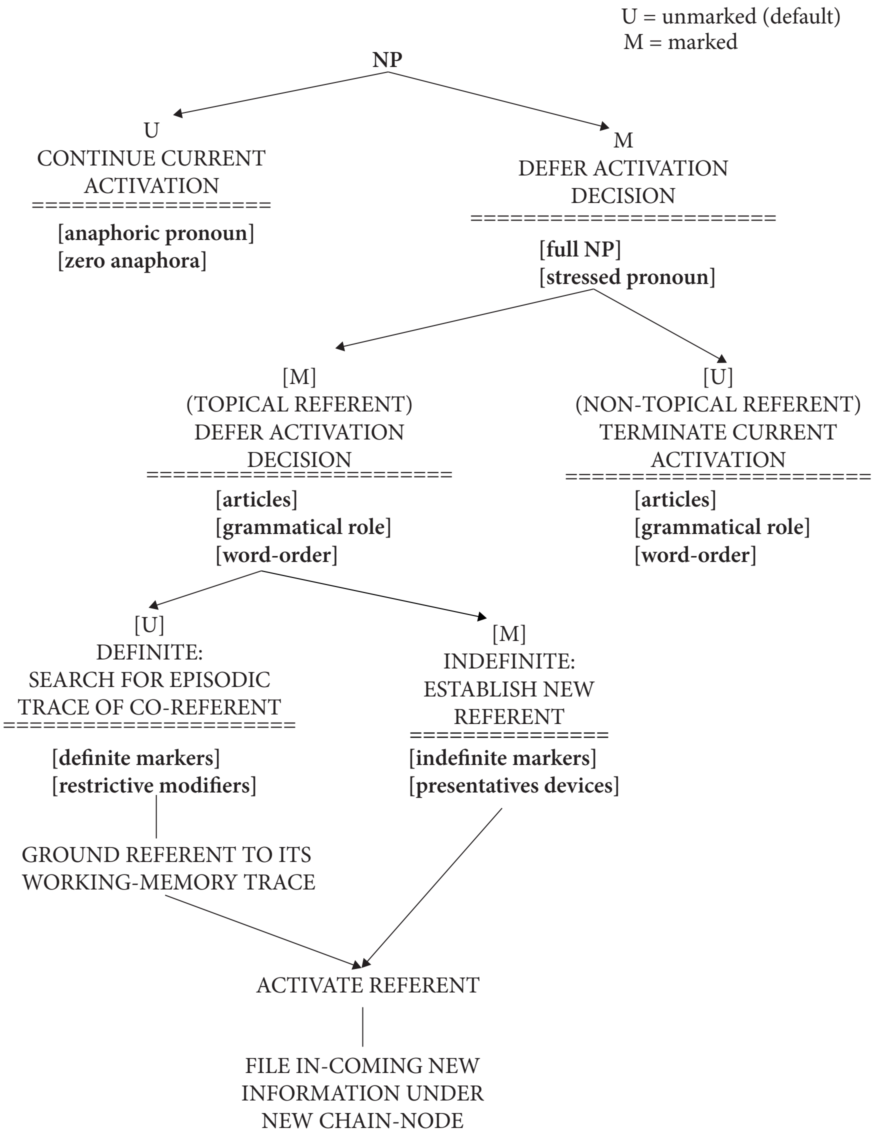
Search and grounding operations apply only when a currently-inactive referent with an accessible episodic-memory trace (definite) is to be re-activated (53a-ii). They involve two separate mental operations:

(54) **Search and grounding operations**:
  a. Search for the referent in episodic memory
  b. Establish a grounding connection between the referent's current text location and its last prior location

The main grammar-cued mental operations relevant to referential coherence are summarized in (55) below as a series of ordered binary choices, given in terms of the speaker's perspective, as instructions to the hearer. This speaker-oriented format in fact subsumes the speaker's assumptions about what the hearer does or doesn't know. The speaker's grammatical cues are listed in brackets.

For each binary choice in (54), one of the two processing instructions is the *default* choice (‘*unmarked*’, U), the one that is more frequent in natural communication, and thus cognitively less costly. The other option, the *marked* case (M), is less frequent in natural communication and thus cognitively more costly.

(55) **Major grammar-cued mental operations in referent processing**:



From the perspective of the hearer, the grammar-cued operations outlined in (55) can be rendered as the processing instructions in (56). These instructions are given in the form of conditional statements (if *p*, then *q*), with *p* standing for grammatical cue and *q* standing for mental operation.

(56) **Major grammar-cued mental operations in referential coherence (hearer's perspective)**:

a. if **ZERO/PRO** ===> continue current activation; keep filing incoming information under same node

b. if **FULL NP** ===>
   i. defer activation decision; then
   ii. determine referent's topicality

c. if **NON-TOPICAL** ===>
   i. do not activate
   ii. continue current activation

d. if **TOPICAL** ===> de-activate the current active node; then

e. if **INDEFINITE** ===>
   i. do not search for episodic antecedence;
   ii. initiate new referent node
   iii. activate the new referent node;
   iv. start filing incoming new information under the new node.

f. if **DEFINITE** ===> determine the source of definiteness:
   i. **Speech situation** (mental model);
   ii. **Generic-lexical** (mental model);
   iii. **Episodic text** (mental model); then:
   iv. search for antecedent in the appropriate mental model;
   v. ground the referent to its antecedent in the relevant mental model;
   vi. initiate a new file, labeled by the new topical referent;
   vii. activate the new topical referent, thus the file labeled by it;
   viii. start filing new information into the new file.

6.8 Discussion

The cognitive model proposed above is a reasonably parsimonious interpretation of the distribution of grammar in discourse contexts (text), as well as of the cross-linguistic distribution of syntactic constructions. It is fully consonant with what is presently known about the neuro-cognition of attention, working-memory and episodic memory. What is more, it makes highly specific, testable empirical predictions. It has never been tested experimentally, so that at the moment it remains a hypothesis.

One of the most striking facts about discourse coherence in general and referential coherence in particular is the incredible amount of grammatical machinery that is expended on cuing the search for the *antecedent co-referent* of topical referents, and then on *grounding* – connecting – the referent to its antecedent. The connections created this way, particularly for definite referents, are often long-distance ones, involving the more *global* coherence structure of the text. Such long-distance connections may cut across chain, paragraph and episode boundaries, thus across the hierarchic structure of the mentally-stored text. There may indeed be a strong adaptive motivation for such long-distance grounding, one that may be given as:

(57) **Anaphoric grounding constraint**:
When an important/topical referent is re-introduced into the discourse, access to the information filed in its antecedent text location must be assured.

The adaptive rationale for this constraint is fairly transparent:

- **Indefinite referents**: The relevance of a referent appearing in the text for the first time can be justified only by its *current* text location. That is where – when – it must cohere.
- **Definite referents**: The relevance of a recurring referent must be justified twice. First, to its *current* text location. Then to its *antecedent* text location, which might still have some bearing on its current relevance. This is why definite referents must be grounded to their antecedents.

If the stored text is indeed structured in episodic memory as a network of nodes and connections, long distance anaphoric grounding across the text is part of the mechanism by which the coherence of mentally-stored text is maintained. In this respect, coherence is nothing but connectivity.

Abbreviations of grammatical terms

ACC	accusative	PERF	perfect
ANT	anterior	PFV	perfective
DIR	directional	REM	remote
HAB	habitual	S	subject
IMPFV	imperfective	SUB	subordinator
IRR	irrealis	TOP	topic
MOD	modal	WH	question marker
NEG	negative	3s	3rd person singular
NOM	nominal	3sf	3rd person singular masculine
O	object	3sm	3rd person singular feminine

CHAPTER 7

Coherence and clause chaining

7.1 Re-orientation

Chained or conjoined clauses are the most common clause type in natural discourse, a statistical prominence that is even more striking in spoken language and non-academic writing. Consider, for example, the text distribution of main (conjoined) vs. subordinate (embedded) clauses in two written English texts, one academic writing, the other low-brow fiction (Givón 1991b):[1]

(1) **Frequency distribution of main vs. subordinate clauses in written English narrative**

written-academic						**written-informal**					
conjoined		**subordinate**		**total**		**conjoined**		**subordinate**		**total**	
N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
43	36.0	77	**64.0**	120	100.0	120	**86.0**	20	14.0	140	100.0

The grammatical structure of clause chains has tantalized linguists ever since Robert Longacre's (1972a, 1972b) pioneering work on Papua-New Guinea languages. The ensuing confusion has much to do with how data and formal theory in linguistics collide. At a more empirical corner of the field, clause chaining has been largely ignored by psychologists of discourse processing – and for good reasons. The way linguists get their high over the minutiae of grammar, whether formalized or not, is bound to confound fellow travelers. This is of course unfortunate, since clause chaining is the hierarchic level of language where referential and thematic coherence coincide, and where the bulk of grammar is deployed.

1. The academic text was 10 pp. from Chomsky (1973). The fiction text was 12 pp. from L'Amour (1962).

On the data side we have the oft-extravagant grammar of cataphoric switch-reference (DS) vs. same-reference (SS). This structural exotica, found in chain-medial or chain-final clauses, was noted first in languages of the Papuan Highlands, and then lay dormant for over a decade.

On the formal side, we have one of the most bizarre features of the formalism, its insistence that 'controlled' syntactic processes – those that are sensitive to their discourse context and thus exhibit 'government' between adjacent clauses – must be expressed in terms of a *subordinate* syntactic configuration. Chained/conjoined clauses thus join relative clauses, verbal complements and adverbial clauses as subordinate or 'governed', in effect rendering all clause-types in human language subordinate and giving rise, on occasion, to droll episodes of formal contortion.[2]

There is a sleeper issue here, one that has been largely ignored by both the formalist and functionalist community in linguistics, as well as the baffled cognitive audience. As elsewhere in grammar, complex synchronic structures are best understood in terms of the diachrony that gives them rise from more simple precursors.[3] This chapter will stray periodically into the diachronic evolution of clause-chaining systems, trying to decipher how the mundane and functionally transparent building blocks of referential and thematic coherence can give rise, over time, to the great complexity of extant morpho-syntax.

7.2 Recapitulation I: Clause-chains and thematic coherence

As noted in the preceding chapter, human discourse is typically multi-propositional. That is, we tend to string together multiple event/state clauses in sequences that maintain thematic *continuity*, or *coherence*. In the process, the multiple strands of thematic coherence tend to persist from one clause to the next across stretches of discourse, or across clause-chains.

The overall coherence of human discourse is a tapestry of multiple strands, of which the most concrete and easier-to-track are:

2. See Preface to Givón (2017).

3. For discussion, see Givón (1971, 1979/2019, 2009, 2015a).

(2) **Strands of thematic coherence**
  a. referents
  b. spatiality
  c. temporality
  d. modality
  e. speech-acts
  f. perspective (speaker/hearer)
  g. action routines[4]

Most often, these strands of coherence maintain their continuity together, breaking off together at major thematic junctures; that is, at the end of thematic units. These units are organized hierarchically, as in, schematically:[5]

(3) **Hierarchic structure of discourse**

lower

clause
clause chain
paragraph
episode
story

higher

The most basic unit of discourse coherence above the clause level is the clause chain (a.k.a. 'sentence'). It is the arena where the bulk of grammatical structures performs their communicative functions. The overall structure of clause-chains can be given as, schematically:

4. Action routines have to do with the real-world plausibility of temporally concatenated events. As an example, consider: (a) 'She open the fridge, pulled out a carton of milk, poured herself a glass and drank'; as against: (b) 'She drank, poured herself a glass, pulled out a carton of milk and opened the fridge'. In our real-world experience of how things are generally done, clause-chain (a) is coherent while clause-chain (b) is incoherent.

5. As noted above (Chapter 6), unlike narrative, conversation involves repeated changes of perspective ('turns'). However, coherent collaborative conversation has a similar – if more complex – hierarchic thematic structure as narrative and procedural discourse. This becomes clear when coherence is studied cross-turns over long stretches of conversation; see Chafe (1997); Coates (1997); Ervin-Tripp and Kuntay (1997); Linell and Korolija (1997).

(4) **Structure of clause chain (schematic)**

…# RD, CI, CM, CM, CM, CM, (…..), CF#…

RD = reorientation device
CI = chain-initial clause
CM = chain-medial clause(s)
CF = chain-final clause
# = chain boundary

Prosodically, clauses tend to come under their own unifying intonation contours. Within-chain (between-word) intonation breaks tend be ca. 50mscs long. Between-clause (chain-medial) intonation breaks tend to be lower than 100msecs long. And between-chain intonation breaks tend to be ca. 100msecs or longer.[6] Inter-clausal intonation breaks correspond roughly to comma punctuation [,] in written discourse. Inter-chain breaks to period [.] or semi-colon [;] punctuation.

7.3 Recapitulation II: The grammar of referential coherence

7.3.1 General outline

The most concrete grammatical devices that code referential coherence, and the ones easiest to track across clauses, chains and paragraphs, are ranked in (5) below in terms of their degree of anaphoric referential continuity:[7]

(5) **Most common referential coherence devices**

highest continuity

a. zero anaphora
b. obligatory pronominal agreement
c. unstressed anaphoric pronouns
d. stressed independent pronouns
e. demonstratives
f. definite NPs
g. Indefinite NPs

lowest continuity

6. For early inspiration and an extensive review of the literature, see Pawley and Syder (1975/2000). For further discussion and the detailed experimental measurements, see Givón (1991a, 2015a, Chapter 23).

7. See Chapter 6 above.

As noted earlier (Chapter 6), grammatical relations – subject vs. direct object vs. oblique – also play an important role in the coding of referential coherence, intersecting with the devices in (5). All other things being equal, referents marked as subjects tend to be more continuous and more important; those marked as direct objects tend to be less so; and those marked as obliques tend to be even less so.[8]

In spite of the strong statistical association between anaphoric referential continuity ('accessibility') and cataphoric referential persistence ('importance', 'topicality'), the two dimensions are distinct and can be dissociated. Most conspicuously, an indefinite NP is by definition maximally discontinuous anaphorically, but may be either less topical and thus cataphorically less persistent, or more topical and thus cataphorically more persistent.

Part of the hierarchic scale above, its top (5a, b, c, d, e), can be re-expressed as a well-known diachronic chain:[9]

(6) DEM > INDEP. PRO > UNSTRESSED PRO > OBLIG. PRO AGREEMENT > ZERO

The significance of this diachronic continuum will be made clear further below

7.3.2 Highest continuity devices

Consider first the contrast between unstressed anaphoric pronouns and zero anaphora in English:

(7) **Unstressed anaphoric pronoun vs. zero**:
John went to the mirror, [Ø] examined his thinning hair, [Ø] sighed and [Ø] turned.
a. Then **he** walked out.
b. *Then [Ø] walked out

Both the unstressed anaphoric pronoun in (7a) and anaphoric zero in (7b) signal maximal referential continuity. Yet (7b) is inappropriate because zero anaphora in English cannot be used across a chain boundary, only across chain-medial junctures.

Consider next the contrast between unstressed anaphoric pronouns and stressed independent pronouns:

8. See Chapter 6 above, as well as Givón (ed. 1997b).

9. See Givón (1976).

(8) **Unstressed anaphoric vs. stressed independent pronouns**:
Mary talked to Marcie for a while.
a. Then **she** left. (⊃ Mary left)
b. Then **SHE** left. (⊃ Marcie left)

The unstressed anaphoric pronoun in (8a) signals referential continuity (SS). The stressed independent pronoun in (8b) signals referential discontinuity or **switch reference** (DS). This use of stressed independent pronouns also applies to objects. Thus, consider the complex subject-object switches in (9) below, all of them in chain-medial contexts:

(9) Marcie slapped John, then **HE** slapped **HER**, then **SHE** slapped **HIM**.

The antecedent of each of the four stressed pronouns in (9) is available directly in the preceding clause. It is the shift of grammatical roles – object-to-subject or subject-to-object – that precipitates the use of a stressed pronoun.

In Spanish, where subject pronominal agreement is obligatory, the two highest-continuity devices of English – zero anaphora (5a) and unstressed anaphoric pronouns (5b) – have merged into a single device, obligatory pronominal agreement, used in both chain-medial and cross-chain contexts. Thus compare the continuations in (10a, b) below to those in (5a, b) above:

(10) Juan volvi-**ó** a la casa y comi-**ó** su cena.
J. returned-**3s** to the house and ate-3s his dinner
'John went back to the house and ate his dinner'.
a. Luego sali-**ó** de nuevo.
then got.out-**3s** of new
'Then **he** went out again'.
b. *Luego **él** sali-**ó** de nuevo.
then **3s** got.out-**3s** of new
*'Then **HE** went out again'.

The infelicity of (10b) is due to the fact that it implies switch reference (and contrast) where none is justified by the context. Such a contrast, now with the appropriate use of the stressed pronoun, is seen in (11b) below, motivated by the switch-reference context and fully corresponding to the English usage in (8b).

(11) María habl-**ó** con Mercedes.
Mary talked-**3s** with Mercedes.
'Mary talked with Mercedes.'
a. Luego volvi-**ó** a la casa.
Then returned-**3s** to the house
'Then **she** went home' (she = Mary)

b. Luego **ella** volvi-**ó** a la casa.
Then **she** returned-**3s** to the house
'Then **SHE** went home' (she = Mercedes)

A similar functional distribution, with obligatory grammatical agreement collapsing the functions of zero anaphora and unstressed anaphoric pronouns, is found in other languages with well-marked subject-agreement paradigms, such as Hebrew or Swahili.

7.3.3 Short-distance discontinuity devices

In languages like Japanese or Chinese, which have neither unstressed anaphoric pronouns nor obligatory pronominal agreement, zero anaphora codes *both* chain-medial and cross-chain referential continuity. Ute is broadly similar in this respect, since its unstressed anaphoric pronouns are optional, and about 70% of maximally continuous referents are zero-coded. Thus consider the zero-coded continuing subjects in the following narrative sequence:[10]

(12) a. yoghovʉchi̱ 'u, [Ø] pagha'ni-na-pʉga-'ura,
Coyote/s the/s walk.about-HAB-REM-be
'Coyote, **he** kept wandering about,'
b. kach [Ø] 'ini-a-sapa̱ paqha-na-pʉ-a, [Ø] 'ɵɵ-'ay-kwa̱-pʉga,
NEG WH-O-MOD kill-HAB-REM-NEG bone-be-go-REM
'**he** hadn't killed anything (for a long time), **he** became bone-skinny,'
c. ka-'ini-aa-sapa̱ [Ø] paqha-na-pʉ-a,
NEG-WH-O-MOD kill-HAB-REM-NEG
'**he** hadn't killed anything (for a long time),'
d. [Ø] tʉgʉy-whqa-vɵrɵ-na-pʉga-'ura…
hungry-search-walk-HAB-REM-be
'**he** was walking about searching hungry…'

When a second participant next comes into the discourse, it is introduced first as an indefinite object NP in (13b) below, then immediately followed by a stressed independent pronoun which marks **switch reference** (DS), as in English or Spanish. Then two more switch-references follow directly in (13c, d). Thus, with Coyote still the topical referent:

10. "Hungry Coyote races Skunk for the prairie dogs", told by Mollie B. Cloud (Givón ed. 2013).

(13) a. …'ú-vway-aqh-'ura 'ú-vwaa-tʉ-'ura 'íni̲-kway 'ura-pʉga…
there-at-it-be there-at-DIR-be WH-MOD be-REM
'…Then, right there, there was what's-his-name…'

b. mu̲kwapi [Ø] maay-pʉga, '**uwas**-kway pacha'ay-kyay-ku̲.
spider/O find-REM **3s/s**-TOP stick-ANT-SUB
'**he** found a spider, as **HE** (Spider) was stuck (there).'

c. 'ú-vway-aqh-'ura '**uwas** magʉni̲-pʉga, [Ø] tʉka-vaa-chi̲-'**u**.
there-at-it-be **3s/s** pounce-REM eat-IRR-NOM-**3s**
'so right away **HE** (Coyote) pounced, intending to eat **it** (Spider).'

d. 'u-vyay-aqh-'ura '**uwas**-'ura 'áy-pʉga:…
there-at-it-be **3s/s**-be say-REM
'so then **HE** (Spider) said:…'

7.3.4 Long-distance discontinuity devices

Nouns or full NPs are used either to introduce brand new (indefinite) referents into the discourse or re-introduce old (definite) ones after a considerable gap of absence. If an indefinite NP is slated to be important/topical and to persist in the subsequent discourse, most commonly some *presentative* device is used, most commonly coding the new participant as grammatical subject, as in the English existential clause in (14a) below, or the Ute seemingly-superfluous independent pronoun (14b):

(14) **English:**
Once there was **a** wizard, he lived in Africa, he went to China to….
Ute:
'**uwas**-'ura yoghovʉchi̲ 'ura-pʉga; khura tʉgʉy-naru'a-puga,
3s/s-be coyote/s be-REM then hunger-buy-REM
tʉkua-tʉgʉy-narua-pʉga…
meat-hunger-buy-REM
'There was once a coyote; he got hungry, he got meat-hungry…'

But new referents can be also introduced into discourse as indefinite objects, and be later upgraded and re-introduced as definite subjects. This is the strategy used in Ute in (13b) above.

Previously-introduced referents are re-introduced into the discourse as definite NPs after a gap of absence typically larger than 2–3 clauses. When the old referent is brought back after longer absence, say across a chain or paragraph boundary and thus with a gap of absence of, typically, 10–20 clauses, special chain-initial *re-orientation devices* (RD; see (5) above) are used, most commonly with a pause (intonation break) that renders the construction paratactic rather than syntactic. Thus compare:

(15) **Common chain-initial re-orientation devices**:
  a. **Subject L-dislocation**:
  …**Now the other guy**, he just quit, took off, vanished…
  b. **Object L-dislocation**:
  …**Now the other guy**, we saw him just once, then he took off and vanished…
  c. **Adverbial phrase**:
  …**So later on**, the other guy took off, just vanished…
  d. **Conjunction**:
  …**Then** the other guy took off and vanished…
  e. **Adverbial clause**:
  …**After he they did that**, the other guy took off…

We have thus identified three clusters of referent-coding devices in terms of their anaphoric continuity, grouping them as follows:

(16) **Expected anaphoric distance (AD) of major referent-coding devices**:

continuity	**devices**	**anaphoric distance**
highest (chain-medial)	zero unstressed pronouns pronominal agreement	1 clause
intermediate (chain-medial)	stressed pronouns	2–3 clauses
lowest (chain initial)	full NPs	> 3 clauses

These generalizations, and the cross-language text-distributional measure of *anaphoric distance* (AD) that characterizes them, were described in considerable detail earlier (Chapter 6).

7.3.5 From anaphoric to catapohoric continuity

In the preceding sections, we surveyed the major grammatical devices that code referential continuity in purely anaphoric terms. That is, in terms of the *anaphoric distance* between them and their nearest co-referent in the *preceding* discourse. But many important interesting grammatical devises involve the referent's *cataphoric* context. That is, grammatical devices signal either referential continuity (SS) or discontinuity (DS) in the *subsequent* discourse. In the discussion directly below, I will try to show how both anaphoric and cataphoric continuity can become associated with the *same* grammatical device.

The fundamental inferential linkage – a one-way conditional inference – between anaphoric and cataphoric continuity is fairly transparent, once we remind ourselves of two facts about anaphoric continuity or discontinuity:

- Grammatical devices that signal *anaphoric discontinuity*, whether chain-initial (higher discontinuity) or chain-medial (lower discontinuity), perforce also signal *cataphoric discontinuity*, i.e., switch-reference (DS).
- Grammatical devices that signal maximal *anaphoric* continuity, such as zero or obligatory pronominal agreement, are the most frequent referent-making devices in text. This is due to the fact that human discourse tends to be coherent – thus continuous – across multiple clauses, thus across long equi-topic clause-chains. Consequently, zero and obligatory pronominal agreement, with their high text frequency, wind up also signaling *cataphoric* continuity. That is:

(17) **Inferences from anaphoric to cataphoric coherence**:
  a. anaphoric discontinuity $\supset$ cataphoric DS (logically necessary)
  b. anaphoric continuity $\supset$ cataphoric SS (highly probable)

7.4 The grammaticalization of clause chaining

In this section we will survey, in terms of ascending complexity, how the oft-extravagant grammar of clause chaining in many languages can be gradually assembled from the simple components described above.

7.4.1 Pre-grammar baseline: Second-language pidgin

Consider the follow narrative, produced by a 79 year old Korean-born woman who had spent most of her life in Hawaii. The text is taken from Derek Bickerton's Hawaii Pidgin collection, Stage-I (Bickerton and Odo 1976). The English translation is given in parentheses interlineally.

(18) a. [**0**] Picture marry.
  ([I] was married via a picture.)
  b. **Husband** picture me see [**0**] girl-time Korea.
  (My husband saw a picture of me when [I was] a girl in Korea.)

c. My picture **my husband** see.
(My husband saw my picture.)
d. **He**-like OK marry. [**0**] Come Hawaii.
(He liked it well enough for marrying. So I came to Hawaii.)
e. **Husband** pay, [**0**] help husband better.
(My husband paid for it, so I can come and help him.)
f. That's why [**0**] Hawaii come.
(That's why I came to Hawaii.)
g. **I**-like Hawaii come.
(I liked coming to Hawaii.)
h. **My father, my mama**, [**0**] all say: "[**0**] Go. **You** like, [**0**] go".
(My father, [my] mother, [they] all said: "Go. [If] you like [him], go".)
i. That's why [**0**] come Hawaii.
(That's why I came to Hawaii.)
j. Yes, [**0**] one brother, [**0**] six sister…
(Yes, I had one brother, [I had] six sisters…)
k. No, [**0**] one brother, [**0**] three sister, all together.
(No, I had one brother, [had] three sister altogether.)
l. No, only **me** come.
(No, [of all of us] only I came.)
m. Japan, first-time, **ship** Japan come.
(First the ship came to Japan.)
n. Second [**0**] come Hawaii.
(Next it came to Hawaii.)
o. **This steamer**… [**0**] name Chang-Yang-Huang….
(The steamer was named C.-Y.-H. …)
p. **He** said… ah…
([??] said… hah…)
q. **Some people they**…ah… [**0**] American boat come.
(Some people came on an American boat.)
r. [**0**] Too big.
(It was too big.)
s. **America boat** come, first time in *Made* [?]…
(The American boat stopped first in Made [?]…)
t. Satori [**0**] come,
(Then it came to Satori,)
u. **Satori** they Japan,
(**Satori** is in Japan.)

v. [**0**] Japan come one… [**0**] one month time,
(It came to Japan in one… [?] it took one moth,)

w. **boat** Hawaii come.
(for the boat to come to Hawaii.)

x. Yes, Ulsan… **me**-stop Ulsan. [**0**] Go. **Me** go.
(Yes, I was in Ulsan (once). I went there.)

y. Girl-time another place [**0**] no go, never.
(During my childhood I never went anywhere else'.) (pp. 1–2)

(19) a. [0] Two twin girl.
('I have twin girls.)

b. One… **one girl husband** wika office.
(One of the girls' husband works in an office.)

c. Four year stop **girl** in town over-here…
(The girl lived in town over here for four years…)

d. [**0**] Honolulu office.
(She worked in an office in Honolulu.)

e. **He** name two girl, [**0**] twin girl name.
(He [husband] named the two girls, he named the twin girls.)

f. **One girl** Carol, **one girl** Natalie. [**0**] Twins.
(One girl is named Carol, the other Natalie. They are twins'.)

g. [**0**] Before school, yeah, [**0**] highschool. Yes, [**0**] twins.
(They went to highschool before. Yes, they're twins.)

h. [**0**] Highschool, [**0**] highschool diploma. [**0**] Diploma highschool.
(They have a highschool diploma. [x 3])

i. Diploma **my son** highschool get. Yes, yes, [**0**] Farrington highschool.
(My son also got a highschool diploma, [he went to] Farrington Highschool.)

j. Yes, [**0**] Korea food, everything, everything for [**0**] eat, [**0**] eating, [**0**] eating.
(Yes, **we** eat only Korean food [?].)

k. Yeah, [**0**] everything. Everything food [**0**] can eat.
(Yeah, [we eat] everything. [we eat] all [Korean] the food that we can eat). (p. 4)

The quantitative distribution of the anaphoric distance (AD) of zero, pronoun and full-NP, in the Korean-English pidgin transcripts (18)/(19) above is given in Table (20) below.

(20) **Frequency distribution of AD values for the three main referent-coding devices in Korean-English Pidgin**

	ZERO				PRO			NP		
AD	**1**	**>1**	**speaker/hearer**	**Total**	**1**	**>1**	**Total**	**1**	**>1**	**Total**
N	27	1	4	32	6	4	10	3	11	14
%	**84.3**	3.1	**12.6**	100.0	**60.0**	40.0	100.0	21.5	**78.5**	100.0

These distributions, allowing for the level of variation found in 2nd-language Pidgins,[11] are fairly coherent, in the main following the form-function correlations in grammaticalized languages, summarized in Table (16). Fully **84%** of zero anaphors have the expected AD value of 1. Of the remainder, 12.6% are licenced by situationally-accessible speech-act participants, a well-known condition for zero anaphora. Only 3.1% of the zero-anaphora sample have an AD value greater than 1.[12]

The use of pronouns, whose stress status was not recorded, is just as coherent, with **60%** having the AD value of 1, characteristic of *unstressed* anaphoric pronouns in English, and 40% having an AD value >1, some of which were probably *stressed*.

Fully 78.5% of the full-NPs have the expected AD value of >1, while the remaining 21.5% the value 1. Lastly, out of the total of 42 instances of high-continuity devices – zeros or pronouns, 32 or **76.1%** are zeros. This compares closely with the ca. 70% found in Ute (Givón 1983b; see Chapter 6 above).

It is clear that our pre-grammatical Pidgin has not yet moved to distinguish anaphoric from cataphoric referent-coding devices. Rather, at the rock-bottom level of grammaticalization, this Pidgin uses zero ambiguously, to signal *both* anaphoric and cataphoric referential continuity, relying on the probabilistic inference (17b) above. In the same vein, our Pidgin uses full-NPs to signal anaphoric – and thus by logical inference (17a) also cataphoric – discontinuity – but with one caveat: The signal is not given in the *preceding* clause, but rather in the *very same clause* in which the newly-instituted referent is lodged.

11. See discussion of the degree of variability in Pidgin communication in Bickerton and Givón (1976).

12. For comparison with typical AD values in English, Spanish, Biblical Hebrew, Ute, Japanese and Chinese, see Chapter 6 above.

7.4.2 Zero (SS) vs. independent pronoun (DS): Ute

The grammar of reference in Ute is in the midst of restructuring, with two important changes that concern us here. First, stressed independent pronouns, derived transparently from the current generation of demonstratives, have taken over the function of chain-medial switch reference (DS), as shown in narrative (21) below, recapitulating (13) above:

(21) a. …'ú-vway-aqh-'ura 'ú-vwaa-tʉ-'ura 'íni̲-kway 'ura-pʉga…
there-at-it-be there-at-DIR-be WH-MOD be-REM
…Then, right there, there was what's-his-name…

b. mu̲kwapi [Ø] maay-pʉga, '**uwas**-kway pacha'ay-kyay-ku̲.
spider/O find-REM **3s/s**-TOP stick-ANT-SUB
he found a spider, as **HE** (Spider) was stuck (there).

c. 'ú-vway-aqh-'ura '**uwas** magʉni̲-pʉga, [Ø] tʉka-vaa-chi̲-'**u**.
there-at-it-be **3s/s** pounce-REM eat-IRR-NOM-**3s**
so right away **HE** (Coyote) pounced, intending to eat **it** (Spider).

d. 'u-vyay-aqh-'ura '**uwas**-'ura 'áy-pʉga:…
there-at-it-be **3s/s**-be say-REM
so then **HE** (Spider) said:…'

Second, unstressed case-neutral clitic pronouns, derived transparently from the current generation of stressed independent pronouns, are invading the functional slot of maximal referential continuity, still largely occupied by zero. Such pronouns are optional and exhibit, overwhelmingly, an *absolutive* distribution (subject of intransitive, object of transitive; see e.g. the object pronoun in (21c) above). Their host word is yet unfixed and can be, in principle, any word-type in the clauses. However, 70% of them are already found as *verb suffixes* (Givón 1983b).

Table (22) below shows how clitic pronouns in Ute now fill roughly the same functional slot of high referential continuity as zero anaphors, with mean AD values of 1.5 vs. 1.2, respectively. This compares with the AD of 2.8–2.4 for fronted stressed pronouns and 10.8–9.6 for fronted full NPs.

(22) **Mean AD values for major referent-coding devices in spoken Ute**

category		**N**	**mean AD value**
zero		321	**1.21**
unstressed PRO		42	**1.54**
stressed PRO	SV	75	**2.80**
	VS	61	1.95
	OV	12	**2.41**
	VO	1	1.00
definite NP	SV	39	**10.84**
	VS	25	1.48
	OV	34	**9.67**
	VO	13	4.46

Lastly, zero anaphors still constitute **88.4%** – 321/363 – of the total sample of the high-continuity referent-coding devices in Ute. In the diachronic evolution of obligatory pronominal agreement on the verb and the invasion of the functional slot of zero by anaphoric pronouns, Ute represents an early stage.

7.4.3 Agreement (SS) vs. independent pronouns (DS): Bantu, Romance

In Bantu, Romance, Semitic and many other languages, erstwhile clitic subject pronouns have transformed fully into obligatory subject agreement, thus fully occupying the erstwhile functional slot of zero anaphora. In Bantu, one sees an earlier stage of this displacement, with the current generation of subject-agreement prefixes still transparently related to the current independent subject pronouns. Thus, compare Bemba 3rd-person demonstratives, also 3rd-person independent subject/object pronouns, to the Bemba obligatory subject agreement prefixes.[13]

13. See Givón (1973).

(23) **Bemba demonstrative pronouns and subject pronominal agreement**

N-class	near speaker	remote	subj agr. prefix
1 (SG)	u-yu	u-lya	a-/u-
2 (PL)	a-ba	ba-lya	ba-
3 (SG)	u-u	u-lya	u-
4 (PL)	i-i	i-lya	i-
5 (SG)	i-li	li-lya	li-
6 (PL)	a-ya	ya-lya	ya-
7 (SG)	i-chi	chi-lya	chi-
8 (PL)	i-fi	fi-lya	fi-

Compare now, in contrast, the current generation of Spanish independent subject pronouns with its obligatory subject agreement suffixes. The latter represent an older generation of clitic anaphoric pronouns, thus also and older generation of independent pronouns. This older generation of pronouns is entirely fused now with the tense-aspect suffixes. Thus, for the verb *hablar* 'speak':

(24) **Spanish independent subject pronouns and pronominal agreement suffixes**

subject pronouns	preterit subj. suffixes	present/habitual subject suffixes
yo	habl-é	habl-o
tu	habl-áste	habl-as
el/ella	hab-ó	habl-a
nosotros	habl-amos	habl-amos
vos(otros)	habl-asteis	ahabl-áis
ellos/ellas	habl-aron	habl-an

7.5 Complex grammaticalization of continuing reference (SS) vs. switch-reference (DS)

7.5.1 Preliminaries

In the preceding section, I suggested a natural, universal pattern of early grammaticalization of the contrast between *cataphoric* same-subject (SS, referential continuity) and switch-subject (DS, referential discontinuity) in chain-medial contexts. The marking of this contrast turns out to have piggy-backed on the universal contrast between zero (or its functional equivalent, pronominal agreement) and stressed independent pronouns – as *anaphoric* reference markers. In this section we will explore more complex systems of marking chain-medial same-reference (SS) vs. switch-reference (DS). We will consider the possibility that such systems arose diachronically via re-analysis and re-structuring of the universal simple devices – zero, pronominal agreement and stressed pronouns – described above.

The most complex clause-chaining systems, and the most extravagantly grammaticalized, are those found in the Trans New Guinea (henceforth TNG) language family (or phylum; Roberts 1997). We will begin with some of the more simple systems, the ones where the diachronic sources of the chain-medial or chain-final DS vs. SS morphology can be still tracked down.

7.5.2 Early-stages of complex grammaticalization: Kanite, Kosena

Consider the following narrative in Kanite, beginning in mid-chain (Longacre 1972a, p. 5):

(25) a. … hi-s-hu-**ta'a**-ke-'**ka**
do-INT-do-**we**-CONJ-**you**
'…(if) we do this,'

b. naki a'nemo-'ka hoya ali-'**ka**
so women-you garden work-**you**
'then you women work the garden,'

c. naki ali ha'noma hu-ne'atale-'**ka**
so work finish do-COMPL-**you**
'and when you finish,'

d. popo hu-'**ka**
hoe do-**you**
'you hoe'

e. inuna kae-'**ka**
weeds burn-**you**
'and burn the weeds,'

f. naki ha'no hu-tale-'**ka**-te-ke-**ta'a**
so finish do-COMPL-**you**-CONJ-**we**
'then (when) you finish,'

g. naki viemoka-ta'a heki'yamo'ma nehi-s-i-**ta'a**…
so men-we fence make-INT-it-**we**
'we men will (then) finish making the fence (and)…'

The narrative begins with a chain-medial cataphoric-DS clause (25a), whose continuing subject is marked by the obligatory pronoun/agreement 'we'. This is followed, on the same verb, by the conjunction (*-ke-*) and a pronoun ('you') that points, cataphorically, to the subject of the *next* clause. The very same combination is found in (25f), now switching the subject back from 'you' to 'we'. In-between (25b, c, d, f), one finds clauses with continuing subject – anaphoric *and* cataphoric SS – marked by the very same obligatory pronominal agreement found in the DS clauses (25a, f). The same is also found in clause (25g). The very same pronouns serve for obligatory subject agreement, switch reference, and the compounds 'you women' (25b) and 'we men' (25g).

The diachronic scenario of how this fairly rudimentary system was assembled is relatively transparent (Haiman 1983; Roberts 1997):

(26) **From chain-initial stressed pronouns to chain medial DS marking**:

a. Stressed independent pronouns first cliticize to the verb as obligatory pronominal agreement, marking anaphoric-SS and, by inference (17b), also cataphoric-SS. This is the stage noted earlier in Bantu, Romance and Semitic languages.

b. Later, the very same stressed independent pronouns also cliticized to the conjunction *ke-*, which precedes in an L-dislocation construction.

c. Those stressed L-dislocated pronouns pointed *both* anaphorically and cataphorically, thus to an anaphor in the next clause (e.g. 'as for **HER, she**'ll be late').

d. The combination *ke*-PRO then cliticized to the preceding verb and the pronoun became de-stressed, now acting as a cataphoric switch-reference (DS) device.

A hint about the diachrony of the SS vs. DS system in the TNG family can be seen in Telefol (Healey 1966). In this language, the same double-agreement switch-reference mechanism seen in Kanite chain-medial DS clauses is found in *chain-final* clauses. A similar situation has been described in a closely-related language, Mian (Fedden 2011). Given the obligatory conjunction as part of the chain-medial switch-reference mechanism in Kanite, the Telefol/Mian situation suggests an alternative diachronic scenario:

(27) **Alternative diachronic scenario**:

a. An L-dislocated independent pronoun – preceded by a conjunction – served as a new-topic-introducing device at the chain-initial slot of a following chain.

b. Given the V-final order of the PNG-Highlands languages, the conjunction-PRO complex then cliticized on the verb of the *preceding* clause.

c. This chain-final DS mechanism was later generalized, spreading gradually to chain-medial DS contexts.

A situation reminiscent of Telefol/Mian, and perhaps an intermediate stage in our alternative scenario (27), is seen in Kosena, another Papua-New Guinea language. However, here the cataphoric-SS construction is marked with the suffix *-é* (see (27a, d) below). In the cataphoric-DS construction, on the other hand, the obligatory subject pronoun/agreement stands alone. Thus consider the following short narrative (Longacre 1972a, pp. 11–12):

(28) a. …is-é-'**a**,
hear-ss-**1s**
'…I heard (it),'

b. ániva mi minkáké káálúse mainma-'**a**
so that then airplane get-**1s**
'then I took the airplane'

c. Talamo' má-si-yú-wá-isa-'**a**,
Tarabo here-me-leave-PRES/3s-**1s**
'and it left me in Tarabo,'

d. minkáké sípivi mal-é-'**a**
then jeep get-ss – **1s**
'then I got a jeep'

e. Okáva mói-si-yúwá-isa-'**a**
Okapa up-me-leave-PRES/3s-**1s**
'and it left me in Okapa,'

f. vondé'a mi maavá'á i-lá-'**a**
Thursday that here go/rise-PA-**1s**.
'and on Thursday I came up here.'

The chain-medial cataphoric-SS construction (28a, d) always requires the suffix *-é*, perhaps a reflex of the *-ke* suffix in Kanite (see (25) above), which is then followed by the obligatory subject pronoun (here *-'a* 'I'). The same subject pronoun is also used to signal *chain-medial* cataphoric-DS – minus the SS suffix *-é* (28b, c, e). Lastly, the very same subject pronoun is also used in *chain-final* cataphoric-DS contexts (28f), with the addition of a more finite past-tense suffix. Longacre's comment on this is revealing:

> "…in Kosena a different-subject construction quite regularly ends a sentence [= clause] within a chain which terminates with the independent [= finite] verb (at the end of the paragraph)…" (1972a, p. 12; bracketed material added)

7.5.3 Late-stage complex grammaticalization

7.5.3.1 Kalam

Kalam, another TNG language, is a rigid SOV language with a high density of serial verbs, most of them appearing as unmarked bare (non-finite) stems. Kalam has one of the most complex clause-chaining systems found in the Papuan Highlands. The system divides main clauses into three types:

a. **Chain final**: This is the most finite clause type, with tense-aspect-modal marking, subject pronominal agreement and no switch-reference morphology.
b. **Chain-medial DS**: These clauses are marked for tense-aspect and subject pronominal agreement. In addition, they are marked for cataphoric switch-subject (DS), including the marking of the person/number of the *anticipated* subject of the following clause.
c. **Chain-medial SS**: These least-finite clauses display no tense-aspect marking, no subject pronominal agreement, and only one possible modal marker (irrealis).

Both chain-medial clause types (b) and (c) are also marked for cataphoric simultaneous vs. sequential temporality. Examples of the most common clause-types in Kalam texts are given in (29) below. For an extensive description, see Pawley (1966).[14]

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14. The data cited here are from Givón (1991a). Andy Pawley (i.p.c.) notes that in the TNG family, new SS/DS morphology is often not innovated from scratch, but rather the very same slots are re-filled by new morphemes that retain the

(29) a. **Chain-final, perfective (deictic-serial)**:

…bi-nak ak spet ominal dand sand-**ip**…
man-your the spade two carry leave-**PFV/3S**
'…The man carries away the two spades…'

b. **Chain-final, durative**:

…mon kamb ak yupiri-**sap**…
wood pile the gather-**DUR/3S**
'…she's gathering the wood-pile…'

c. **Chain-medial, simultaneous-DS, immed. past, followed by chain-medial sequential-SS**:

…kikaruk am-**nak-nin** nuk kimb-**iy**…
chicken go-**IMPA/3S-SIM/DS** she leave-**SIM/SS**
'…the chicken having gone away, she leaves (and then she)…'

d. **Chain-medial, sequential-DS, remote past followed by chain-medial-simultaneous, immediate past (deictic-serial)**:

…ny-**ek** nuk dand korip ow-ak-nin…
give-**RPA/SEQ-DS** she carry/**SS** house come-**IMPA/3S-SIM/DS**…
'…(he) having given in to her, she brings it over to the house…'

e. **Chain-medial sequential SS (intrumental-serial)**:

…nyaip nyilung ak d-**iy** konam tik-iy…
knife small the take-SEQ/**SS** throat cut-**SEQ/SS**
'…she cuts its throat with the small knife…'

f. **Chain-medial simultaneous-SS followed by chain final**:

…kikaruk gok tangiy-**ying** a-**sp-ay** akam…
chicken some walk-**SIM/SS** say-**PRES-3P** Q
'…(I wonder if) the chicken is walking and making noise…'

g. **Chain-medial irrealis-SS followed by chain-final (causative-serial)**:

…nying mal-**ning** gi-**sap**…
water fill-**IRR/SS** do-**PRES/3S**
'…she intends to fill (it) with water…'

h. **Chain-medial irrealis-SS (resultative-serial)**:

…mindak kind nuk pik-juw-**ning**…
later back her hit-dislocate-**IRR/SS**
'…later he aims to dislocate her back (and he)…'

---

original function of the slot. Roberts (1997) and Comrie and Davis (2015) make similar observations. This obviously renders internal reconstruction harder to apply, making one more dependent on comparative data.

The advanced diachronic age of the Kalam complex system is underscored by the fact that most verb suffixes are short and highly condensed multi-feature *portmanteau* morphemes, often conflating tense-aspect-modality, subject pronoun, the cataphoric SS vs. DS distinction, and the cataphoric sequential vs. simultaneous distinction. But there is still some interesting predictability in these semantically-complex morphemes: The suffixes that mark cataphoric-SS (28e, h), thus marking the highest referential continuity, are consistently *less finite*, lacking T-A-M marking. And some SS-indicating serial verbs (as 'carry' in (29d) above) lack any SS-marking morphology. Such zero-marked non-finiteness can come, on occasion, in multi-verb chains in Kalam, as in (Givón 1991a):

(30) a. …mon **tip** **pang** **kom** **moch** **g**-ip…
wood **chop/ss** **break/ss** **roll/ss** **crush/ss** **do**-PFV/3S
'…he cut-chopped rolled-crushed the wood…'
b. …tiy-tawel bap **d**-iy **kom** **kom** **g**-iy…
tea-towel piece **take**-SEQ/SS **wrap/ss** **wrap/ss** **do**-SEQ/SS
'…she wraps (it) in a tea-towel…'

One could of course argue that many of these bare-stem serial verbs are already *co-lexicalized*. But this is a natural consequence of their being both non-finite – thus zero-marked – and signaling cataphoric-SS. The role of marked vs. zeroed-out tense-aspect-modality, thus finiteness, and how it combines with the grammar of referential coherence to code the more global thematic coherence in discourse, will be discussed in Section 7.8. below.

7.5.3.2 Tairora

Tairora is an SOV language of the Gorokan group of the TNG family (Vincent 1973a, 1973b), with a grammaticalized clause-chaining system and several serial-verb constructions. Its verbal morphology does not distinguish totally between chain-medial and chain-final clauses, thus again supporting the suggestion that chain-medial cataphoric-DS morphology may be an expansion of chain-final morphology.

Main clauses in Tairora are divided into the following types:[15]

a. **Finite** (with tense marking):
   i. **Cataphoric-DS** (switch-subject), with subject pronominal agreement
   ii. **No-DS marking**, with subject pronominal agreement

15. Data cited from Givón (1991a); see also Vincent (1973a, b).

b. **Non-finite**: without tense marking but with subject pronominal agreement

In our texts, a verbal suffix *-ro* serves a double function: In non-finite clauses, it marks 3rd-person singular subject agreement, thus by default also cataphoric-SS (same-subject), as in:[16]

(31) a. …vainiti vi-va naaho kai'a vara-re-va vi-**ro**…
man DEM-S garden work take-IRR-3s go-**3s/ss**
'…the man goes to work his garden (and then does)…'

b. …"te iha te'a-ke vata-uro" ti-**ro**…
1s wood cut-ASP put-PA/1s say-**3s/ss**
'…"I've cut and stacked (the) wood" he said (and does)…'

c. …saavori paepae vata-ira vi-vare-**ro**…
shovel knife put-ANT/3s go-take-**3s/ss**
'…he goes back to where he had put the shovel and knife (and does)…'

In finite clauses, when the past suffix *-iva* is used, *-ro* marks cataphoric DS (switch subject) and, simultaneously, 3rd-person singular subject-agreement. Such usages can be seen in:

(32) …v-iva-**ro**, vainti-vano iha mini ke-**ro**…
go-PA/3s-**3s/DS** man-S wood there leave-**3s/ss**
'…(she) having left, the man no laves the wood there…'

7.5.3.3 Kobon and Haruai

As noted above, when morphological systems mature and grow older, they condense and lose their transparency, so that their diachronic evolution cannot be easily reconstructed. Such a situation can be seen in Kobon, another TNG language, and Haruai, an unrelated but typologically similar Papuan Highlands language. In these languages, in finite chain-final clauses – the *least continuous* context within the chain – the subject pronominal suffixes often condense with the T-A-M suffixes into a *portmanteau* morpheme. In chain-medial contexts, different pronominal forms mark the DS vs. SS distinction, but the verb lacks any tense-aspect marking. That is, the verb in these **high-continuity** contexts is **less finite**. Thus for Kobon (Comrie and Davis 2015):

16. *Ibid.*

(33) a. **Chain-medial-SS followed by chain-final**:
yad kaj pak-**em**, ram ud ar-**nab-in**
I pig kill-**SS/1s** house take go-**FUT-1s**
'I will kill a pig and take it to the house'

b. **Chain-medial-DS followed by chain final**:
yad kaj pak-**nö,** ne ram ud ar-**nab-ön**
I pig kill-**DS/1s** you house take go-**FUT-2s**
'I will kill a pig and you will take it to the house'

In many chain-medial-SS contexts, the least finite bare-stem ('serial-verb') verb form is used in Kobon, much like in Kalam (30). Thus (Davis 1987):

(34) **am** ram laṇ mɨd-**ey-a**. **am** ram laṇ mɨd-**ö**,
go house above be-**DUR-RMPA/3s go** house above be-**DS/3s**
sib g-**a**.
darkness do-**RMPA/3s**
'He went up and stayed at the house. And having gone up to the house, it became dark'.

Adverbial clauses are often marked as finite chain-final clauses, as in (Davis 1987):

(35) a. ruö ram ru-ag-**öp**, laṇ ar-**öp**.
next.day earth NEG-dawn-**PERF/3s** above go-**PERF/3s**
'The next day before it dawned, he went up.

b. **aram** laṇ l-**öm**, mɨd-**ö**, mɨd-**ö** yawr kub ranu
go above put-**SS/3s** be-**DS/3s** be-**DS/3s** bird big that
aw-**ub**.
come-**PERF/3s**
And having gone and arrived up (there) and stayed, and after a while the big bird came'.

In Haruai, the chain-medial-SS verb is even less finite, marking neither TAM nor subject pronominal agreement, while the less continuous chain-medial-DS verb still marks subject pronominal agreement. The fully finite chain-final verbal suffix conflates tense-aspect, subject pronominal agreement and speech-act. Thus (Comrie and Davis 2015):

(36) a. **Chain-medial-SS followed by chain-final**:
an hön-a pal-**ön**, rag ram-a du-öl-**a**
we pig-FOC kill-**SS** carry house-FOC go-PRES/1p-**DECL**
'We killed the pig and took (it) to the house'

b. **Chain-medial-DS followed by chain-final**:

naṇ	kwöi-a	nöl-**man**,	nuṇ	rag	ram-a
you	sweet.potato-FOC	give-**DS/2s**	he	carry	house-FOC

du-**a**
go/PRES/3S-**DECL**
'You gave (him) a sweet pootato and he took (it) to the house'

Comrie and Davis (2015 ms.) summarize the finite vs. non-fine verb morphology of Kobon as follows:[17]

(37) **Selected Kobon verbal morphology**

	chain-medial (non-finite)		**chain-final (finite)**	
p/#	**SS**	**DS**	**RM.PA**	**PRF**
1s	-em	-**nö**	-**nö**	-bin
2s	-(m)ön	-ö	-na	-ban
3s	-öm	-ö	-a	-öp
1du	-ul	-**lo**	-**lo**	-bul
2/3du	-mil	-**lö**	-**lö**	-bil
1p	-un	-**no**	-**no**	-bun
2p	-mem	-**be/pe**	-**be/pe**	-bim
3p	-öm	-lö	-la	-bal

What is most striking about the data in (37) is that in 5 out of 8 cases, the verb suffix of the chain-final remote past (RM.PST) corresponds to the chain-medial-DS verb suffix. This is further support for the suggested alternative diachronic scenario (27), above.[18]

17. Andy Pawley (i.p.c.) notes that with some exceptions, the verb suffixes in the *perfect* (PRF) column must have conflated an invariant element -*b*-, perhaps an aspect marker, followed by the base pronoun forms found in the SS column. This conforms with the observation, further below, that the SS forms are the least finite and dispense with T-A-M morphology.

18. Andy Pawley (i.p.c.) suggests that the close similarity between the DS and remote past (RM.PST) forms in Kobon is due in part to the fact that Kobon lost a word-final -*k*, one that is still attested in Kalam.

What the combined Kobon and Haruai data suggest is a gradient of **finiteness** in their complex, old, highly-compressed verbal morphology:

(38) **Finiteness and referential/thematic continuity**:

most finite chain-final > chain-medial DS > chain-medial-SS **least finite**
least continuous **most continuous**

In other words, a correlation between continuity and non-finiteness.[19]

7.5.3.4 Dusan

A gradation of finiteness as in Kobon and Haruai above (38) can also be seen in Dusan, another TNG language. In this language, SS verb-suffixes mark neither subject pronouns nor tense-aspect-modality. DS verb suffixes are marked for subject pronouns but neither for T-A-M nor for speech-act value. Only chain-final verb suffixes mark all three finite categories. What is more, many serial verbs that project cataphoric-SS don't carry any SS-marking suffix, a situation already noted in Kalam, above. Such non-finite zero marking is all it takes for those verbs to indicate cataphoric-SS. As an illustration, consider the following narrative segment (Reesink 2014):

(39) a. …ende at nam qur qoat igam-**a**
thus do/**ss** tree fruit wait/**ss** be-**2/3s/DS**
'…this (while) he would be ling in wait at the tree's fruits,

b. wai yar saragaim-**a**
animal come/s**S** rustle-**3s/DA**
an animal would come making rustling noise,

c. ig-**ub** magi-**b** ar-**a**
hear-**ss** whistle-**ss** call-**2/3s/DS**
(and) he would hear it

d. inaun ig-**ub** di-**ab** igurau gumot-neri arirm-**a**
moon hear-**ss** come.up-**ss** stopper stab-take.out/**ss** throw-**2/3s/DS**
(whistle and) call the moon (and) come up and knock out the stopper,

e. dar-**a**
come.down-**2/3s/DS**
and (he) would come down,

19. For further detail see Givón (2015a).

f.	wei-**b**	di	begen	eng	wai	sir	wo-t
	open-**ss**	come.up/**ss**	light	that	animal	exactly	3s-at
	arirm-**a**,						
	throw-2/**3/DS**						

and it (the moon) would come up in the open and throw light right on the animal,

g.	Sarag	qamar	wai	eng	wa-**b**	igo-**ai**.
	S.	first.born	animal	that	3s/O/shoot-**SS**	be-**3S/RMPA/DECL**

and Sarang the first-born would be shooting it (that animal)'.

7.6 Finiteness gradients and clause chaining

7.6.1 Finiteness: A brief introduction

In the preceding sections we noted how finiteness seems to play a consistent role in the grammar of clause chaining, yielding the coherent hierarchic predictions in (38) above. Linguists have traditionally treated finiteness as a property of verbs. But a more comprehensive reflection should tag it as a property of clauses, where the zero-marking of the *verbal* tense-aspect-modality and pronominal agreement in chain-medial clauses, most conspicuously in the most continuous chain-medial-SS clauses, is matched by zero marking of the continuous *topical referent*, be it subject or object.

A fairly transparent example from English involves the non-finite complements of equi-subject modal-aspectual verbs and of equi-object manipulation verbs, as in:

(40) a. **Non-finite SS complements of modal-aspectual verbs**:
She wanted [**0**] **to**-leave ([0] = she]
She finished [**0**] eat-**ing** ([0] = she)

b. **Non – finite DS complements of manipulation verbs**:
She told him [**0**] **to**-leave ([0] = him)
She made him [**0**] leave ([0] = him)

(41) a. **Finite ADV-clause: Unrestricted reference**:
After she came home, she/he cooked dinner (no restriction)

b. **Non-finite ADV-clause: Obligatory continuous reference**:
After [**0**] com-**ing**, she cooked dinner (= she came; *he came)
After [**0**] com-**ing**, he cooked dinner (= he came; *she came)

Another way of looking at non-finiteness, or its sub-category, *nominalization*, is as a diachronic process of structural adjustment from the clausal/verbal to the nominal prototype. That is:

(42) **Structural adjustments from verbal to nominal prototype**:

	finite verbal clause		non-finite (nominalized) clause
a. **lexical category**:	verb	>	head noun
b. **nominal marking**:	case, number, class	>	zero
c. **verbal modalities**:	T-A-M	>	zero or reduction
d. **pronouns**:	pronominal agreement	>	loss or reduction
e. **case marking**:	subject/object	>	zero of genitive
f. **restriction**:	-------	>	added determiners
g. **modification**:	adverbs	>	adjectives
h. **clausal marking**:	-------	>	case-marking on clause

The two extremes – fully finite vs. fully nominalized clauses, displaying many of the structural changes in (42) above, may be exemplified in:

(43) a. **Fully finite verbal clause**:
She *knew* mathematics extensively.
b. **Nominalized NP**:
Her extensive *knowledge* of mathematics

The same tradition that views finiteness as a property of verbs also treats it as a discrete either-or phenomenon. But since the finite verbal prototype (or its nominal converse) is defined by multiple features (42a-h), finiteness is at least in principle a matter of *degree*. Consider, for example, the finely graded finiteness scale in English, as in (44) below. At the very bottom, one finds the prototype finite clause (44h). At the very top, the radically nominalized non-finite NP in (44a). But most of the bracketed syntactic constructions mid-scale in (44) fall in-between, exhibiting intermediate degrees of finiteness or, conversely, nominalization.

(44) **least finite (most nominalized)**

a. [Her good **knowledge** of math] surely helped.
b. [Her **knowing** math well] surely helped.
c. [For her **to know** math so well] surely helped.
d. She wanted [**to know** math well].
e. [**Knowing** math well], she had no problem solving it.
f. [**Having known** math well since childhood], she found the exam easy.
g. He assumed [(that)she **knew** math well].
h. She **knew** math well.

most finite

The English examples thus far suggested that non-finiteness distributes primarily in nominalized clauses. That is, clauses that are found in prototypically nominal slots such as clausal subject, clausal object, V-complement (by analogy with object), REL-clause (by analogy with nominal modifier) or ADV-clause (by protracted analogy with V-complements or REL-clauses).[20] But as noted above, non-finiteness in clause-chaining has little to do – at least synchronically – with prototypical nominal slots. Rather, as suggested in (38) above, it correlates reliably with referential or thematic *continuity*. This can be seen in the use of participial clauses as chain-medial-SS clauses in English, as in (45) below. In the OV-type clause-chaining (45a), the finite clause is *chain-final*. In the VO-style (45b), the finite clause is *chain-initial*:

(45) a. [**0**] Com-**ing** into the room, [**0**]look-**ing** around and [**0**] see-**ing** nobody there, **Mary** stopp-**ed**.
b. **Mary** walk-**ed** into the room [**0**] look-**ing** for her keyes, [**0**] search-**ing** all over, [**0**] turn-**ing** the place upside down but [**0**] find-**ing** nothing.

A similar diachronically-early recruitment of non-finite participial clauses to mark chain-medial cataphoric-SS has been describe in Misumalpan (Macro-Chibchan) languages, as in the following example of serial-verb constructions in Miskitu, cited from Hale (1988, 1991):[21]

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20. See Givón (2015a, Chapter 10).

21. *Ibid*., Chapter 24.

(46) a. baha ulu-ka pruk-**i** ik-**amna**
that wasp-O hit-**SS** kill-**FUT/1**
'I'll swat and kill that wasp'

b. witin raks kum brih bal-**an**
3s gun one get/**SS** come-**PA/3**
'he brought over a gun'

c. usus pal-**i** bal-**an**
buzzard fly-**SS** come-**PA/3**
'the buzzard flew over'

d. nasma laya tak-**i** ta krik-**i** drum-**an**
honey liquid exit-**SS** end break-**SS** extend-**PA/3**
'the honey came out and started to extend'

The same recruitment of the non-finite participial suffix to march chain-medial-SS can be seen in Ika, a related Chibchan language, as in (Frank 1985):

(47) a. perih-se'-ri win-was-**i** zhun-**na**
dog-ERG-TOP 3p-chase-**NF/SS** descend-**PA**
'the dogs chased (it) down'

b. ehm-win-ideis-**i** ehn-zhun-**na**-ri
PRT-3p-carry-**NF/SS** PRT-descend-**PA**-TOP
'they carry it down'

c. guiajina-zeh gehmmi perih-se' aneh-kus-**i** guak-aki nu'-na
puma-GEN cub dog-ERG ???-bite-**NF/SS** kill-PERF AUX-PA
'the dogs bit and killed the puma cub'

As in many of the TNG languages above, finite chain-final morphology has also been recruited in Miskitu to mark *chain-medial DS*. Thus, note the use of the finite chain-final *past-tense* suffix *-an* as chain-medial DS marker in the serial-verb constructions in (48) below (Hale 1988, 1991):

(48) a. witin ai-pruk-**an** kauhwi-**ri**
3s 1s/O-hit-**DS/3** fall-**PA/1**
'he hit me down' (lit. 'he hit me and I fell')

b. witin sula yab-**an** plap-**an**
3s s deer cause-**DS/3** run-**PA/3**
'he made the deer run'

Lastly, note that much as in English, the non-finite suffix used to mark the cataphoric-SS in Macro-Chibchan is the very same one used as the *durative/participial* marker. Thus, from Ngäbere (Young and Givon 1990):

(49) a. ti kra gïg-**e**
1s net.bag buy-NF/DUR
'I buy net-bags'
b. ti tï-**e** käre mä-bïdä
1s think-NF/DUR always 2s-toward
'I always think about you'

The functions of the non-fionite/participial suffix in Macro-Chibchan languages are summarized in Table (49) below (Young and Givón 1990a/b):

(50)

language	**suffix**	**function**
Rama	-i	NF, sequential-SS, imperfective
Ika	-i	sequential-SS
	-e'	simultaneous-SS
	-(ä)n	NP
Misu	-i	NF, SS
Miskitu	-i	NF, SS
Ulwa	-i	NF, SS
N. Sumu	-wi(k)/-ti(k)	NF, SS
Ngäbere	-(r)e	NF, imperfective
Teribe	-ë	NF, imperfective
Cabécar	-n	NF, imperfective

In the next section we will look into a more elaborate diachronic scenario via which participial clauses can enter the grammar of clause-chaining.

7.6.2 Participials with case-agreement: Jiwarli

In Jiwarli, a West-Australian aboriginal language, several types of subordinate clauses are obligatorily marked for referential continuity (SS) or discontinuity (DS) vis-a-vis their main clause. To this end, the case-marking system has been recruited to code the SS vs. DS contrast. In SS ADV-clauses, the verb agrees with the case-marking of the *co-referent* argument in the main clause. In DS ADV-clauses, the verb agrees with the case-marking of the *non-coreferent* argument in the main clause. Thus compare (Austin 1992):

(51) **Case-agreement with main-clause subject-SS**:

a. nhurra-kara-**lu** thika-nma yarrukarri-**ngu**-**ru**-thu
you-PL-**ERG** eat-IMPER want-**IMPFV/SS**-**ERG**-DEF
'You eat it if (you) want it!'

b. panhalu-**ru** yukarri-**ngu**-**ru** ngatha-**nha** nhanya-nyja
he-**ERG** stand-**IMPFV/SS**-**ERG** 1s-**ACC** see-PA
'He – while (he was) standing up – saw me'

c. manthara-**lu** kurrpirli-**nha** pinya-nyja yanga-**rnu**-**ru**
man-**ERG** kangaroo-**ACC** spear-PA chase-**IMPFV/SS**-**ERG**
'The man speared the kangaroo while (he was) chasing it'

d. mantharta kumpa-inha wurnta-**wu** yinka-**rnu**
man/**ABS** sit-PRES shield-**DAT** adz-**IMPFV/SS/ABS**
'The man sits adzing a shield'

(52) **Case-agreement with main-clause non-subject: DS**

a. tharla-nma yinha julyu-**nha** kamu-rri-**ya**-**nha**
feed-IMPF this old.man-**ACC** hunger-INCH-**IMPFV/DS**-**ACC**
'Feed this old man who is getting hungry'

b. ngatha nhanya-nyja ngatha-**nha** malu
I see-PA I-**ACC** shadow
yukerri-**ya**-**nha**
stand-**IMPFV/DS**-**ACC** water-LOC
'I saw my shadow standing in the water'

c. wuru ngunha tharrpa-rninyja ngarti-**ngka** kajalpu-**la**
stick that insert-PA inside-**LOC** emu-**LOC**
ngarri-**ngka** ngurntha-**iniya**-**la**
ashes-**LOC** lie-**IMPFV/DS**-**LOC**
'(He) inserted the stick inside the emu (that was) lying in the ashes'

What makes the Jiwarli recruitment of case-agreement to mark the SS vs. DS contrast in ADV-clauses so natural is the fact that Jiwarli, like many other languages (Homeric Greek, Latin), already has *obligatory case-agreement* of modifiers within the noun phrase, as in (Austin 1992):

(53) ngatha mana-nyja yanya-**nha** mantharta-**nha** Ngurtirti-**nha**
I get-PA other-**ACC** man-**ACC** Ngurtirti-**ACC**
'I got another man Ngurtirti'

The Jiwarli data cited above suggest a diachronic extension from participial modifiers within the NP to participial ADV-clauses. A similar drift of case agreement is reported in Mojave (Yuman; Munro 1976) and Pima and Papago (Uto-Aztecan; Munro 1983; Scancarelli 1989).

The next diachronic extension – from participial ADV-clauses to conjoied chain-medial clauses – is relatively straight-forward, as is suggested by the English use of non-finite participials, as in (45), above. If the erstwhile ADV-clause carried SS- vs. DS-marking morphology, that morphology is transferred automatically into the grammar of *chain-medial clauses*. Such an extension is also reported in Kavineña, (Takanan, Amazonian Bolivia; Guillaum 2000), in Amahuaca (Panoan; Amazonian Perú; Sparing-Chavez 1998), and in Matsees (Panoa, Amazonian Perú; D. Fleck, i.p.c).

The diachronic drift of non-finite participial clauses in Jiwarly may be summarized, tentatively, as follows:

(54) participial NP modifiers ==> participial ADV-clauses ==> chain-medial main clauses

7.7 Clause-chaining and discourse coherence

The hierarchic organization of discourse into clauses, clause-chains, paragraphs, episodes, etc. is a central feature in the coherent design of human language as an instrument of communication. Within this design, grammar plays a crucial role in signaling the coherence of discourse. In our survey of the grammar of clause-chaining, the discussion of finite vs. non-finite marking of clauses brings into sharp relief a number of central issues. From a narrower perspective, the striking parallel between the reduced grammatical marking of *both* referents and verbs in chain-medial clauses illustrates how referential and thematic coherence march in tandem; and how temporal, aspectual, modal and event/action coherence, marked grammatically on the verb, are the most prominent non-reference-related strands of thematic coherence.

Conversely, the more expanded grammatical marking of both referents and verbs found in chain-initial or chain-final clauses signals discourse contexts of *discontinuity*, whereby many thematic coherence strands – reference, locality, temporality, aspectuality, modality or action/event sequence – are discontinued together. Clause-chain, paragraph or episode boundaries are the hierarchically-organized loci where discourse coherence breaks, gets re-evaluated, and then re-organized.

Lastly, the organizing principles of human communication – continuity, connectivity, predictability, accessibility and coherence – are but five aspects of the same adaptive imperative, our absolute reliance on access to the mind of our interlocutor. Communication, it seems, is an enterprise whereby the coherent *process* of assembling a coherently-structured *product* is the best guarantee that a coherent version of that product – however imperfect – may reach the mind of one's interlocutor.

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Abbreviations of grammatical terms

p	person
#	number
1s	1st person singular
2s	2nd person singular
3s	3rd person singular
1du	1st person dual
2/3du	2nd/3rd person dual
1p	1st person plural
2p	2nd person plural
3p	3rd person plural
ABL	ablative
ACC	accusative
AD	anaphoric distance
ADV	adverbial
ANT	anterior (tense-aspect)
COMPL	completive
CONJ	conjunction
DAT	dative
DECL	declarative
DEF	definite
DEM	demonstrative
DIR	directional
DS	different subject (switch reference)
DUR	durative (tense-aspect)
ERG	ergative
FOC	focus
FUT	future
GB	Government and Binding
HAB	habitual (tense-aspect)
IMPA	immediate past
IMPER	imperative
INDEP. PRO	independent pronoun
INT	intentional
IRR	irrealis
LOC	locative
MOD	modal
NEG	negative

NF	non-finite
NOM	nominative
NP	noun phrase
O	object
OBLIG	obligative
PA	past
PAR	participial
PASS	passive
PFV	perfective
PRES	present
PRF	perfect
PRO	pronoun
PRON	pronominal
REL	relative
REM	remote (tense-aspect)
RMPA	remote past
S	subject
SEQ	sequential
SIM	simultaneous
SS	same subject (continued reference)
SUB	subordinator
T-A-M	tense-aspect-modality
TOP	topic
WH	question particle/pronoun

CHAPTER 8

The coherence of organized science

> …The game of science is, in principle, without end. He who decides one day that scientific statements do not call for any further tests, and that they can be regarded as finally verified, retires from the game…
>
> K. Popper, *The Logic of Scientific Discove* (1934/1959)

8.1 The scientist vs. the organism

In many obvious ways, organized science toils in the same vineyard and under similar handic aps as the cognizing organism. The history of philosophy attests to this, after a fashion, in repeatedly lumping together epistemology – the theory of knowledge – and philosophy of science. Indeed, the same great exponents of epistemological Empiricism (Aristotle) and Rationalism (Plato) in the 4th Century B.C. have been repeatedly invoked by inductivist and deductivist philosophers of science, respectively. Here is how Karl Popper acknowledges, albeit in somewhat condescending terms, the historical affinity between the two strains of 'growth of knowledge':[1]

> "…For the most important way in which *common-sense knowledge* grows is, precisely, by turning into *scientific knowledge*. Moreover, it seems clear that the growth of scientific knowledge is the most important and interesting case of the growth of knowledge. It should be remembered, in this context, that almost all the problems of traditional epistemology are connected with the problem of the growth of knowledge.
>
> I am inclined to say even more: from Plato to Descartes, Leibniz, Kant, Duhem and Poincaré; and from Bacon to Hobbes and Locke, to Hume, Mill and Russell, the *theory of knowledge* was inspired by the hope that it would enable us not only to know more about knowledge,

1. Popper's condescension to the 'common-sense knowledge' of the cognizing organism is reminiscent of his fellow Viennese expatriate Carnap's condescension to pragmatics, that messy step-sister of logical semantics.

but also to contribute to the advance of knowledge – of *scientific knowledge*, that is…" (1959, p. 19; italics added)[2]

It is thus hardly surprising that the pragmatic middle ground in epistemology should run in parallel with the pragmatic middle ground in the philosophy of science – from Aristotle to Kant to Peirce to Hanson. For the oft-intertwined notions of **context** and **coherence** are equally relevant to the cognizing and communicating organism as they are to the scientist. And so, if the notion of context that is most relevant to communication is the mind of one's interlocutor (see chs 5,6 above), then the notion of context most relevant to organized science is the minds of one's scientific community; that is, one's colleagues. What makes such a sweeping assertion half-way plausible is the identification of *other minds* with *coherently-organized knowledge*. In the case of the communicating organism (Chapters 5, 6, 7), this coherent body of knowledge falls into three familiar bins:

a. generic knowledge of our **shared universe** (permanent semantic memory)
b. specific knowledge of our **shared speech situation** (attention and working memory)
c. specific knowledge of our **shared current discourse** (episodic memory).

In the case of organized science, the corresponding three knowledge bins are, respectively:

a. the shared **general knowledge** of our scientific discipline
b. the shared **current discussion** in our research project
c. the shared **episodic knowledge** of our research project.

Like all analogies, the parallelism between organized science and the cognizing and communicating organism can be stretched only up to a point, beyond which one needs to concede some obvious differences:

- The propositions of science are conscious, deliberately and reasoned; while much of the knowledge of organisms is implicit, sub-conscious, automated.

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2. While implicitly conceding many points to the pragmatic middle ground, Popper (1959) was an articulate exponent of deductivism in the philosophy of science, thus of rationalist epistemology. This is apparent from his lumping Kant, the pre-modern pioneer of middle-ground epistemology, with the rationalists.

- Organized science deals exclusively with epistemic (knowledge) modalities, that is, with what is or was or may be; while the organism deals with *both* epistemics and deontics (intentions); that is, also with what ought to be.

Given that the parallels between the cognizing organism and organized science is hardly new, it is not surprising to find two well-known students of the social dynamics of science, Kuhn (1962) and Lakatos (1978), acknowledging that the interlocutor in organized science – one's *community of scholars* – is always there, whether invoked or un-invoked.[3]

I would like to open this chapter with a brief survey of traditional – reductionist – philosophy of science, and where the pragmatics of context and coherence may fit in.

8.2 Reductionist extremes in the philosophy of science

8.2.1 Preamble

Much like epistemology, philosophy of science has tended to oscillate, over its long history, between two reductionist extremes, deductivism (Rationalism) and inductivism (Empiricism). Like the proverbial blind men describing the elephant, each of the two schools focused almost exclusively on one aspect of the complex process of scientific inquiry, be it *deductive inference* or *inductive inference*, de-emphasize all others. What is more, both schools joined force in trivializing – or mystifying – the process of hypothesis formation, and the central role taken in it by Aristotle's third mode of reasoning – *abductive inference*.

3. In homage to the intellectual winds of the 1960s and Paul Goodman's faded utopian dream, *Community of Scholars*. Pragmatics has been, ever since the pre-Socratics, an elusive un-invoked fellow traveler of epistemology, thus rcalling to mind (again?) an old story. Before embarking upon his ill-fated *Anabasis* ca. 403 BC, Xenophon, heeding his teacher Socrates' advice, went up to Delphi to consult the God's priestess. Suspecting what the answer was likely to be, he did not own up to his exact plans, nor invoked the God's name. Whereby the Pythia came back with her cryptic response: "Invoked or un-invoked, the God will be there".

8.2.2 Deductivist accounts

The difference between deductivists and inductivists in organized science hinges, as in epistemology, on the directionality of the relationship between facts (Russell's 'individual statements') and theories (Russell's 'general statements'), a distinction that is fundamental to both schools. From a cognitive perspective – Popper's poor-mouthed 'common-sense knowledge', the relation between individual facts and general knowledge in science is isomorphic to the relation between *episodic memory* (statements about specific individuals and events) and *semantic memory* (statements about general classes).[4]

With the distinction between the two types of knowledge – facts and theories – taken for granted by both schools, Rationalists in the philosophy of science emphasize the aspect of knowledge accretion that depends on **deductive inference**. This emphasis is most conspicuous in the work of the best practitioner of the genre, Karl Popper. Popper's vision of the overwhelming role of deduction in scientific inquiry is formulated in terms of the core distinction between individual and universal statements:

> "… Every application of science is based upon an inference from scientific hypotheses (which are *universal*) to *singular* cases, i.e. upon a *deduction* of singular prediction…" (1959, p. 64; italics added)

Indeed, Popper is more adamant about the centrality of the distinction between individual and universal statements than the empiricist/inductivist Rudolph Carnap was, leastwise in his later accounts. Here is Popper castigating Carnap:

> "…It is therefore not possible to abolish the distinction between individual concepts and universal concepts with arguments like the following of Carnap's: '…this distinction is not justified' he says, because '…every concept can be regarded as an individual or a universal concept according to the point of view adopted'. Carnap tries to support this assertion

4. As mature cognitive neuroscience makes it reasonably clear, neither one can proceed without the other at any given point during the accretion of knowledge. Put another way, some species of Kantian pragmatism must always be taken for granted, so that, since the very start, 'concepts without percepts are blind, while percepts without concepts are empty'. No organism is ever at a cognitive point of *tabula rasa*. Nor is, for that matter, the scientist; whose current theory and current facts are already in place, at any given point, almost by definition.

'…that (almost) *all so-called individual concepts are* (names of) *classes*, just like universal concepts'. This last assertion is quite correct, as I have shown, but has nothing to do with the distinction in question…" (*ibid.*, p. 67)][5]

The process of how universal concepts are arrived at, and the central role that empiricists/inductivists ascribe to inductive inference, is left deliberately vague in Popper's account. This is of course understandable, given that deductive inference *alone* cannot account for scientific generalizations either, however central it may be in Popper's rendition of the scientific cycle. Deduction is deployed, according to Popper, in the *testing*, not the initial assembling, of general theoretical statements:

> "…There can be no doubt that *we learn the use* of universal words, that is, of their *application* to individuals, by ostensive gestures and by similar means…" (*ibid.*, p. 65)

It is not that Popper doesn't know that other phases, above and beyond deductive reasoning, take their rightful place in scientific inquiry. It is just that he considers them devoid of 'true philosophical interest':

> "…I propose to look at science in a way which is slightly different from that favored by the various psychologistic schools: I wish to *distinguish sharply between objective science, on the one hand, and 'our knowledge' on the other.* I readily admit that only observation can give us 'knowledge concerning the facts', and that we can (as Hahn says) 'become aware of facts only by observation'. But this awareness, this knowledge of ours, does not justify or establish the truth of any statement. I do not believe, therefore, that the question which epistemology must ask is '…on what does our *knowledge* rest?…', or more exactly, how can I, having had the *experience* S, justify my description of it, and defend it against doubt… In my view, what epistemology has to ask is, rather: How do we test scientific statements by their deductive consequences?…" (1959, pp. 97–98)

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5. Carnap thus argues as a pragmatist, conceding that what looks like an individual fact from a top-down perspective may look like a general theory from a bottom-up perspective. The history of science and the evolution of naturalistic ('common sense') knowledge are replete with erstwhile theories that, after repeated failures to falsify, became solid facts.

Popper's disdain for the 'psychological' closely parallels Carnap's and Wittgenstein's. This strong preference for the logical over psychological – the rational over the naturalistic – is reminiscent of Chomsky's (1965) visceral disdain for the equally naturalist 'performance', opting for the rational, abstract 'competence'.

Popper is at his sharpest as a critic of extreme inductivism. Much of the animus is directed, perhaps aptly, at Wittgenstein's *Tractatus*:

> "…The positivist dislikes the idea that there should be meaningful problems outside the field of 'positive' empirical science – problems to be dealt with by genuine philosophical theory. He dislikes the idea that there should be a genuine theory of knowledge, an epistemology or a methodology… In the two years since the first publication of this book, it was the standing criticism raised by members of the Vienna Circle against my idea that a theory of method which was neither an *empirical science* nor *pure logic* was impossible: What was outside of these two fields was sheer nonsense…" (*ibid.*, p. 51; italics added)

It is hard to find a clearer statement of extreme reductionism in philosophy. And likewise:

> "…only two kinds of statements exist for them: logical tautologies and empirical statements. If methodology is not logic, then, they will conclude, it must be a branch of some science – the science, say, of *the behavior of scientists at work*…" (*ibid.*, p. 52; italics added)

Popper points out the essential fallibility of inductive inference as an instrument of generalization:

> "…According to this view, the logic of scientific discovery would be identical with inductive logic… It is usual to call an inference 'inductive' if it passes from *singular statements* (sometime called 'particular statements'), such as accounts of the results of observations or experiments, to *universal statements*, such as hypotheses or theories…" (*ibid.*, p. 27)

And further:

> "…positivists in their anxiety to annihilate metaphysics, annihilate natural science along with it. For scientific laws too, cannot be logically reduced to elementary statements of experience…" (*ibid.*, p. 36)

It is not clear, however, if Popper's complaint is akin to Quine's (1951). The point may perhaps be clarified by a simple-minded example. Consider the putative inductive inference:

(1) **Induction from particulars to the general**:
  a. Socrates is both Greek and bald.
  b. Other encountered persons *x, y, z,…n* are also both Greek and bald.
  ——————————————————————
  c. All Greeks are bald.

Two separate objections can be raised concerning the logical status of the inductive inference (1). First, one may concede that knowledge of the general statement (1c) may have indeed been garnered from prior experience with the particular statements (1a) and (1b). But those statements already *presuppose* prior knowledge of the (equally general) classes 'Greek' and 'bald', thus knowledge of their *membership criteria*, which are themselves *general statements*. Via inductive inference (1) we have created neither a new class 'bald' nor a new class 'Greek'. Rather, we have merely *enriched* the pre-existing class 'Greek' by adding another criterial feature to it, 'bald'. At its best, inductive inference turns out to be a means of probing the association between criterial features of *pre-existing* general classes, e.g. adding a criterion, as in (1). Inductive inference thus further elaborates on *already-known* general statements. What induction seems incapable of doing is what empiricists have always wanted it to do – create general statements *di novo* out of individual experiences.

Popper's second objection is handled a bit more explicitly when he notes, like Wittgenstein and Peirce, the inherent uncertainty – the *leap of faith* – associated with induction. That is, the logical frailness of generalizing from past to future experience; or from a small sample to the general population. Invoking Hume, Popper notes:

> "…that those instances…of which we have had no experience [are likely to] resemble those of which we have had experience…All probable arguments are built on the supposition that there is conformity betwixt the future and the past…" (*ibid.*, appendix vii, p. 369; bracketed material added)

It is useful to note that Wittgenstein (1918) made the very same criticism:

> "…the procedure of induction consists in accepting as true the *simplest* law that can be reconciled with our experience. This procedure, however, has no logical justification, but only a psychological one… It is a hypothesis that the sun will rise tomorrow [based on the inductive observation of repeated instances of sunrise]: and this means that we do not *know* whether it will rise…" (1918, p. 143; brackets added)

Popper (1959) is somewhat of a mixed bag as deductivists go, at various points conceding the usefulness of pragmatics in science (see below). Deductivists in the social sciences, on the other hand, have taken a much more militant position, often to the point of caricature. Thus Bach (1965), in extolling Chomsky's reductive position, sets up the stark opposition between extreme empiricism (the bad guys) and extreme rationalism (the good guys):

> "…Whereas the Baconian stresses caution and 'sticking to facts' with a distrust of theory and hypotheses…, the Keplerian emphasizes the creative nature of scientific discovery, the *leap to general hypotheses* – often mathematical in form, whose value is judged in terms of fruitfulness, simplicity and elegance…The prevailing assumptions of American linguistics prior to 1957 were essentially Baconian in character…[Chomsky's approach, on the other hand was a] deductively formulated method…" (1965, pp. 113–114; bracketed material added)

Bach then likens the Chomskyan paradigm in linguistics to the 'good guys' in physics, quoting from Dirac's put down of Schroedinger:

> "…I think there is a moral to this story, namely, that it is more important to have beauty in one's equations than to have them fit the experiment…" (*ibid.*, pp. 113–114)

In the same vein, Lees (1957) chimes in:

> "…Once it has developed beyond the prescientific stage of collection and classification of interesting facts, a scientific discipline is characterized essentially by the introduction of *abstract constructs* and theories and the validation of those theories by testing their predictive power…" (1957, p. 376; italics added)

Chomsky himself has, as a matter of habit, taken the process of discovery for granted, focusing almost entirely on how the general statement ('the grammar') accounts for ('predict') all possible individual facts ('grammatical sentences'):

> "…By "grammar of the language L" I will mean a device of some sort (that is, a *set of rules*) that provides, at least, a complete specification of an infinite set of *grammatical sentences* of L and their structural description…" (1961, p. 6; italics added)

8.2.3 Inductivist accounts

Extreme inductivists in the philosophy of science can be just as smug as their deductivist counterparts in dismissing the cognizing organism's unimpeachably empirical natural epistemology as 'primitive' and less worthy of the philosopher's attention, as compared to the more reflective, analytic accretion of knowledge in organized science. Thus, in conceding the historical parallel between epistemology and philosophy of science, Russell (1918) is unabashed about where his heart lies:

> "…It seems to me that when your object is not simply the study of the history or development of mind, but to ascertain the nature of the world, you do not want to go any further back than you are already yourself. You do not want to go back to the vagueness of the child or monkey, because you will find that quite sufficient difficulty is raised by your own vagueness… There is one type of mind which considers that what is called *primitive experience* must be a better guide to wisdom than the experience of *reflective persons*, and there is the type of mind which takes exactly the opposite view… It is quite clear that the educated person sees, hears, feels, does everything in a very different way from a young child or animal, and that this whole manner of experiencing the world and of thinking about the world is very much more analytic than that of a more primitive experience…" (1918, p. 181; italics added)

Russell is as focused as Popper is on the fundamental distinction between individual and general statements, like Popper underscoring the parallel between the organism and the scientist:

> "…The first distinction that concerns us is the distinction between percepts and concepts, i.e. between objects of acts of perception and objects of acts of conception. *If there is* a distinction between particulars and universals, percepts will be among particulars, while concepts will be among universals…" (1911; in Russell 1956, p. 105; italics added)

After much hand waving, both logical and pseudo-empirical, Russell concedes a sense in which the distinction between the two types of knowledge does exist:

> "…We have thus a division of all entities into two classes: (1) particulars, which enter into complexes only as subjects of predicates or as the terms of relations, and, if they belong to the world of which we have experience, exist in time and cannot occupy more than one place at one time in the space to which they belong; (2) universals, which can occur as predicates or relations in complexes, do not exist in time, and have no relation to one place which they may not simultaneously have to another…" (1911; in Russell 1956, p. 124)

In his late-life reflections, Carnap (1963) recapitulated the extreme formulation of his early years, founded on the presumed availability of sense-derived atomic facts (individual statements):

> "…According to the original conception, the system of knowledge, although growing constantly more comprehensive, was regarded as a closed system in the following sense. We assumed that there was a certain rock bottom of the knowledge, the knowledge of the immediately given, which was indubitable. Every other kind of knowledge was supposed to be firmly supported by this basis and therefore likewise decidable with certainty. This is the picture that I had given in *Logischer Aufbau*. It was supported by the influence of Mach's doctrine of the sensations as the elements of all knowledge, by Russell's logical atomism, and finally by Wittgenstein's thesis that all propositions are truth-functions of the elementary propositions…" (1963, p. 57)

In explaining why his old, strict-empiricist model was later abandoned, Carnap goes on:

> "…Looking back at this view from our present position, I must admit that it was difficult to reconcile with certain other conceptions that we had at the time, especially in the methodology of science. Therefore the development and clarification of our methodological view led inevitably to an abandonment of the rigid frame of our theory of knowledge. The important feature of our methodological position, the emphasis on the hypothetical character of the laws of nature [general statements], in particular, of physical theories… It was clear that the laws of physics

could not possibly be completely verified. This led Schlick, under the influence of Wittgenstein, to the view that physical laws could no longer be regarded as general sentences but rather as rules for derivation of singular sentences… The influence of Karl Popper's book *Logic der Forschung* worked in the same direction. Thus some of us, especially Neurath, Hahn and I, came to the conclusion that we had to look for a more liberal criterion of significance than verifiability…" (*ibid.*, p. 57; bracketed material added)

The close resemblance of Carnap's later position to Popper's Hypothetico-Deductive (H-D) model is easy to discern. Particularly striking are (i) the tentative hypothesis status of general statements (scientific theories); and (ii) the 'rules for derivation' mapping from general to particular statements. The latter, in Carnap's late formulation, are analogous to Popper's deductive reasoning stage, whereby possible if yet-unobserved facts are deduced as *logical consequences* of a hypothesis, its logically binding *predictions*. Those predictions are then tested by the logical criterion of *falsifiability*.

As one would expect, inductivists were as good as deductivists in ferreting out the exposed pragmatic underbelly of their opponents' position. Hence Wittgenstein's celebrated trashing of deductive logic in the *Tractatus* (1918):

"…The propositions of logic are tautologies. Therefore the propositions of logic say nothing. (They are the analytic propositions)…" (1918, p. 121)

Wittgenstein is, of course, concerned here with the ability of logical propositions to convey new information, a concern couched in terms of the prevailing Positivist *Zeitgeist* – individual statements about objective reality:

"… Tautologies and contradictions are not pictures of reality. They do not represent any possible situations. For the former admits *all* possible situations, and the latter *none*…" (*ibid.*, p. 69)

Wittgenstein next ties up the discussion of tautology and contradiction to the scale of three epistemic modalities (certain, possible, impossible), noting that an information-bearing proposition stands at neither extreme of the scale:

"…a tautology's truth is certain, a proposition's possible, a contradiction's impossible. Certain, possible, impossible: here we have the first indication of the *scale* that we need in the theory of probability…" (*ibid.*, pp. 69–70; italics added)

Lastly, as noted above, Wittgenstein the flaming empiricist was just as aware as his deductivist counterparts of the soft pragmatic underbelly of induction:

> "…the procedure of induction consists in accepting as true the simplest law that can be reconciled with our experience. This procedure, however, has no logical justification, but only a psychological one…" (*ibid.*, p. 143; italics added)

As in the case of extreme deductivism, inductivism at its most reductive extreme crops up in the wild flower-beds of the social sciences, where true believers have been just as adept at quoting *their* paragons of physics; as in, e.g., d'Andrade's (1954) quoting Newton:

> "…the best and safest method of philosophizing [doing science]… seems to be, first to inquire diligently into the properties of things, and of establishing these properties by experiment, and then to proceed more slowly to hypotheses [theories] for the explanation of them…" (1954, p. 64; bracketed material added)

In the same vein, L. Bloomfield, a noted linguist and at the time a recent convert to Behaviorism, observed:

> "…the only useful generalizations about language are inductive generalizations…" (Bloomfield 1933, p. 20)

And likewise in his review of Sapir's *Language* (Bloomfield 1922):

> "…we must study people's habits of language – the way they talk – without bothering about mental processes that we may conceive to underlie or accompany habits. We must dodge this issue by a fundamental assumption, leaving it to a separate investigation, in which our results will figure as data along the results of other social sciences…" (1922, p. 142)

And again in his critique of his old mentor, Hermann Paul:

> "…The other great weakness of Paul's 'Principles' is in his insistence upon "psychological" interpretation… [and on] mental processes which the speakers are supposed to have undergone… The only evidence for these mental processes is the linguistic process; they add nothing to the discussion but only obscure it…" (1933, p. 17; bracketed material added)

And likewise:

> "…In order to give a scientifically accurate definition of meaning for every form of the language, one should have to have a scientifically accurate knowledge of everything in the speakers' world… In practice, we define the meaning of a linguistic form, whenever we can, in terms of some other science…" (*ibid.*, pp. 139–140)

And lastly:

> "…The mentalistic theory… supposes that the variability of human conduct is due to the interference of some non-physical factors, a *spirit* or *will* or *mind*…that is present in every human being…[and] is entirely different from material things and accordingly follows some other kind of causation or perhaps non at all…" (*ibid.*, pp. 32–33)

8.3 Pragmatics in empirical science

8.3.1 Preamble

In one guise or another, the pragmatics of context, thus of coherence, has been a silent partner in epistemology and philosophy of science ever since Aristotle. As noted above, both avowed deductivists (Popper) and avowed inductivists (Carnap) were forced to concede grounds to pragmatics. In the case of Carnap, this involved primarily the relaxation of the erstwhile-rigid boundary between factual and theoretical statements. In the case of Popper, the concessions were more extensive.

More to the point, pragmatics has been an integral part of the actual *practice* of science from the very start, most conspicuously again in Aristotle's practice of biology and bio-classification. What the more flexible accounts of organized science have done, beginning with Peirce, is pull pragmatics out into the open and inflict it upon philosophy of science, which until then had indulged in the very same reductionist excesses as had traditional epistemology. I will begin this discussion by surveying the major junctures where pragmatics intrudes upon the process of scientific inquiry.

8.3.2 Theory-laden facts

Facts are not picturable, observable entities
R. N. Hanson, *Patterns of Discovery* (1958)

As noted above, the stringent segregation between factual ('particular') and theoretical ('general') statement had been the hallmark of both reductionist schools in philosophy of science. What Pragmatist accounts have demonstrated, with arguments and case studies, is that the distinction, however useful, is in principle untenable. For, much like Kant's dialectic account of epistemology, data and theory in science define each other in a recurring dialectic circle. So that at any given point, the one may re-define the other, and vice versa. That is, when fiddling with the theory, one takes the facts to be solid. Once the theory has been stabilized, one can – from a new safe vantage point – re-evaluate the solidity of the facts.

The most comprehensive account of this is found in Hanson (1958), beginning with the rejection of the traditional empiricist view of objective sensory data. Hanson illustrates the frame-dependence – **context sensitivity** – of 'observed facts' with the following example from Biology:

> "…Imagine these two [scientists] observing a Protozoon – Amoeba. One sees a one-celled animal, the other a non-celled animal. The first sees Amoeba in all its *analogies* with different types of single cells: liver cells, nerve cells, epithelium cells. These have a wall, a nucleus, cytoplasm, etc. Within this class, Amoeba is distinguished only by its independence. The other, however, sees Amoeba's *homology* not with single cells, but with whole animals. Like all animals Amoeba ingests its food, digests and assimilates it. It excretes, reproduces and is mobile – more like a complete animal than an individual tissue cell…" (1958, p. 4; italics added)

Is either perspective wrong? Hardly. They are both right, each in its respective theoretical **context**. In the same vein, one could cite the celebrated example from physics, whereby from one theoretical perspective and its attendant set of measurements (and instruments), light is 'objectively' *waves*, but from another it is *particles*. Again, both perspectives are valid, each revealing an important aspect of the complex whole.

Another way in which data turn out, again and again, to be contaminated by theory is in the notoriously elastic realm of **relevance**. As will be noted further below, at many junctures in the cycle of scientific inquiry one has to weigh data against other data and decide which is more relevant for the **purpose at hand**; with the 'purpose at hand' being, invariably, a theoretical construct. In this connection, returning to the amoeba, Hanson (1958) observes:

> "…This is not an experimental issue, yet it can affect experiments. What either man regards as significant questions or *relevant data* can be determined by whether he stresses the first or the last term of 'unicellular animal'…" (1958, pp. 4–5; italics added)

In sifting through the data with theory-dependent criteria such as *relevance* or *purpose*, the scientist merely recapitulates the ways of bio-organisms, who filter out tall mounds of 'objective' data at any given moment, reducing the pile to a small and thus manageable fraction – those facts that are most relevant – *at the time, for the purpose at hand*. Both the scientist and the organism, in their respective domains, are highly selective in what they admit into evidence. And their selectivity has relatively little to do with the objective status of the facts. The amount of available 'objective' data is, in both domains, staggering. Neither induction nor deduction could reduce it to a manageable – processable – proportion. Only pragmatic reasoning, taking into account the **relevant context** will accomplish that. Put another way, for both the organism and the scientists, facts gain their **coherence** when viewed in their relevant context, frame, gestalt. And often enough, the relevant context of facts is the general theory within which they are embedded, with which they must cohere.

8.3.3 Abductive inference

At the core of any pragmatic account of knowledge incrementation stands *abductive reasoning*, the instrument by which new hypotheses, new theoretical insights and illuminating explanations are put on science's table. Aristotle's lone explicit discussion of abduction (a.k.a. 'reduction') in the *Prior Analytic II* seems at first blush a relatively trivial extension of his standard account of deduction as explanation. In deductive inference, the middle term in the derivation – the general statement (*explanans*) – is as firm as a rock. In abductive reasoning, on the other hand, the middle term's connection to the third term, the conclusion (*explanandum*), is more tenuous:

> "…By reduction we mean an argument in which the first term clearly belongs to the middle, but the relation of the middle to the last term is uncertain though equally or more convincing than the conclusion; or again an argument in which the terms intermediate between the last

term and the middle are few; for in any of these cases it turns out that we approach more nearly to knowledge. For example, let A stand for *what can be taught*, B for *knowledge*, C for *justice*. Now it is clear that *knowledge can be taught*; but it is uncertain whether *virtue is knowledge*. If now BC ['justice is knowledge'] is equally or more convincing than AC ['justice can be taught'] we have a *reduction*; for we are nearer to knowledge, since we have made an extra assumption, being before without knowledge that A belongs to C ['justice can be taught']…" (*Prior Analytic* II, 25; J. Barnes ed. 1984, p. 110; italics and bracketed material added)

Thus described, Aristotle's 'reduction' may be interpreted in two difference ways. First, as a less-than-firm deduction, in which a dubious second term, as in (2b) below, leads to a dubious conclusion (2c):

(2) **Aristotle 'reduction' as dubious deduction**:
a. knowledge can be taught. (certain prior statement)
b. $^{?}$justice is (a kind of) knowledge. (uncertain general statement; *explanans*)
____
c. $^{?}$justice can be taught. (uncertain conclusion; *explanandum*)

One could, however, be more generous with Aristotle, taking his 'reduction' to be a species of **hypothetical-explanatory reasoning** – as the terms *explanans* and *explanandum* surely suggest. Under such an interpretation, the second term (3b) would now be the explanatory hypothesis, on whose eventual truth-value the third term (3c) will continue to depend – till further notice. That is:

(3) **Aristotle's 'reduction' as hypothetical reasoning**:
a. knowledge can be taught (certain prior statement)
b. *if* justice *were* (a kind of) knowledge (uncertain hypothesis; *explanans*)
____
c. then justice *may* also be taught (uncertain conclusion; *explanandum*)

The hypothetical reasoning in (3) closely resembles Hanson's (1958) Peircean account of abduction (see below), for which the oft-cited passage from Aristotle's *Posterior Analytic II* is perhaps an apt poetic metaphor:

> "…The particular facts are not merely brought together, but there is a new element added to the combination by the very act of thought by which they are combined…The pearls are there, but they will not hang together until someone provides the string…" (*Poesterior Analytic II*, 19; cited from McKeon ed. 1941)

Hanson's Peircean interpretation of Aristotle's abduction runs as follows:

> "…Aristotle lists three types of inferences. These are deductive, inductive and one other called *apagoge*. This is translated as 'reduction'. Peirce translates it as 'abduction' or 'retroduction'. What distinguishes this kind of argument for Aristotle is that the relation of the middle to the last term is uncertain, though equally or more probable than the conclusion; or again an argument in which the terms intermediate between the last term and the middle are few. For in any of these cases it turns out that we approach more nearly to knowledge… since we have taken a new term…" (1958, p. 85)

It is Peirce, rather than Aristotle, who sorts out the role of abduction in empirical science, as well as its relation to induction and deduction:

> "…The first starting of a hypothesis and the entertaining of it, whether as a simple interrogation or with any degree of confidence, is an inferential step which I propose to call *abduction*… This will include a preference for any one hypothesis over others which would equally well explain the facts, so long as this preference is not based upon any *previous knowledge* [thus ruling out deduction] bearing upon the truth of the hypotheses, nor on any *testing* [hereby ruling out induction] of any of the hypotheses, after having admitted them on probation. I call all such inference by the peculiar name, *abduction*, because its legitimacy depends upon altogether different principles from those of other kinds of inference…" (1940, p. 151; italics and bracketed material added)

Peirce takes great pains to differentiate abduction from induction too, a worthy endeavor since many have at one time or another considered abduction a weakened, lower-certainty species of induction. Thus:

> "…[*induction*] sets out with a theory and it measures the degree of concordance of that theory with fact. It never can originate any idea whatever. No more can *deduction*. All ideas of science come to it by

> way of *abduction*. Abduction consists in studying the facts and devising theories to explain them. Its only justification is that if we are ever to understand things at all, it must be[6] in that way. Abductive and inductive reasoning are utterly irreducible, either to the other or to Deduction, or deduction to either of them…" (C. S. Peirce, *Collected Writings*, 1934, vol. V, p. 146; italics and bracketed material added)

Peirce also notes the association between Aristotle's three modes of inference and his three epistemic modalities – 'necessarily true', 'possibly true' and 'false':

> "…Deduction proves that something *must* be; Induction shows that something *actually is* operative; Abduction merely suggests that something *may be* …" (*ibid.* p. 171)

As for the precise role of abduction in hypothesis formation, Peirce's (1940) rendition is somewhat compressed:

> "…The surprising fact C is observed; But if [theory] A were true, C would be a matter of course; Hence, there is a reason to suspect that [theory] A is true…" (1940, p. 151; bracketed material added)

The version given by Hanson (1958) is a bit more expanded, contrasting the pragmatic account with its likely inductivist and deductivist counterparts:

> "… 1. Some surprising phenomenon P is observed. 2. P would be explicable as a matter of course if H were true. 3. Hence there is reason to think that H is true. H cannot be retroductively [abductively] inferred until its contents is present in 2. Inductive accounts expect H to emerge from repetition of P. H-D [Popperian] accounts make P emerge from some unaccounted-for creation of H as a 'high-level hypothesis'…" (1958, p. 86; bracketed material added)

Peirce (1940) also locates deduction and induction within the empirical cycle:

> "…The operation of testing a hypothesis by experiment, which consists in remarking that, if it is true, observations made under certain conditions ought to have certain results, and then causing those conditions to be fulfilled, and noting the results, and, if they are favorable, extending a certain confidence to the hypothesis, I call *induction*…" (1940, p. 152)

6. The logical force of 'must' here is not that of certainty, but of guesswork or hypothesis.

In arguing against the Popper's deductivism (H-D), Hanson (1958) foregrounds the role of abduction:

> "…Physicists do not start from hypotheses; they start from data. By the time a law has been fixed into an H-D system, really original physical thinking is over. The pedestrian process of deducing observation statements from hypotheses comes only after the physicist sees that the hypothesis will at least explain the initial data requiring explanation. [The] H-D account is helpful only when discussing the argument of a finished research report… the analysis leaves undiscussed the reasoning…" (1958, p. 71)

8.3.4 Role of the three inference types in the empirical cycle

The order of application of the three modes of inference in a run-of-the-mill empirical cycle may be now given as (4) below, with the impetus to the new cycle being facts that **do not cohere** with the current theoretical knowledge:

(4) a. **Incompatible facts**: Facts *F do not cohere* with current theory *T*
  b. **Abduction**: suppose a new hypothesis *H*, yet to be tested, were true
  c. **Deduction**: predict testable logical consequences of *H*.
  d. **Induction**: test the predicted logical consequences of *H*; then:
    i. **Fail to falsify**: if consequences are upheld, one has failed to falsify *H*; till further notice, hypothesis H holds.
    ii. **Falsify**: if the consequences are not as predicted, *H* is thereby falsified; then
    iii. **Back to the drawing board**: Repeat steps (b), (c), (d) above.

The predicted – deduced – logical consequences of *H* (4c) are logically binding only in one direction, via *modus tolens*, leading to *falsification*:

(5) **The deductive-logical power of falsification**:
  a. $H \supset$ consequence
  b. NEG-consequences $\supset$ NEG-H

Positive results, on the other hand, do not confirm *H*, but only *fail to falsify* it. So that, for the moment and until further tests may yet falsify it, hypothesis *H* is safe.

This is where it become obvious where coherence fits in the gradual, ever-incomplete accretion of scientific knowledge. First, the impetus for a new investigative cycle in science (5a) is the *incompatibility* of some newly noticed facts with current theoretical knowledge. Put another way, the facts *do not cohere* with current knowledge. In science – much like in the mind of organisms – facts are not atomic entities, but rather are connected to each other within a coherent larger structure; they must fit together within an organized, well structured theory. And further, incompatible facts must lead to a new cycle of abductive (5b), deductive (5c) and inductive (5d) steps that, taken together, one hopes, will *restore coherence*, however temporarily.

8.4 Explanation as contextual coherence

8.4.1 Deductive 'explanations'

The idea that a generalization or a statement of class-membership somehow counts as an explanation goes back to Aristotle's treatment of deduction in both the *Prior* and *Posterior Analytic*. Thus, recall (2) and (3) above, recapitulated below:

(6) **Schema of deductive explanation**
   a. antecedent particular facts
   b. general rule (*explanans*)
   ____
   c. new puzzling facts (*explanandum*)

The potential poverty of the deductive 'explanation' in (6) becomes apparent when we inspect actual cases. Consider, for example, the deductive explanation (7b) below of the puzzling fact (7c) 'Socrates is bald':

(7) a. Socrates is Greek
   b. All Greeks is Bald (*explanans*)
   ____
   c. Socrates is bald (*explanandum*)

What knowledge has one gained, exactly, by the 'explanation' (8b)? If Socrates is Greek (8a) and Socrates in bald (7c), is he really bald *because* he was Greek, the putative 'explanation' (7b)? What does this 'explanation' tell us above and beyond the rather mundane observation that members of a class must abide by its membership criteria?

Deductive 'explanations' like (6), (7) crop up repeatedly as pseudo explanations in popular and less-popular science. Consider, for example, the presumed explanatory power of the pop-biology catch phrase 'survival of the fittest':

(8) Individual *x* is fittest
Only the fittest survive (*explanans*)
———————————————
Individual *x* survived. (*explanandum*)

The circularity of using (8b) to 'explain' (8c) is sufficiently obvious.

In the same vein, consider the explanatory power of the term 'reinforcement' in Behaviorist psychology:

(9) a. Individual *x* repeatedly performed task *y*.
b. Repetition reinforces learning. (*explanans*)
———————————————
c. Individual *x* learned task *y*. (*explanandum*)

Consider lastly the explanatory power of a well-known statement in early deductivist linguistics (Ross 1967):

(10) a. Structure *x* is a complex-NP.
b. One can never copy out of complex-NPs. (*explanans*)
———————————————
c. One cannot copy out of structure *x*. (*explanandum*)

In summing up the difficulty raised by the traditional Aristotelian notion of the general statement ('middle-term') of deduction as an 'explanation', Scriven (1962) observes:

> "…Hempel and Oppenheim's first mistake, then, lies in the supposition that by subsumption under a generalization one has automatically explained *something*, and that queries about this "explanation" represent a request for *further* and *different* explanation…" (1962, p. 97)

8.4.2 The pragmatics of explanation

In a way, the pragmatic account of explanation is buried, as an embryonic vestige, inside Aristotle's account of deductive 'explanation'. This is so because the latter can achieve, at the very least, a *more general* account of the hitherto disparate facts. Indeed, explanation is akin to placing erstwhile disparate facts in a **wider context**, so that what appeared at first blush accidental now becomes natural, understandable, taken as a matter of course. Thus (Scriven 1962):

> "…What is scientific explanation? It is a *topically unified* communication, the contents of which imparts *understanding* of some scientific phenomenon. And the better it is, the more efficiently and reliably it does this, i.e., with less redundancy and higher *over-all* probability. What is understanding? Understanding is, roughly, *organized knowledge*, i.e., knowledge of the *relations* between various facts and/or laws. These relations are many kinds – deductive, inductive, analogical, etc. Understanding is deeper, more thorough, the greater the span of this relational knowledge…" (1962, p. 102; italics added)

Contextualization, whether simple or complex, is the very essence of coherence – bringing together hitherto disparate facts into an organized, complex whole, into a network in which they are now connected, within which they now *cohere*. This is how the parts of bio-organisms cohere in a functionally-organized body, how atomic chunks of knowledge or belief cohere in the working mind/brain, how parts of society cohere into a viable whole, how words and utterances cohere in the wider context of semantic memory, episodic memory or working memory.

Establishing new coherence where a grating incoherence reigned before, fitting puzzling new facts into a new theoretical context – perspective – where they now cohere, is what new scientific hypotheses purport to accomplish. And they accomplish this by proposing something hitherto unknown; or, as Peirce suggested about the exercise of abduction, 'something by knowing of which one knows something more profound'.

8.5 Causal explanation

8.5.1 Preamble

> …The belief in causality is metaphysical. It is nothing but a typical metaphysical hypothesization of a well-justified methodological rule – the scientist's decision never to abandon his search for laws…
>
> K. Popper *The Logic of Scientific Discovery* (1934/1959)

Traditional philosophers of science, whether inductivist or deductivist, have tended to rely almost exclusively on classical Newtonian physics for examples of scientific practice and, in particular, of causal explanation. Understandably, they tended to select cases of simple, chain-like, mechanical causation as paradigm examples of causal explanation. Here is how Russell (1948) describes it:

> "…Inference from experience to the physical world can…be justified by the assumption that there are causal chains, each member of which is a complex structure ordered by the *spatio-temporal* [relation of] *com-presence*… All members of such a [causation] chain are similar in structure…" (1948, p. 244; bracketed material and italics added)

The key term here is, of course, is *spatio-temporal com-presence,* which one may as well translate as *co-occurrence*. But as simple as it may seem at first, causation turns out to be a theory-laden notion, a metaphysical construct that is inferred, often in complex and indirect ways, from various types of spatio-temporal co-occurrence, most often *subsequence*; and in particular from the *conditional asymmetries* of temporally-ordered facts.

A more realistic, pragmatic account of causal explanation, such as Hanson's, notes that members of a 'simple causation chain' are seldom if ever just the purported "*…discrete events bound to neighbouring events very much like themselves…*" (Hanson 1958, p. 50).

In an eloquent dissection of the ontology of causation, Hanson shows why the simple-chain model of causation is a caricature of science, either in modern physics or in the more complex yet biological and behavioral sciences:

> "…what we refer to as 'causes' are *theory-loaded* from beginning to end. They are not simple, tangible links in the chain of sense experience, but rather details in an *intricate pattern of concepts*…" (1958, p. 54; italics added)

And further:

> "…This is the whole story about necessary connection. 'Effect' and 'cause', so far from naming links in a queue of events, gesture towards *webs of criss-crossed theoretical notions*, information, and patterns of experiment…The notions behind 'the cause x' and 'the effect y' are intelligible only against a *pattern of theory*, namely one which puts guarantees on inferences from x to y…" (1958, p. 64; italics added)

8.5.2 The ontology of causation

8.5.2.1 From temporal order to logical conditionality

Popper, Russell and Hanson are indeed right that at the core of causal inference lies the original observation of one-way – irreversible – temporal order, which is easily extended to a one-way conditional inference. The observed facts are:

(11) **Observation of rigid temporal order**:
  a. event *a* always precede another event *b*
  b. event *b* never occurs unless event *a* occured first

A rather natural, perfectly logical interpretation then converts the rigid temporal order (11) into a one-way conditional inference:

(12) **From temporal precedence to conditional inference**:
  If an event *a* always precedes event *b* but never vice versa, and if event *b* never occurs unless event *a* occurs first, then event *a* must be the *logical pre-condition* to event *b*, so that a *one-way conditional* relation holds between them; that is: $b \supset a$".

8.5.2.2 From conditionality to causality

So far, we have remained safely within the realm of logic. The next step, however, takes us, by an act of *metaphysical re-branding*, into re-interpreting logical conditionality as causality:[7]

(13) **Metaphysical re-branding of conditionality as causality**:
  If event *a* always precedes event *b* but never vice versa, and if in addition event *b* never occurs unless event *a* occurs first, so that event *a* is the logical pre-condition to event *b*, then event *a* is re-branded as the 'cause' of event *b*.

---

7. Esa Itkonen (i.p.c.) has objected to branding the notions of 'cause' and 'causer' metaphysical, suggesting that they are, instead, sound empirical observation with considerable psychological reality (Itkonen 1983). I agree that causation is an important *explanatory* notion with manifest *psychological* reality for both the bio-organism and the scientist. Alas, that does not make it less metaphysical.

'Causes' are events, commonly though by no means exclusively involving **volitional agents** that initiated the 'cause' event. Such an agent can now itself be re-branded, by another metaphysical *fiat*, as the 'cause' of the resulting event. That is:

(14) **Metaphysical fiat of re-branding the agent-of-cause as causer**:
If the behavior of a volitional agent initiates – thus 'causes' – an event *a*, and if event *a* is branded as the 'cause' of the event *b*, then the agent that initiated and 'caused' event *a* can also be branded as the 'causer' of event *b*".

The metaphysical *fiat* (14) was originally noted by Zeno Vendler (1967), who interpreted it as a transformation from *cause event* to *causer agent*. That is:

(15) a. Because John stayed, Mary left.
b. Ergo, John's staying causes Mary to leave.
c. Ergo, John caused Mary to leave.

Causality in physics tends to involve pairs – or chains – of event that abide by a rigid temporal order. They are thus readily re-interpreted as case of logical conditionality (12). The next step, re-branding of the temporally prior and logically necessary event as 'cause' (13), is still a relatively benign metaphysical exercise. The next step, however, re-branding an agent participant in the 'cause' event as the 'causer', shifts the arena to the realm of living organisms and their volitional behavior, as Vendler's Example (15) aptly suggests. Whereby a whole range for further complexities about the nature of explanation and understanding, and who exactly is their intended audience, rears its lovely head.

From our perspective here, causal explanation is a more complex species of cognizing organisms **seeking coherence** in their understanding the surrounding universe. Added complexity in causal explanation arises with the advent of volitionally-acting agents.

8.5.2.3 From causality to agency

With the advent of forward-moving aquatic tubular organisms, the general spatial design of higher organisms, the vertebrates, has been set in cement, seemingly for eternity. Their perceptual capacities concentrated near their now-front feeding aperture, soon giving rise to a central-control nervous system, the brain. And while their motion towards food may have at first been random, it soon became governed by the direction of perceived food. Which eventually brought about controlled **purposive motion** – toward floating food, moving prey or potential mates, and away from predators or threatening natural conditions.

Purposive motion, as well as a growing capacity for grabbing either free-floating food or self-propelled prey, is what initially rendered our front-moving organisms **volitional agents**. Their prior cognitive universe of dumb nouns and stative adjectives has now become a universe of active-agentive verbs, both of intransitive motion ('move toward the light'), of action upon dumb objects ('eat the kelp') as well as other purposeful animates ('catch the fish', 'mate with the male'). Thus contrast:

(16) **Agentless states**:
a. The sky is blue
b. The mountain is tall
c. The leaf lies on the ground
d. The amoeba is floating in the water
e. This is a pine-tree.
Agentless events:
f. The leaf fell to the ground
g. The amoeba floated down to the bottom
h. The tree lost its leaves
Sentient states:
i. She wanted to leave
j. He saw the deer
k. They knew it was late
Agented events (= actions):
l. He ate the apple
m. She shot the dear
n. They left the house.

Even without implicating the sophisticated cognition, action and language of humans, organisms whose sensory-motor-cognitive capacities are sophisticated enough for purposive motion, feeding, mating, aggression and defense, thus a wide range of adaptive behavior and survival in a spatio-temporal universe, are purposive volitional agents. Such organisms must be able to differentiate between a growing variety of dumb objects, some adaptively irrelevant, others potential food, breeding sites or hiding sites; others moving randomly, harmless and unthreatening. They must also recognize live organisms that, like themselves, can move purposefully, be potential prey striving to escape or potential predators bent on devouring you, or potential mates. But what cognitive capacities must an organism possess in order to tell apart random vs. purposive motion? And how does one moving organism make judgements about the volition and agency of another?

8.5.2.4 Volitional motion, purposive action and agency

Purposive motion toward food sources (prey) or away from danger (predators) could have been the *ur*-action that gave rise to sentient beings' *ur*-concept of agency. Though pre-motile free-falling organisms, swaying with the tides in the primordial soup, may have already been capable of the following inference:

(17) **Inference about random motion as the default ground**:
"If it doesn't break the more-frequent statistical norm of the multiple entities that float either randomly or downward all around me, then it must be part of the spatial *ground* that demands no urgent attention".

In contrast, construing a moving organism as a volitional agent requires a more complex set inferences:

(18) **Inferring intention from motion under own power**:
a. If an entity is a less-common, smaller *figure* vis-a-vis the larger, less-frequent *ground*; and
b. If its motion seems non-random, violating the statistical norm of either random sway or steady gravity-induced sinking; and
c. If it is, larger than the normal gravity- or tide-impelled flotsam; and
d. If it looks and moves sort-of *like me*;
e. Then its motion may also be considered *like my motion*; and
f. Given what I know via *direct access* about my own purposive motion;
g. Then this moving entity must be impelled to move by the same invisible *internal force* that makes me move – *purpose, intention*.

The chain of inferences in (18) presuppose an ontological pre-condition to knowledge – Kant's distinction between the world 'as of itself' vs. the world 'as it appears to us'. That is:

(19) We have no direct access to knowledge of the external world. Rather, we are forever at the mercy of our perceptual-cognitive capacities.

However, inference (18d, e) allows sentient beings like us two important exceptions to Kant's ontological constraint (19) – just in cases the object of cognition is either the cognizer themselves or one *like the cognizer*. That is, more explicitly:

(20) **Inference of other entities' volition or purpose**:
a. I, the cognizer, have privileged direct access to my own mind.
b. Therefore, I know when I move volitionally, on purpose.
c. By extension, then, when other entities that *look like me* seem to move non-randomly, just like me, then
d. I am entitled to infer that their non-random motion is due, just like *my* non-random motion, to *their* volition or purpose.
e. In this limited instance, then, I may claim the same direct access to their mind as I have to my own.

The complex inferential chains in (18) and (20) are at the bottom of our intuitive assumption that we have access to *other minds*.

Let us re-consider now the most common predication types listed in (16) above, and compare them with those in (21) below:

(21) a. The horse **galloped**
b. The rock **fell**.
c. The man **went** to the store
d. The cocoanut **fell** to the ground.
e. The woman **hit** the horse
f. The coconut **hit** the child.
g. The girl **sent** her brother to the store.
———————————————
h. The woman **wanted** to leave.
i. They **expected** him to leave.
j. The child **knew** that her mother left.

Event types (21a, c, e, g) all involve visible actions by animate subjects, the very data that allows sentient beings to infer that another entity is a volitional agent, as reasoned in (20) above. However, event types (21h, i, j.), involving conscious (dative) subjects, are internal, thus invisible to us, stuck as we are on the Kantian outside. To interpret such events, we need an added set of inferences to supplement (20) above:

(22) **Supplementary inference of mental act**:
a. Some of an entity's volitional acts may be *internal* and *invisible*.
b. Now, if that entity is *like me*,
c. Then such invisible internal acts must be – like mine – *mental*.

The long chain of abductive inferences in (20) and (22) ascribe to other non-randomly-moving beings that look and behave like us some invisible metaphysical powers that are nonetheless highly predictive of their behavior – intention, volition, purpose. The explanations that such reasoning furnishes about the behavior of others are complex and not strictly logical. But they are nonetheless rather satisfying and adaptive, recalling again Perirce's view of abduction as 'something by knowing of which one knows something more profound'. What is more, explanatory inferences (20), (22) are no more metaphysical than the inferences by which we have leaped from temporal antecedence and conditionality to 'cause' (13) and then 'causer' (14).

Causal explanation and the metaphysical postulates of volition as internal cause, it seems, move us a bit further along the protracted path toward another metaphysical entity – understanding. They are all part of our attempt to see the world – including ourselves and those just like us – coherently. Our apparent unwillingness to reject causal explanation in spite of its being 'metaphysical' is nothing but an extension of Popper's **explanatory imperative**.

More to the point, explanation, understanding and seeking coherence are not idle pursuits of scientists. They are, above all, practical adaptive tools for purposeful organisms, who would benefit immensely from being able to *predict* the behavior of entities in their adaptive context, not only of dumb objects but also of other purposeful organisms, especially those whose behavior is crucial to one's survival; that is:

- potential sexually or socially cooperating conspecifics;
- potentially hostile enemies or predators;
- potentially edible prey.

8.6 Functional explanation

Functional explanation has been the *sine qua non* of empirical biology ever since Aristotle. In traditional philosophy of science, however, it used to be frowned upon almost universally as another metaphysical heresy – ascribing intentionality to non-human organisms! To wit (Hempel and Oppenheim 1948):

> "…One of the reasons for the perseverance of teleological considerations in biology probably lies in the fruitfulness of the teleological approach as a *heuristic device*: Biological research which was *psychologically motivated* by a teleological orientation, by an interest in purposes in nature, has frequently led to important results which can be stated in

> non-teleological terminology and which increase our scientific knowledge of causal connections between biological phenomena…Another aspect that lends appeal to teleological considerations is their *anthropomorphic character*. A teleological explanation tends to make us feel that we really "understand" the phenomenon in question, because it is accounted for in terms of purpose, with which we are familiar from our own experience of purposive behavior. But it is important to distinguish between understanding in the *psychological* sense of a feeling of *empathic familiarity* from understanding in the theoretical, or cognitive, sense of exhibiting the phenomenon to be explained as a special case of some general regularity…" (Hempel and Oppenheim 1948, p. 17; italics added)

In a subsequent exercise of know-nothingness, Hempel (1959) paid homage to the hallowed causal chains of physics, then noted this most quaint habit of behavioral – or even biological – scientists to indulge in functional analysis:

> "…In the exact physical sciences, according to this view, all explanation is achieved ultimately by reference to causal or correlational antecedents; whereas in psychology and the social and historical disciplines – and, according to some, even in biology – the establishment of causal or correlational connections, while desirable and important, is not sufficient. Proper understanding of the phenomena studied in these fields is held to require other types of explanation. Perhaps the most important of the alternative methods that have been developed for this purpose is the method of *functional analysis,* which has found extensive use in biology, psychology, sociology and anthropology…" (1959, p. 121; italics added)

The condescension runs the gamut from 'anthropomorphic' to 'heuristic' to 'analogical' to 'impressionistic' to 'non-objective' to 'unproven' to 'mushy' to 'metaphysical', depending on the time, place and discipline. Whole scientific fields originally founded upon the 19th Century's Darwinian functionalism – Cultural Anthropology, Psychology, Linguistics – have become mired in silly non-sequiturs, whereby the argument veers cyclically between the positivist's *show me* and the deductivist's *derive it*.

The ground over which this battle has been fought most actively is neither Anthropology, where the battle has essentially been lost; nor Linguistics, where a pal of dark smoke still hangs over the battlefield; but rather Psychology, where a biologically-minded, anthropologically-aware venture has branded itself

Evolutionary Psychology (Barkow *et al.* eds 1992; Whiten and Byrne eds 1997; *inter alia*). While the exact details may vary, and on occasion rankle sympathetic evolutionists (e.g. Gray *et al.* 2004), the founding sentiment is unimpeachably Darwinian: What is good for the body is good for the soul. If the brain has evolved, so must have the mind – with all its attendant paraphernalia of cognition, sociality, culture, language, art.

To quote S. J. Gould (1980) again, arguing against a now-forgotten spike of structuralism in evolutionary biology:

> "…the fascination generated by Dawkins'[8] theory arises from some bad habits of Western scientific thought – from attitudes (pardon the jargon) that we call *atomism, reductionism*, and [genetic] *determinism*. The idea that wholes should be understood by decomposing into "basic" units; that properties of microscopic units can generate and explain the behavior of macroscopic results; that all events and objects have definite, predictable, determined causes. These ideas have been successful in our study of simple objects, made of few components, and uninfluenced by prior history…. But organisms are much more than amalgamations of genes. They have an [evolutionary] history that matters; their parts interact in complex ways. Organisms are built by genes acting in concert, influenced by environments, translated into parts that selection sees and parts invisible to selection. Molecules that determine the properties of water are poor analogues to genes and bodies. I may not be a master of my fate, but my intuition of wholeness probably reflects biological truth…" (Gould 1980, pp. 77–78; bracketed material added)

In my own discipline, linguistics, a recalcitrant offshoot of structuralism has somehow taken root, initially under the impact of Behaviorism in psychology, with a later soupçon of Cartesian innatism. At the core of this strange brew lies the idea that a complex biologically-based structure such as human language, whose correspondingly-complex function – communication – is utterly obvious, requires no explanation. Or worse, that it explains itself. Or worse yet, that this gorgeous structural edifice is independent of adaptive function – by virtue of being *innate*. Anyone with the most rudimentary acquaintance with adaptive-selectional biology, from Aristotle to Darwin to E. O. Wilson, would

8. Gould was reviewing Dawkins' (1976) *The Selfish Gene*, which rudely shortchanged the role of adaptive behavior in natural selection.

fairly cringe at such nonsense.[9] For it flies in the face of what we know about explanation as an adaptive reflex of bio-organisms, a reflex of trying to understand, of needing to make sense, of striving to see a chaotic world as a tad more coherent.

8.7 Closure

The common perception of science as being about facts is endearing, but woefully misguided. Facts are sweet enough, gathering more and more of them can surely give you a rise. But science has never been about facts, just as language has never been about words, or biology about tissues and organs, or culture about quaint initiation ceremonies and the minutiae of yam exchange. Rather, science has always been about how the facts *cohere* within a broader context. Cohere with each other; cohere within a wider network of more abstract higher nodes; cohere within an explanatory hypothesis, a theory.

To the organism as to the scientist, facts are only meaningful as long as they guide us toward a broader, more coherent perspective. Or, from the opposite end, a theory is only useful as a framework – however temporary – for organizing hitherto-random facts. It was born of facts that did not cohere with a previous theory, that clashed with it, made an ugly raucous. And it will crash when newly discovered facts don't cohere with it – but rather clash and falsify it.

One hopes, of course, that one's pet theory would last a while, bloom and flourish. Truth is, though, your mind's current darling is barely holding its head above the water. Soon it will give up the ghost – and for a happy reason. For we always learn more facts, or discover more illuminating perspectives. For knowledge, unlike faith, is not about being right forever, but about getting closer and then closer yet to that frustrating target that just keeps moving. Though of course, part of the reason why it keeps moving is that our mind never stays still either as it searches for better coherence.

Acknowledgements

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9. For some detail see Givón (1979/2019, Chapter 1).

CHAPTER 9

Coherence and human nature: Are we a warlike species?

> Man is naturally peaceable and timorous, at the slightest danger his first impulse is to flee; he becomes warlike only by dint of habit and experience.
>
> J.-J. Rousseau, *The State of War*

> During the time men lived without a common power to keep them all in awe, they were in that condition which is called war; and such a war as is of every man against every man.
>
> T. Hobbes, *Leviathan*

> If I am not for myself, who is for me?
> But by myself, what am I?
>
> Rabbi Hillel, *Mishna*, ca. 160 AD

9.1 Nature vs. artifice

In this and the next chapter, I will stray just a bit outside the academic preserve in order to raise some fundamental questions about the way we organize our lives in the current iteration of the Society of Strangers. For not only in the groves of academe but also in the society at large, loud polar extremes threaten to crowd us out of the pragmatic middle. We are, it seems, out-shouted by armies that march in the night, that scream their *sig heils* in mass rallies or churn out alternative facts on the *bendida* Internet. I have chosen to frame the discussion with the age-old debate about human nature, and whether it is all that natural.

The debate over who we are by nature harkens back to antiquity, where it was most commonly subsumed under the question of whether our behavior was the product of nature (*physis*), or of convention (*nomos)*. This distinction was considered central in all three traditional branches of Classical philosophy – physics (incl. cosmology and biology), epistemology (logic, language, mind) and ethics (morality, law, politics). Thus, for example, the minor Greek philosopher

Diogenes of Sinope (the Cynic) is reported to have placed the distinction between nature and convention at the heart of his discussion of human conduct:

> "…fortune he would contrast with courage, *nature* with *convention*, passion with reason…" (Diogenes Laertius, vol. II, *Diogenes*, p. 39–40; italics added)

I will begin by tracing the discussion through the meandering Biblical, Classical, Medieval and Enlightenment sources. I will then show how the post-Darwinian evolutionary perspective re-configured the old dichotomy in more contemporary terms.

9.2 Judaic antiquity

The Hebrew Biblical tradition seems to have taken it for granted, without much reflection, that humans were by nature evil, and thus required the strong hand of a judgemental, vindictive God to keep them on the moral straight and narrow. This is implicit first in the story of the *Original Sin* and the subsequent *Fall*:[1]

> "…And to Adam he said: "Because you listened to your wife and ate from the tree that I ordered you not to eat from, the earth will be cursed for you, in sadness you will eat from it all the days of your life, it will grow thistles and thorns and you will eat the grasses of the field; by the sweat of your brow you shall eat your bread till you go back to the earth from which you were taken, for you are dust and shall go back to dust"…" (Gen. 3:17–19)
>
> "…And Jehovah saw that man's thoughts were bad all over the earth, and the impulse of his heart was bad every day, and Jehovah regretted making man on earth, and His heart was saddened; and Jehovah said: "Let me wipe the man I have made off the face of the earth"…" (Gen. 6:5–7)

The Biblical Jehovah's solution for how to deal with His wayward creation was to counter their natural sinfulness (*physis*) with God's legislative fiat (*nomos*) – the Ten Commandments, which He prefaced with the assertion of His ultimate, capricious divine power:

1. While the original sin is usually pegged at eating the forbidden fruit, the murder of Abel by Cain comes in a close second.

> "…I am Jehovah your God who brought you out of the land of Egypt, from the slave quarters; you shall have no other god but me…" (Exodus 20:2–4)

The Divine injunctions of the Ten Commandments applied, naturally, to the way one treated members of one's *in-group*. Outsiders – the proverbial Others – remained fair game, with God's explicit dispensation, licensing the children of Israel to practice brutal, exterminatory racism:

> "…and God shall give them to you, and you shall beat them and destroy them, and you shall not make peace with them or pity them; you shall not give your daughters to their sons nor your sons to their daughters…" (Deut. 7:2–3)

> "…and they wiped out everybody in the city, from man to woman, from young to old and oxen and donkeys all put to the sword… and Joshua swore to Jehovah: Cursed be he who ever rises to re-build Jericho…" (Josh. 6:21–26)

The Old Testament's mid-section, from *Joshua* through *Judges, Samuel* and *Kings*, is replete with similar invectives.

9.3 Christian antiquity

One would expect the Prince of Peace to have mellowed down the harsh, sin-oriented tribal code of the Old Testament, as some Gospel passages seem to suggest:

> "…You have heard that it was said, 'You shall love your neighbor and hate your enemy'. But I say to you, love your enemies, do good to those who hate you, bless those who curse you, and pray for those who spitefully use you and persecute you…" (Matt. 5:43–44)

By the Gospel of John, however, we are back to the exclusionary reward-and-punishment ethos of the Old Testament. Thus:

> "…That whoever believes in Him shall not perish but have eternal life… but he who does not believe in Him is condemned already, because he has not believed in the name of the only begotten Son of God…" (John 3:16–17)

Later Church Fathers were clearly bothered by the inherent contradiction – how a benevolent, omnipotent God could allow evil into His world. Thus, **St. Augustine** goes into considerable contortions, first asserting man's inherent natural goodness:

> "…Evil is contrary to nature, in fact it can only do harm to nature; and it would not be a fault to withdraw from God were it not that it is more natural to adhere to him…" (*City of God*, XI.17, p. 448)

Considerable sophistry is called for to explain how natural good has somehow begotten unnatural evil:

> "…Thus the evil act, the transgression of eating the forbidden fruit, was committed only when those who did it were already evil; that bad fruit could only have come from a bad tree. Further, the badness of the tree came about *contrary to nature*, because without the fault in the will, which is against nature, it certainly could not have happened…" (*ibid*., XIV.13, p. 572; italics added)

The chain of argument eventually lead to the parable of the *Two Cities*, one Godly, the other earthly, a contrast that harkens back to Augustine's early entanglement with *Manichean* dualism:

> "…We see then that two cities were created by two kinds of love: the earthly city was created by self-love reaching the point of contempt to God, the Heavenly City by the love of God carried as far as contempt of self…" (*ibid*., XIV.28, p. 593)

The other giant of Catholic Theology, **St. Thomas Aquinas**, is more explicit about the role of the original sin as source of all human corruptibility:

> "…According to the Catholic Faith we are bound to hold that the first sin of the first man is transmitted to his descendants, by way of origin. For this reason children are taken to be baptized soon after their birth, to show that they have to be washed from some uncleanness…" (*Summa Theologica*, Pt. I, *Treatise of Law*, q. 81 "Of the cause of sin on the part of man")

9.4 Greek antiquity

9.4.1 Epicure (404–323 BC)

The Classical philosophers labored mightily, if not always successfully, to apply the contrast between nature (*physis*) and artifice (*nomos*) even-handedly across their physics, epistemology and ethics. Of the lot, Epicure was by far the most consistent in advocating a non-creationist physics and an empiricist epistemology:

> "…To begin with, nothing comes into being out of what is non-existent. For in that case anything would have arisen out of anything, standing as it would in no need of its proper source… The whole of being consists of bodies and space. For the existence of bodies is everywhere attested by sense itself, and it is upon sensation that reason must rely when it attempts to infer the known from the unknown. And if that which disappeared had been destroyed and become non-existent, everything would have perished, that into which the things were dissolved being non-existent…" (Diogenes Laertius vol. II. X: *Epicurus*, p. 569)

In extending his view of naturalness to language, Epicure argued for an iconic relation between the *meaning* of words and their *sounds*:

> "…Hence even the names of things were not originally due to convention [*ex arkhes* = *nomos*], but to the nature [*physis*] of the men of each tribe [, who,] under the impulse of specific feelings or specific sensory perceptions[,] uttered specific cries. The air thus emitted was moulded by their individual feelings or sensory perceptions, and differently according to the specific regions which the tribes inhabited…" (*ibid*., p. 605; bracketed material added)

Epicure's naturalist perspective was then extended to a *pleasure-based* ethics:

> "…we call pleasure the alpha and omega of a blessed life. Pleasure is our first and kindred good. It is the starting point of every choice and of every aversion, and to it we come back, inasmuch as we make feeling the rule by which to judge every good thing. And since pleasure is our first and native good…" (*ibid*., p. 655)

9.4.2 Aristotle (384–322 BC)

In contrast with Epicure, Aristotle, a fellow empiricist, was a *creationist* in the traditional Greek mold. This counter-naturalist perspective on cosmology was extended to language, in a celebrated passage that also recapitulates Epicure's empiricism:

> "…Now spoken sounds [=words] are symbols of affections of the soul [=thoughts], and written marks are symbols of spoken sounds. And just as written marks are not the same for all men [=are language specific], neither are spoken sounds. But what these are in the first place signs of – affections of the soul – are the same for all men [=are universal]; and what these affections are likenesses of – actual things – are also the same for all men…" (*De Interpretatione*; in J. Barnes, ed. 1984, p. 25; bracketed material added)

As for morality, Aristotle turned out to be a confirmed hedger, first laying out the basic question as:

> "…Now some think that we are made good by *nature*, others by *habituation*, others by *teaching*. Nature's part evidently does not depend on us, but as a result of some *divine cause* is present in those who are truly fortunate; but argument and teaching, we may suspect, are not powerful with all men…" (*Nicomachean Ethics*; in Barnes, ed. 1984, p. 1864)

He then seems to follow Epicure in asserting that what is natural in human conduct is the striving for *pleasure* and *happiness*. However, only in persons with 'superior refinement' or 'active disposition' does this natural bent transform into ethical values, such as *honor*:

> "…most men, and men of the most vulgar type, seem (not without some reason) to identify the good, or happiness, with pleasure; which is the reason why they love the life of enjoyment… But people of superior refinement and active disposition identify happiness with honour; for this is, roughly speaking, the end of political life…" (*ibid*., p. 1731)

Morality then seems to be anchored in people's *natural sociality*:

> "…now by self-sufficient we do not mean that which is sufficient for a man by himself, for one who lives a solitary life, but also for parents, children, wife, and in general his friends and fellow citizens, since man is sociable by nature…" (*ibid*., p. 1734)

In anticipating Christ then, Aristotle asserts that morality is a matter of how we treat others:

> "…Now the worst man is he who exercises his wickedness towards himself and towards his friends, and the best man is not he who exercises his excellence toward himself but he who exercises it towards another…" (*ibid*., p. 1783)

But moral excellence is still *not* a product of nature (*physis*), being rather acquired through habit, (*nomos*). Then, in a near-contortionist hedge, Aristotle concludes that habits cannot be formed contrary to nature, effectively abolishing the distinction between nature and convention:

> "…Excellence, then, being of two kinds, intellectual and moral; intellectual excellence in the main owes both its birth and its growth to teaching…while moral excellence comes about as a result of habit. From this it is also plain that none of the moral excellences arise in us by nature; for nothing that exists by nature can form a habit contrary to nature…" (*ibid*., p. 1742)

Lastly, in a final hedge in the *Politics*, Aristotle concludes that political organization is natural because it follows from our *natural sociality*:

> "…When several villages are united in a single complete community… the state comes into existence, originating in the bare needs of life… And therefore, if the earlier forms of society were natural, so is the state…Hence it is evident that the state is a creation of nature, and that man is by nature a political animal…" (Aristotle, *Politics*, Barnes, ed. 1984, p. 1987)

9.4.3 **Plato (427–347 BC)**

Plato, the most conspicuous Greek exponent of philosophical *rationalism*, held that our knowledge of the external word is determined by *innate ideas*, already in our mind prior to experience. However, those innate ideas are due to our *experience* in *previous lives*, a shocking concession to *empiricism*. Here is how Socrates explains the logic of this doctrine in *Meno*:

> "…Thus the soul, since it is immortal and has been born many times, and has seen all things both here and in the other world, has learned everything that is. So we need not be surprised if it can recall the

> knowledge by virtue of everything else which, as we can see, it once possessed…" (*The Collected Dialogues of Plato*, E. Hamilton & H. Cairns, eds 1961; *Meno*, p. 364)

It may well be that Plato's espousal of the naturalness of the sound-meaning correspondence in words reflects his position on innateness – provided one could decide whose voice speaks for the real Plato. Thus, in *Cratylus*, Hermogenes first cites Cratylus as tending toward Epicures naturalist position:

> "…I should explain to you, Socrates, that our friend Cratylus has been arguing about names. He says that they are natural and not conventional – not a portion of the human voice which men agree to use – but that there is a truth or correctness in them, which is the same for Helens as for Barbarians…" (*ibid*., *Cratylus*, p. 383)

Hermogenes then confesses that he himself tends toward Aristotle's arbitrariness position:

> "…I have often talked over this matter, both with Cratylus and others, and cannot convince myself that there is any principle of correctness in names[,] other than convention and agreement…" (*ibid*., *Cratylus*, p. 383)

Then Socrates opts for Cratylus' Epicurean-naturalist position:

> "…And Cratylus is right in saying that things have names by nature, and that not every man is an artificer of names, but he only looks to the name which each thing by nature has, and is able to express the true forms [*eida*] of things in letters and syllables…" (*ibid*., *Cratylus*, p. 429)

Whereby Socrates proceeds to buttress his argument with some of the most hilarious fake etymologies of complex Greek words.[2]

Plato's ambiguity, much like Aristotle's, persists in the discussion of human morality. Thus, in the *Republic*, Socrates seems to argue for the naturalness of 'just' (*dikos*), suggesting that whoever applies 'just' only to cases of harming

2. Socrates' etymological slights of hand in the *Cratylus* dialogue inspired several generations of Neo-Platonic Hellenic grammarians in Alexandria to develop a more realistic account of the morphologically-complex Greek verbal paradigms (Itkonen 2010).

a friend but not to harming an enemy is wrong, violating the universality of ethics and justice:

> "…If, then, anyone affirms that it is just to render each his due, and he means by this that injury and harm is what is due to his enemies from the just man and benefits to his friends, he was no truly wise man who said it. For what he meant was not true. For it has been made clear to us that in no case is it just to harm anyone…" (*ibid.*, *Republic* I, p. 585)

In the *Laws*, however, Clinias argues for the arbitrariness of morality and a nigh-Hobbesean naturalness of war:

> "…Humanity is in a condition of public war of every man against every man, and private war of each man with himself…" (*ibid.*, *Laws* I, p. 1228)

Still, further on in the *Laws*, Athenian seems to argue for Epicure's *natural morality*:

> "…There is nothing, then, of all a man owns so natively alive as the soul to shun evil but follow on the trail of the chief good…" (*ibid.*, *Laws* V, p. 1315)

But the very same Athenian then switches position, arguing that only selfishness it truly natural:

> "…But of all the faults of the soul the gravest is one which is inborn in most men, one which all excuse themselves and none therefore attempts to avoid – that is conveyed in the maxim that 'everyone is naturally his own friend', and that it is only right and proper that he should be so, whereas, in truth, this same violent attachment to self is the constant source of all manner of misdeed in every one of us…" (*ibid.*, *Laws* V, p. 1318)

Lastly, Plato, speaking via Socrates and anticipating Aristotle, also espoused the Golden Rule:

> "…May I do onto others as I would that they should do onto me…" (*ibid.*, *Laws*, p. 1225)

9.5 The Enlightenment

9.5.1 The chain of transmission

The complex chain of transmission via which the Classical discussion of physics, epistemology and ethics threaded its way through Rome and its Hellenistic periphery is of some interest. First, the Homeric heroic tradition was extended in Rome through the works of Virgil, Ovid and Horace. Platonic thinking found a safe haven in Ptolemaic Alexandria (Itkonen 2010), where it soon blended into the works of the early Church fathers, such as St. Augustine. The Stoic school of philosophy flourished in the works of Seneca and Cicero. And Aristotle's work was preserved by Arab scholars in North Africa and Spain, eventually to be-rediscovered and translated into Latin by St. Thomas Aquinas, soon making the empiricism of *The Philosopher* a near-official Church doctrine.[3]

Most significant perhaps was the transmission of Epicure's naturalistic philosophy through *Titus Lucretius Caro* (99–55 BC), in his monumental poetic work The Nature of Things (*De Rerum Naturae*). The Church's position throughout this complex process remained ambiguous. The systematic burning of 'pagan' scrolls after the Council of Nicea (AD 325) resulted in a mass destruction of the Classical canon. At the same time, intellectually-curious monks copied banned manuscripts and preserved them in the nooks and crannies of monastic libraries.

The re-emergence of the Classical canon out of monastic libraries in late Medieval Europe stimulated the Renaissance literary works of Petrarca, Boccacio and Dante. Most influential, perhaps, was the re-discovery of Lucretius' *De Rerum Naturae* in an Austrian monastic library in 1528, a discovery that presaged the flowering of both science and humanism in the Renaissance and, subsequently, the Enlightenment (Greenblatt 2011). Most germane to our discussion here is the re-discovery of Epicurean naturalism via Lucretius. This, in turn, led to resurgent interest in human nature, natural morality, and the human propensity for war. In the following sections we survey how the old argument about natural vs. conventional morality fared in the Enlightenment.

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3. See Bourke (ed. 1960), pp. 194–211.

9.5.2 Thomas Hobbes (1588–1679)

Echoes of Epicure's naturalism ring loud and clear in Hobbes' sweeping introduction to *Leviathan* (1651), even as God is affirmed as the author of created nature:

> "…Nature (the art whereby God has made and governed the world) is by the art of man, as in many other things, so in this also imitated, that it can make an artificial animal. For seeing life is but a motion of limbs, the beginning whereof is in some principal part within, why may we not say that all automata (engines that move themselves by springs and wheels as doth a watch) have an artificial life? For what is the heart but a spring?; and the nerves but so many strings; and the joints, but so many wheels, giving motion to the whole body, such as was intended by the Artificer? Art goes yet further, imitating that most rational and excellent work of Nature, man. For by art is created that great Leviathan called Commonwealth, or State (in Latin Civitas), which is but an artificial man, though of greater stature and strength than the natural, for whose protection and defence it was intended…" (*Leviathan*, p. 9)

Hobbes then sways toward Aristotle's view of human morality as an artifice:

> "…So that in the nature of man, we find three principal causes of quarrel. First, competition; secondly, diffidence; thirdly, glory…Hereby it is manifest that during the time men lived without a common power to keep them all in awe, they are in that condition which is called war; and such a war as is of every man against every man…" (*Leviathan*, p. 65)

And likewise:

> "…That the condition of mere nature, that is to say, of absolute liberty, such as is theirs that neither are sovereigns nor subjects, is anarchy and the condition of war…" (ibid., p. 173)

9.5.3 J.-J. Rousseau (1712–1778)

In the most primitive natural state of humanity, still somewhat above the state of 'brutes', Rousseau purported to detect the **Noble Savage** with his presumed natural morality:

> "…nothing is so gentle as man in his primitive state, when placed by nature at an equal distance from the stupidity of brutes and the fatal enlightenment of civil man…" (Rousseau 1754, p. 64)

Rousseau's description of our descent from that ideal primitive state is an eery echo of the biblical Fall:

> "…Hence although men had become less forebearing, and although natural pity had already undergone some alteration, this period of the development of human faculties, maintaining a middle position between the indolence of our primitive state and the petulant activity of our egocentrism, must have been the happiest and most durable epoch. The more one reflects on it, the more one finds that this state was the least subject to upheavals and the best for man, and that he must have left it only by virtue of some fatal chance happening that, for the common good, ought never to have happened. The example of savages, almost all of whom have been found in this state, seems to confirm that the human race had been made to remain in it always; that this state is the veritable youth of the world; and that all the subsequent progress has been in appearance so many steps toward the perfection of the individual, and in fact toward the decay of the species…" (*ibid*., p. 65)

Like many of his Enlightenment contemporaries, Rousseau indulged liberally in speculative evolutionist descriptions of the rise of human society, first the 'noble savage' and his nuclear family, then primitive tribes – the *Society of Intimates*, then onward to more complex city-states and the *Society of Strangers*:

> "…The most ancient of all societies and the only natural one is that of the family. Even so children remain bound to the father only as long as they need him for their preservation. As soon as that need ceases, the natural bond dissolves… This common freedom is a consequence of man's nature. His first law is to attend to his own preservation, his first cares are those he owes himself… The family is, then, if you will, the first model of political societies; the chief is the image of the father, the people are the image of the children, and all, being born equal and free, alienate their freedom only for the sake of their utility…" (Rousseau 1762, *The Social Contract*, p. 42)

While arguing against Hobbes, Rousseau cannot help but concede the inherent conflict between selfishness and sociality:

> "…This sum of forces can only arise from the *cooperation* of many; but since each man's force and freedom are his primary instrument of *self-preservation*, how can he commit them without harming himself, and without neglecting the care he owes himself?…" (*ibid*., p. 49; italics added)

His description of the evolutionary transition from the State of Nature to the ever-expanding civic state involves the ceding of natural instinctives in exchange for social benefits accruing from the *Leviathan* – Hobbes' artificial, controlling, potentially-oppressive state; hence the **Social Contract**:

> "…This transition from the state of nature to the civil state produces a most remarkable change in man by substituting justice for instinct in his conduct, and endowing his actions with the morality they previously lacked… Although in this state he deprives himself of several advantages he has from nature he gains such great advantages in return, his faculties are exercised and developed, his ideas enlarged, his sentiments ennobled, his entire soul is elevated…" (*ibid*., p. 53)

Still, Rouseau remains ambiguous about the transition from the natural Society of Intimates to the rule-bound Society of Strangers. Thus, in a veritable Jeremiad that echoes the biblical Fall:

> "…Thus the whole face of the earth is changed; everywhere nature has disappeared; everywhere human art has taken its place; independence and natural liberty have given way to laws and; there is no free being any more…" (*ibid*., pp. 167–168)

9.5.4 Adam Smith (1723–1790)

In Adam Smith's work we find the most explicit reflection of the split in the Classical view of human morality. His first book, *The Theory of Moral Sentiment* (1759), is a magnificent elaboration on Epicure's *natural empathy*. Somewhat less emphatically in *The Wealth of Nations* (1776), Smith tilts toward Aristotle's *natural selfishness*. We will survey the two in order.

a. The Theory of Moral Sentiment (1759)

In a most prescient way, Smith anticipated the recent discussion in evolutionary psychology about the role of *natural empathy* and *Theory of Mind* – indeed theory of *other minds* – in the evolution of human sociality. He links inter-personal ethics to our natural ability to place ourselves inside the head of our fellow humans. This natural propensity is founded on a simple calculus of **likeness** – because you are like me, your mental processes must be like mine:

> "…Every faculty in one man is the measure by which he judges of the like faculty in another. I judge of your sight by my sight, of your ear by my ear, of your reason by my reason, of your resentment by my resentment, of your love by my love. I neither have, nor can have, any other way of judging about them…" (Smith 1759, p. 11)

From this, an easy step takes us to *empathy*:

> "…In all such cases…[of seeing a person suffering an injury]…the spectator must, first of all, endeavour, as much as he can, to put himself in the situation of the other, and to bring home to himself every little circumstance of distress which could possibly occur to the sufferer. He must adopt the whole case of his companion with all its minute incidents; and strive to render [,] as perfect as possible, that imaginary… situation upon which his sympathy is founded…" [*ibid*., p. 13]

Smith then recapitulates what we have known throughout our 8-million-odd tenure as a social species – that we vest our sympathy more readily in members of our *in-group* than in outsiders:

> "…We expect less sympathy from a common acquaintance than from a friend…We expect still less sympathy from an assembly of strangers…" (*ibid*., p. 15)

And likewise:

> "…It is thus that man, who can subsist only in society, was fitted by Nature to that situation for which it was made. All the members of human society stand in need of each others assistance…All the different members are bound together by the agreeable bands of love and affection…" (*ibid*., p. 72)

b. The Wealth of Nations (1776)

Adam Smith's better known book, *The Wealth of Nations*, seems to have been given an undeserving bad rap as presumably inspired by Hobbes bleak view of human nature, perhaps also by Malthus' study of over-population and the ensuing cut-throat competition. In fact, the book is mostly a sober technocratic study of the workings of markets, pricing, and industrial production. It is a veritable paean to the efficiency of the division of labor and the regulatory power of free-trading markets. Only peripherally does Smith allude to the *natural selfishness* that undergirds free markets:

> "…It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity, but to their self-love, and never talk to them of our own necessities but of their advantages. Nobody but a beggar chuses to depend chiefly upon the benevolence of his fellow-citizens…" (Smith 1776, p. 26–27)

9.5.5 Charles Darwin (1809–1882)

Like Adam Smith, Darwin distributed the two Classical perspectives on human nature and morality in two separate books.

a. The Origin of Species (1859)

The gist of Darwin's view of natural selection, the mechanism that drives the production of variant biological types and their gradual evolution, is the competition for survival between individuals or groups that occupy the same adaptive niche. Although the framework seems Malthusian, the book makes no explicit reference to population explosions. Thus:

> "…all organic species are exposed to severe competition…" (Darwin 1859, p. 489)

And:

> "…The struggle for existence inevitably follows from the high geometrical ratio of increase which is common to all organic beings… More individuals are born than can possible survive… As the individuals of the same species come into the closest competition with each other, the struggle will be most severe between them; it will be almost as severe between varieties of the same species, and next in severity between the species of the same genus…" (*ibid.*, p. 746)

While not dealing explicitly with human morality, the evolutionary perspective that emerges out of *The Origin of Species* is clearly Hobbesean and Malthusian – selfish, competitive, individual motivation is the primary driver of natural selection.

b. The Descent of Man (1871)

In sharp contrast to *The Origin of Species, The Descent of Man* is suffused with Epicurean *natural morality* and *inherent sociality*, not only of humans but of all social species:

> "…The feeling of pleasure from society is probably an extension of the parental of filial affections; and this extension may be in chief part attributed to natural selection… For with those animals which were benefitted by living in close association, the individuals which took the greatest pleasure in society would best escape various dangers…" (*ibid*., p. 823)

In this context, Darwin cites Adam Smith's idea of *natural empathy* as the driving force of human sociality:

> "…Adam Smith formerly argued…that the basis for sympathy lies in our strong retentiveness of states of pain and pleasure. Hence, "the sight of another person enduring hunger, cold, fatigue, revives in us some recollection of these states, which are painful even in idea". We are thus impelled to relieve the sufferings of another, in order that our own painful feelings may be at the same time relieved. In like manner we are led to participate in the pleasures of others…" (*ibid*., p. 823)

And again:

> "…Now with those animals which live permanently in a body, the social instincts are ever present and persistent. Such animals are always ready to utter the danger-signal, to defend the community, and to give aid to their fellows in accordance with their habits; they feel at all times, without the stimulus of passion and desire, some degree of love and sympathy for them; they are unhappy if long separated from them, and always happy to be in their company. So it is with ourselves. A man who possesses no trace of such feelings would be an unnatural monster…" (*ibid*., p. 828)

9.6 The post-Darwinian synthesis

9.6.1 Overview

On the threshold of the scientific study of biological evolution, we were left with a more nuanced view of human nature and morality – and thus to the potential naturalness of war. Two profound thinkers, Adam Smith and Charles Darwin, refused to treat the topic in a reductionist either-or manner. They thus opened the door to a more complex view of human morality and sociality, whereby humans are endowed naturally with *both* selfish and social motivations, which may – and often do – come into conflict. To understand the resolution of such moral conflicts, one needs to consider the contextual factors that may tip human behavior one way or the other.

In the more recent empirical study of human behavior, four brand new scientific fields – primatology, evolutionary psychology, evolutionary anthropology an d cognitive neuroscience – emerged in the latter part of the 20th Century, in one way or another elaborating on Smith's and Darwin's insights on the naturalness of empathy and sociality. Echoes of the Classical discussion are still discernible, but we can now flesh out the traditional dichotomy of nature (*physis*) vs. artifice (*nomos*) with a more explicit empirical perspective. In the process, a number of suggestive equivalencies – though by no means full identities – are worth considering:

a. classical term	**b. mode of transmission**	**c. mode of mental processing**	**d. scope**
nature	genetic encoding	instinct, habit, subconscious	human-universal
artifice	learning, growth, culture, language	attended, conscious, rational	culture-specific

Will discuss these in order.

a. **The classical terms**
   The contrast between nature (*physis*) and artifice (*nomos*) has been rendered in some modern discussions as *nature vs. nurture*. Nurture, however, implies external input, and may thus tilt the contrast towards the Classical epistemological clash between Platonic rationalism and Aristotelian empiricism, not our focus here.

b. **Mode of transmission**
The two terms of the Classical contrast are correlated here with their respective modes of transmission. The Classical 'nature' is present at birth, is the product of evolution, and is encoded in and transmitted by genes. The classical 'artifice' is acquired during post-natal growth, maturation and learning, with culture and communication being, potentially, the instruments of transmission from mature adults to the immature young.

c. **Mode of mental processing**
We have discussed the contrast between attended and automated processing in considerable detail in Chapters 3, 4, 5, above. To recapitulate briefly, the genetically-endowed capacities of complex organisms are rooted in lower-brain and mid-brain structures that tend to be fully mature at birth and are fully automated and subconscious. Many of the more recently evolved cortical capacities take long to mature and may remain dependent on attended, conscious processing. This is especially true of mental capacities that are acquired post-natally through maturation and learning. To the extent that moral sentiment is natural, it must be then a habituated, automated, emotional response.

d. **Scope**
What is natural and genetically encoded-and-transmitted is presumably human universal. While at least some of what is acquired by learning and practice can vary across both individuals and groups, and may thus reveal cross-cultural diversity.

9.6.2 Selfishness, altruism and natural selection

The more recent argument about the evolution of human morality eventually focused on the nature of natural selection. An influential line of investigation, suggested initially by Hamilton (1964) and further elaborated by Trivers (1971); West-Eberhard (1975); Burt and Trivers (2006) and others, held that sociality and altruism can be predicted from – thus reduced to – selfish **individual selection**. That is, natural selection operates strictly at the level of competing individuals. Sociality, cooperation, empathy and altruism could then be derived by mechanisms that favor one's genetic kin – **kin altruism**, whereby an individual's genes still survive if they favored and cooperated with their close kin. This mechanism was further extended to **reciprocal altruism**, whereby one reciprocates with one's social intimates – even when they are not close kin.

A more complex line of argument suggests that natural selection may operate at *two* levels, individual selection and **group selection**, and that the two are deployed selectively in different adaptive contexts. This idea was first pursued by D. S. Wilson (1975, 1977, 1980, 1997) and later adopted by E. O. Wilson (2012). An extensive overview of the subject may be found in Okasha (2006). Translated into the vocabulary of the Classical and Smith-Darwin discussion, *both* selfishness and empathy/sociality are natural. Or, in modern terms, both are adaptively evolved and genetically encoded.

9.6.3 Empathy and cooperation in primates and children

Probably the most convincing line of research about the naturalness – thus evolutionary and genetic basis – of human morality comes from the comparative study of primates and human neonates. In a long line of research in primatology and evolutionary anthropology, our closest great-ape relatives – chimpanzees, bonobos and other primates – have been shown to be naturally *both* aggressive and warlike, on the one hand, and empathic and cooperative on the other (de Waal 1982, 1989, 2013; Cheney and Seyfarth 2007). Studies by de Waal (2013) further suggest that chimpanzees also have an innate natural sense of fairness and equity in the allocation of rewards.

A second line of investigation concerns the other-directed behavior of young children, long before they have been socialized to explicit adult moral norms. Such studies have shown that children are spontaneously – naturally – disposed towards cooperation, empathy, and fairness; and that they have a rudimentary *empathic understanding* of the mind of their human interlocutors – both adults and other children (Tomasello 2009). And further, young children also seem to insist on enforcing social norms such as equity and fairness (Schmidt and Tomasello 2012). And further, such a tilt toward empathy and cooperation may have neurological correlates in the human brain (Tucker *et al.* 2005).

Tomasello and his colleagues interpret their results as suggesting a two-step evolution of human cooperation, as well as a sharper break with the pre-human primate pattern:

> "…Modern theories of the evolution of human cooperation focus mainly on altruism. In contrast, we propose that human species-unique forms of cooperation – as well as their species-unique forms of cognition, communication and social life – all derive from mutualistic collaboration (with social selection against cheaters). In the first step, humans became obligate cooperative foragers such that individuals were interdependent with one another and so had a direct interest in the well-being of their partners. In this context, they evolved new skills

for collaboration not possessed by other great apes (joint intentionality), and they helped their potential partners (and avoided cheaters). In the second step, these new collaborative skills and motivations were scaled up to group life in general, as modern humans faced competition from other groups…" (Tomasello *et al.* 2013)

In a subsequent study, Tomasello and Vaish (2013) explicitly equate morality with cooperation, suggesting a two-step development in both evolution and ontogeny, this one reminiscent Aristotle's two-way division between *natural* and *socially-constructed* morality. According to this framework, the first step in the development of morality is cooperation with only close intimates. This is later expanded to cooperation within a larger, less-intimate group via enforced group social norms. Not surprisingly, Tomasello's work recapitulates the *leitmotif* that ran through the entire Classical discussion and was reinforced by modern cultural anthropology (Chapter 4). Empathy and cooperation, and their converse, aggression and war, are apportioned differently in the two most relevant social contexts: the intimate in-group and the non-intimate out-group.

9.6.4 The gender dimension

One may as well note that the innate – natural, evolved – human propensities for cooperation and aggression are not gender-neutral. Rather, males are consistently more competitive, aggressive and warlike, while females are consistently more cooperative and empathic. In this connection, Potts and Hayden (2008) write:

> "…The evolutionary perspective we take here highlights the fact that aggression is predominantly an activity of young males… women have never shared men's propensity to band together spontaneously and sally forth to viciously attack their neighbors… one way to reduce the risk of violence is to empower women and maximize their role in society…" (2008, pp. 13–14)

This *behavioral di-morphism* has been documented in both pre-human primates (de Waal 1982, 1989; Cheney and Seyfarth 2007; Wrangham and Peterson 1996) and humans (Hrdy 1999, 2009; Potts and Hayden 2008; Marlowe 2010).

9.7 Cooperation, morality and the in-out boundary

As noted in Chapter 4, the cultural ecology of social primates is remarkably similar to that of hunting-and-gathering hominids and humans prior to the advent of agriculture. We have characterized this social adaptation as *The Society of Intimates*, whose salient features are:

- small social group size
- kin-based organization of social cooperation
- restricted territorial range
- genetic homogeneity
- cultural homogeneity
- consensual leadership
- non-hierarchic social organization
- informational stability and homogeneity
- in-group cooperation vs. out-group aggression

To distinguish between in-group and out-group members, human societies use well-established external determinants, in particular external appearance and language. As elsewhere in human cognition or science, we infer the invisible from the visible. In all fundamental ways, the calculus of cooperation vs. competition hasn't changed much over the 8-million years of hominid and human evolution, nor over the 10,000-year history of larger-scale Societies of Strangers (Gat 1999, 2006; Otterbein 2004; Potts and Hayden 2006; Smirnov *et al.* 2007). We are still more inclined to cooperate with people who look like us, think like us, live like us and speak our language.

9.8 Human nature and social coherence

One conclusion that one may wish to draw from this survey is methodological: Complex systems are not amenable to reductionist, either-or interpretations. Most often than not, they rise, thrive and sometimes crash through interaction between competing but complementary adaptive principles. The eternal seesaw in American political history between the individual's freedom, autonomy and selfishness that undergird *capitalism* and the cooperative, empathic ethos of *communalism* is a case in point. In complex systems, diverse principles are not in zero-sum competition but rather interact in a hybrid multi-variant system. The **coherence** of complex systems, be they biological or social, is more often than not founded on an *adaptive compromise*, tending towards the Aristotelian middle. Above all, the coherence of complex biologically-based systems seldom entails total uniformity. Rather, it rises and falls on **negotiated diversity**.

From such an adaptive perspective, our current polarization of race, class, gender, religion, and political proclivities arises out of a misunderstanding of what complex multi-variant systems are all about. Consider, for example, how a recent account our current predicament winds up invoking, again, the Classical dichotomy of human nature (Leonard 2017):

> "…For me, it took a 2015 pre-caucus stop by J. C. Watts, a Baptist minister raised in the small town of Eufaula, Okla., who was a Republican congressman from 1995 to 2003, to begin to understand my neighbors – and most likely other rural Americans as well. "The difference between Republicans and Democrats is that Republicans believe people are fundamentally bad, while Democrats see people as fundamentally good," said Mr. Watts, who was in the area to campaign for Senator Rand Paul. "We are born bad," he said and added that children did not need to be taught to behave badly – they are born knowing how to do that. "We teach them how to be good", he said. "We become good by being reborn – born again"…"

The wages of reductionism are more often than not paralysis, as a system, shorn of its evolutionary wisdom, ceases to see competing adaptive motivations as complementary. Thus, in a reflection on the legislative consequences of partisan polarization (Samuelson 2017):

> "…Our government has turned into a quasi-parliamentary system. Controversial programs are supported and opposed mainly, or exclusively, by one party or the other. This is a bad development. It strengthens fringes in both parties, who hold veto power. This discourages compromise and encourages stalemate. The legislation it produces is often acceptable to partisans but less so to the wider middle class, undermining public faith in government…"

Invoked or un-invoked, human nature keeps logging mileage, forever torn between the *scilla* of individual selection and the *charybdis* of group selection, as the system lurches slowly into maladaptive paralysis.

9.9 Closure

The original framing of our question – are we a warlike species? – prejudged the complex, interactive nature of both human society and the human brain. Like other social species, we evolved through protracted interaction of two competing modes of natural selection. Individual selection promoted selfishness and competition within the social unit. Group selection favored empathy and cooperation within the group and aggression toward outsiders. As members of a social species, we are by nature *both* peaceful and warlike, depending on the adaptive context.

The only mechanism by which we may negotiate – peacefully rather than violently – this evolved dual pattern is by recognizing that culture can on occasion mitigated some of the more unpleasant biologically-ingrained traits of human nature. Or, as Potts and Hayden (2008) have noted:

> "…Culture evolves more rapidly than biology does, however, which lends hope to the challenge before us: to understand and rein in our Stone Age behaviors…" (2008, p. 15)

We are, by all accounts, far removed from the Classical ideal of rational perfection, and this state of far-from-grace may be natural, universal and unavoidable.[4] So that perhaps, in our endearing rational belief in – and irrational craving for – the perfectability of human nature, we may wish to consider a wise caution:

> Ring the bells that still can ring
> Forget your perfect offering
> There is a crack in everything
> That's how the light gets in.
>
> L. Cohen, *Anthem*

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4. Starry-eyed, quasi-normative accounts such as J. Q. Wilson's (1993); Gazzaniga's (2005) or Pinker's (2011) notwithstanding.

CHAPTER 10

Coherence and the bounds of diversity

10.1 Preface

I will begin this chapter by recapitulating the central role that diversity, whether of genotype or phenotype, plays in the evolution of biological organisms. In this relatively well-understood context, the internal diversity of populations is counter-balanced by its converse, homogeneity. In seesawing between the two, biological populations maintain the dynamic balance between their capacity for **adaptive change** and their requisite **internal coherence**.

In their balancing act between internal diversity and homogeneity, cultures closely resemble biological populations. Diversity is their guarantor for adaptive dynamism in the face of new environmental challenges. Homogeneity provides for their social cohesion, the *sine qua non* of trust and cooperation in a consensual society. This is, in a nutshell, the story of small-scale societies of intimates, the implicit social compact that prevailed from the dawn of our primate ancestors throughout the subsequent 8 million years of hominoid and human evolution.

With the rise, beginning ca. 8,000 BC, of agriculture, sedentary living, private property and cumulated durable wealth, the old social order was gradually transformed – first in the fertile river valleys of Mesopotamia, Egypt, India and China – into large-scale societies of strangers. Such societies are characterized by increased hierarchic organization, social stratification and inequality, internal cultural and linguistic diversity and coercive governance. During the past 10,000 years of human history, only brief periods of meaningful consensual governance have been recorded.

10.2 Diversity and invariance in evolutionary biology

10.2.1 The Darwinian model

Internal diversity of biological population is one of the three main factors that, in a complex interaction, account for adaptation and evolutionary change (Chapter 2). The three are:

- variation
- invariance
- selection

In Darwin's (1859) original formulation, members of a biological population ('species') exhibit a certain range of internal variation in adaptive traits; that is, traits relevant to their ability to survive and thrive in diverse habitats. Each habitat – environment – favors the survival of variants that are better adapted to it, culling out those that are less adapted. The environment thus acts as the agent of selection. Having been selected, successful variants pass their durable, genetically-coded adaptive traits – their invariance – to their descendants.

Along lines similar to Malthus (1798) and Hobbes (1651), Darwin noted the central role that population growth, over-crowding and **competition** for habitats played in the individual's survival during selection:

> "…all organic species are exposed to severe competition…There is no exception to the rule that every organic being naturally increases at so high a rate, that if not destroyed, the earth would soon be covered by progeny of a single pair…The action of climate seems at first sight to be quite independent of the struggle for existence; but in so far as climate chiefly acts in reducing food, it brings on the most severe struggle between individuals, whether of the same or of distinct species, which subsist on the same kind of food…" (Darwin 1859, pp. 489–493)

In particular, Darwin emphasized that the key to the survival of species was not the individual's survival, but rather the individual's **reproductive success**:

> "…With animals having separate sexes there will in most cases be a struggle between the males for possession of the females. The most vigorous individuals, or those which most successfully struggle with their condition of life, will generally leave more progeny…" (*ibid.*, p. 747)

In the intervening years, the three main factors responsible for Darwinian evolution have been shown to be more complex, undergoing successive elaboration and re-evaluation. Without delving too deep into the technical details, the main added complexities are discussed below.[1]

1. For details see Futuyma (1986); Sapolsky (2017).

10.2.2 Post-Darwinian evolutionary biology

10.2.2.1 Variation

Variation and its converse, invariance, turn out to hinge upon the very same biochemical ingredient – the DNA-coded *genes*. But genetic variation turns out to be only the tip of a mammoth iceberg. For in the processes that are relevant to evolution, variation involves not only genes ('genotype') but also the actual expressed traits ('phenotype'), including behavioral traits. First, as West-Eberhard (2003) has noted, it is the phenotype that interacts directly with the environment during selection, not the genome. What is more, behavioral variation, innovation and experimentation during development are important ingredients in the process of selection, and thus evolution. This is what is known as **epigenetic evolution**, above and beyond the genes – or rather, in collaboration with genetic evolution. This complex, interactive view of evolution has resurrected the idea of inheritance of acquired traits, going back to Lamarck's (1802), Baldwin (1896) and Waddington (1942, 1953). What is more, epigenesis also subsumes life-time learning (West-Eberhard 2003; Tucker and Luu 2012; Tucker, in prep.). In this connection, recall Ernst Mayr's (1982) observation:

> "…Many if not most acquisitions of new structures in the course of evolution can be ascribed to selection forces exerted by newly-acquired behaviors (Mayr 1960). Behavior, thus, plays an important role as the *pacemaker of evolutionary change*. Most adaptive radiations were apparently caused by behavioral shifts…" (1982, p. 612; italics added)

In the same vein, Fernald and White (2000) note:

> "…Behavior can and does influence specific aspects of brain structure and function over *three different time frames*. A causal link is easy to establish on an *evolutionary time scale* because selective forces of the ecological niche of the animal typically are reflected in the body shape, sensory and motor systems, and behavior. Similarly, on a *developmental time scale*, behavior acts in concert with the environment to establish structural changes in the brain that influence an organism throughout its lifetime. Surprisingly, there currently is evidence that in *real time, social behavior* also causes changes in the brain in adult animals…" (2000, p. 1193; italics added)

And likewise West-Eberhard (2003):

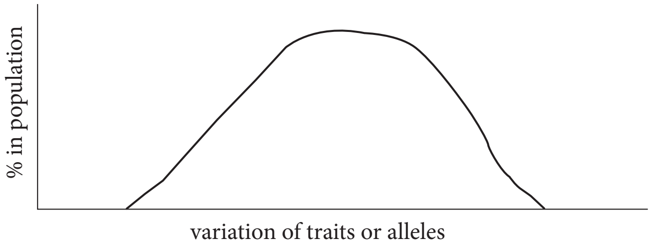
> "…To treat development and selection as if they were competing explanations is to misunderstand evolution… …Developmental variation and natural selection are two aspects of a single process, adaptive evolution…The causal change of adaptive evolution begins with development. *Development*, or ontogenetic changes induced by genomic or environmental factors, causes phenotypic variation within population. If the phenotypic variation caused by developmental variation in turn causes variation in survival and reproductive success, this constitutes *selection*…" (2003, pp. 140–141)

A certain range of internal variation is an absolute requisite for selection and evolution, guaranteeing a sufficient reservoir of adaptive options. But beyond a certain point, excessive internal variation can be detrimental. To begin with, group members must be genetically compatible in order to mate. Beyond a certain threshold, a too-variable gene pool yields non-viable gametes. What is more, biological populations must also be behaviorally compatible in order to insure social and sexual cooperation. Excessive variation, both genetic and behavioral, eventually leads to reproductive isolation and speciation, whereby a sub-population detaches itself from the group, either geographically or behaviorally, and stops plowing back its useful adaptive experience into the common genetic pool (Mayr 1963, 1976; Bonner 1988).

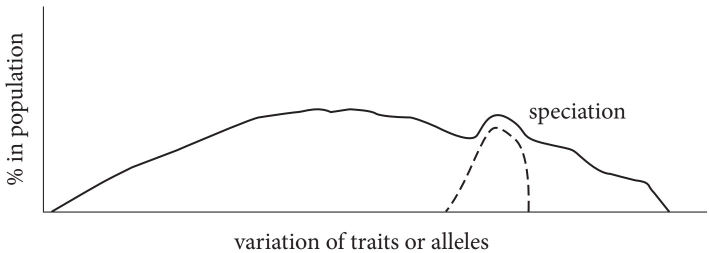
The normal bell-shaped distribution of traits within a population is not an invention of statisticians, but an enduring feature of biological populations. What it expresses is that, for each significant phenotypic trait or gene variant (allele), the majority of the population (say 66% or above) clusters around the mean (say within 1–2 standard deviations), so that genetic and behavioral **population coherence** can be maintained.

At the same time, the minority of outliers around the margins of the curve guarantee the reservoir of variants needed for adapting to new behavioral contexts or environmental niches. Whether a bit more flat or a bit more compact, the bell-shaped curve is the best expression of the balance between homogeneity ('invariance') variation ('diversity') in biological populations (Futuyma 1986, Chapters 4, 5). The bell-shaped curve, excessive variation and excessive uniformity are illustrated schematically in (1), (2) and (3) below, respectively.

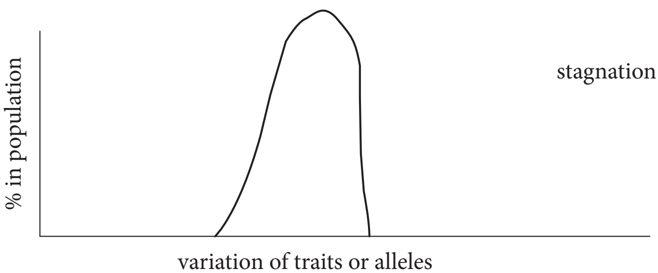
(1) **Normal (bell-shaped) distribution of variants in population**



(2) **Excessively variable distribution of variants in population**



(3) **Extremely uniform distribution of variants in population**



10.2.2.2 **Invariance**

The discovery that the invariance responsible for inheritance of adaptive traits – the genome – was coded in the nuclear DNA (Watson and Crick 1953) reinforced an overly deterministic view of inheritance, whereby short nucleotide sequences, acting as genes, instructed via messenger RNA the production of specific proteins by the protoplasm. In the intervening sixty-odd years, extensive further research has revealed the much more nuanced, complex nature of genes and their interaction with the environment – and with development. To begin with, only a small portion – ca. 5% – of the genome in complex organisms directly codes for proteins and phenotypic traits. The bulk of the DNA in chromosomes is dedicated to the regulation of **gene expression** – on-off switches, blockers and activators (Futuyma 1986, Chapter 3; West-Eberhard, 2003, Chapter 5; Sapolsky 2017, Chapter 8). And those switches are often triggered by the environment.[2]

What is more, the environment with which switches and genes interact is not only external, but also internal, be it developmental, behavioral or neurocognitive, with all three often expressed by hormones (Sapolsky 2017, Chapters 2, 3, 4). The resulting picture is that of a complex system in which genes (phylogeny), development and behavior (ontogeny) and various aspects of the environment work as a complex interactive whole. Taken together, this complex whole characterizes biological evolution. That is:

> "…genes don't make sense outside the context of [their interaction with the] environment…The more genomically complex the organism, the larger the percentage of the genome devoted to gene regulation by the environment…" (Sapolsky 2017, pp. 227–228; bracketed material added)

And in the same vein:

> "…because switches are the focal point of environmental and genetic influence on development, they are the focal points of evolutionary change… switches mediate the interchangeability of genetic and environmental influences that make it possible to adjust the condition sensitivity of regulation and are thereby change the frequency of trait expression under selection…The causal change of adaptive evolution begins with development. *Development*, or ontogenetic changes induced by genomic or environmental factors, causes phenotypic variation within population. If the phenotypic variation caused by developmental variation in turn causes variation in survival and reproductive success, this constitutes *selection*…" (West-Eberhard 2003., pp. 138–141)

10.2.2.3 **Selection**

As noted earlier, the old Darwinian notion of an external environment that gave phenotypes and genes their adaptive pass-or-fail grade has also undergone a profound transformation. The environment that is relevant to selection and

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2. To make things more complex yet, the on or off switches are themselves regulated by genes (Sapolsky 2017, Chapter 8).

evolution is part of an intricate complex of *gene expression* during development, learning and behavior, often finding its interactive arena *inside* the organism. As a result, the three classical factors that undergirded Darwinian evolution – variation, invariance and selection – are seldom independent of each other, but rather engage in a complex interaction.

10.3 The durability of an old social adaptation

10.3.1 Preliminaries

Dissolving the absolute distinction between genes and environment has also obliterated the rigid wall between phylogeny and ontogeny and nature vs. nurture. This more nuanced view of bio-evolution also dismantled the Cartesian fire-wall between the biological and the cultural.[3] Or, to paraphrase Ernst Mayr, in social organisms cultural evolution is often the pacemaker of biological evolution.

In this section I will recapitulate briefly some of the salient characteristics of that remarkably durable social adaptation of human-kind, our 8-million years old *Society of Intimates* (Chapter 4). I will then try to reassess why the entrenched cognitive and social patterns that evolved during the prior 8-million years of hominid and human evolution are still relevant to our current mass *Society of Strangers*.[4]

At the margins of present-day industrialized Western societies, substantial vestiges of the Society of Intimates still survive, notably in small towns and isolated rural communities. Likewise, in less-developed countries, substantial

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3. Old ideological quarrels seldom die. Thus my own discipline, linguistics, has been enmeshed for over a century in repeated skirmishes along the Cartesian fault-line. Not surprisingly, the argument often hinges on whether there is a sharp boundary between pre-human and human communication, between the biological and the cultural, or between variable behavior and invariable 'essence'. Consider: "…It is quite senseless to raise the problem of explaining the evolution of human language from more primitive systems of communication that appear at lower levels of intellectual capacity…" (Chomsky 1968). As against: "…It strains credulity to pretend that language as we know it suddenly sprang up intact as a cultural invention in the absence of extensive cognitive and communicative pre-adaptation…" (Lamendella 1976). For more detail see Givón (1979/2019; 1995, 2009).

4. See Chapter 4, above.

populations of small-scale indigenous societies of intimates exist as enclaves within the nation-state. Such enclaves retain many of their old cultural traits. The general characteristics of the Society of Intimates may be given as follows (see again Chapter 4):[5]

(4) **General traits of the Society of Intimates**
  a. small-size social unit
  b. joint daily foraging and intimate social contact
  c. restricted territorial rang
  d. kin-based social organization and cooperation
  e. restricted and relatively homogeneous gene pool[6]
  f. non-hierarchic, oft-adjustable social organization
  g. consensual, non-hereditary, leadership
  h. cooperation on the inside, hostility on the outside
  i. cultural stability and slow rate of change
  j. cultural and linguistic homogeneity
  k. informational stability and homogeneity

10.3.2 Information and communication in the Society of Intimates

10.3.2.1 Types of mental representation

As noted earlier (Chapters 3, 5), three types of pre-linguistic cognitive capacities provided the scaffolds upon which human communication evolved, and on which we rely to this day during on-going communication. These three

5. Culled from, *inter alia*, Power (1991); Dunbar (1992); Marlowe (2005, 2010); Goodall (1965); deWaal 1982; de Waal and Lanting (1997); Schieffelin (1976); Malinowsky (1932, 1935); Leach (1958); Lounsbury (1965); Weiner (1976); Stiles (1994).

6. Sapolsky (2017) offers a possible challenge to this feature, citing recent research on present-day hunting-gathering groups, where it is suggested that up to 40% of residents are non-kin, presumably outsiders who joined the group. However, this pattern may have developed more recently under the impact of contact with the surrounding, encroaching large-scale Societies of Strangers, and thus does not necessarily represent our ancestral hunter-gatherer populations. And even if one accepts the reported 40% level of non-kin residents, modern hunter-gatherer societies are still much more homogeneous genetically than the surrounding large-scale Societies of Strangers.

mental capacities also represent much of the *context* vis-a-vis which on-going communication is transacted. They are:

(5) **Major cognitive capacities**
   a. **Long-term semantic memory**: The generic cultural information we share as members of our cultural group, about our shared physical, social and internal-mental universe.
   b. **Long-term episodic memory**: The specific episodic information about what happened – or was said – at specific times and places to specific humans, animates or objects, including one's life-time biographic knowledge.
   c. **Attention and working memory**: The specific knowledge of the current situation, what is happening here-and-now where you-and-I are interacting or communicating, sometime about this-or-that entity that is visible or audible on the current scene.

It is worth noting, further, that the mental representation of the current situation in working-memory (5c) may also involve our representation of the *mind of our interlocutor* during ongoing communication (Chapter 5). This presumption of shared mind is not only a core prerequisite to communication, but also a major adaptive feature of the Society of Intimates.

10.3.2.2 Evolved communication

The conflation of the core features that characterize the Society of Intimates, listed in (4) above, virtually guarantee that all three general categories of knowledge in should be universally shared among members of small-scale societies. With such high degree of shared information, what is left there to communicate about? What *topics* are neither taken for granted generically, nor shared episodically, nor jointly-experienced here and now?

There appear to be only three categories of adaptively-urgent information that were *not* socially shared among all small-group members, who foraged together and were always present together in the here-and-now of the early Society of Intimates:

- **Current internal mental states**: fear, anger, arousal, pleasure, pain, hunger
- **Current intents to perform inter-personal acts**: aggression, submission, friendliness, courtship, invitation to move on
- **Urgent external states**: predator, prey, enemy.

These are precisely the topics, often coded by distinct vocal or gestural signals that are found in spontaneous natural communication of our primate kin, as well as in other social mammals and birds. That is, in other small-scale Societies of Intimates (Chenety and Seyfarth 1990, 2007; Zuberbühler 2000, 2002; Boesch 2002, 2005; Boesch and Boesch-Achermann 2000; *inter alia*). What is more, the communicative behavior of avian and mammalian social species is just as dependent as human communication on access to the mind of the interlocutor.[7]

Sometime ca. 2 million years ago, perhaps with the advent of *Homo erectus*, the old pattern of near-universal sharing of information within the intimate hominid social group began to falter. The reason may have to do with a new pattern of more durable fixed home-base, from which small foraging groups ranged farther and farther afield. In the case of men, small hunting groups stayed away from home-base for several nights (Hrdy 2009; Marlowe 2005, 2010; Bickerton 2005; *inter alia*).[8]

With the new pattern of residence and mobility, a great amount of relevant adaptive information was now shared only within small foraging groups, and was not automatically available to the rest of the community. The need to share that information about game, terrain or potential enemy with the rest of the group was, presumably, the early impetus for the evolution of human language, with its expanded vocabulary, reliable word-coding sound system, and eventually grammar.

As the daily dispersal of the group away from home-base decreased the amount of vital information shared across the group, well-coded language stepped into the breach. The advent of human language was thus not only the response to the early move toward alienation, but also what made the more massive subsequent alienation of the Society of Strangers possible.

7. Following the original challenge by Premack and Woodruff (1978), who denied that non-human social species have 'Theory of Mind', a large body of works has ventured to prove just the opposite. A representative sample is: Hare *et al.* (2000); Liebal *et al.* (2004); Bräurer *et al.;* Flombaum and Santos (2005, 2007); Daly *et al.* (2006); Schmelz *et al.* (2011); Seyfarth and Cheney (2012); Whiten (2013); Heyes (2014); Crockford *et al.* (2012, 2015, 2017); Clayton *et al.* (2007); Bugnyar (2011, 2013); Bugnyar and Heinrich (2005); Bugnyar *et al.* (2016); *inter alia*.

8. For more detail see Givón (2009, Chapter 12).

10.4 The Society of Strangers

As noted earlier, the small-scale Society of Intimates remained an amazingly stable social adaptation in hominids and humans from the dawn of social primates till the late neolithic era ca. 8,000 BC. More complex large-scale societies of strangers began to appear with the advent of agriculture and sedentary residence. The new subsistence mode, pioneered in the great river basins – Tigris-Euphrates, Nile, Hindus-Ganges, Yangtse-Yellow River, Mayan tropics – radiated out gradually, giving rise to new skills and technologies, including wood-working, masonry, metallurgy, pottery, and eventually literacy.

Ever larger social units sprang up around the early Bronze Age (ca. 5000 BC), involving permanent settlements, surplus foodstuff, food storage and preservation, and trade. In the wake of all these came higher population density and larger and larger social units. Long-term settlements made improved arable land, irrigation and durable orchards possible, which in turn precipitated private ownership of 'real' property, inheritance, and the subsequent rise of patriarchy and slavery.

In all major traits, the large-scale Society of Strangers is the converse of the Society of Intimates (see (4) above). That is:

(6) **General traits of the Society of Strangers**
- a. Large social unit
- b. Little daily contact across the social unit
- c. Wide territorial range
- d. Less kin-based social organization and cooperation[9]
- e. Expanded and less homogeneous gene pool
- f. Hierarchic social organization
- g. Non-consensual, coercive leadership
- h. Enforced cooperation with strangers
- i. Cultural dynamism and fast rate of change
- j. Cultural diversity
- k. Rapid informational change and diversity

9. This is not to suggest that kin-based social organization has disappeared altogether, how could it? First, hereditary leadership and nepotism at the higher nodes of the hierarchy have remained the norm of non-consensual large-scale societies. And second, kin-based sociality and cooperation persisted inside the smaller family- and clan-based lower organizational nodes.

10.5 Human nature

10.5.1 Recapitulation

As noted in the preceding chapter, the argument about whether humans are by nature selfish and warlike or empathic and cooperative harkens back to antiquity, seesawing for over two millennia between two extreme positions. It culminated in the Enlightenment, where Hobbes (1651) argued for one extreme, of humans being by nature selfish and warlike, while Rouseau (1762) opted for the other extreme, the empathic *noble savage*.

Two profound thinkers of the late-to-post-Enlightenment, Adam Smith (1759, 1776) and Charles Darwin (1859, 1871), rejected the old either-or argument, suggesting instead that humans were by nature *both* selfish and pro-social, with the two arrayed in a tenuous balance and often in conflict. In the post-Darwinian study of the evolution of human culture and behavior, four brand new scientific fields – primatology, evolutionary psychology, evolutionary anthropology and cognitive neuroscience – arose and then virtually merged in the latter part of the 20th Century, in one way or another elaborating on Smith's and Darwin's integrative insights. The ensuing, complex line of investigation suggests that natural selection can operate at *both* levels, individual selection and group selection; and that the two are deployed selectively in different adaptive contexts (D. S. Wilson 1975, 1977, 1980, 1997; E. O. Wilson 2012; Okasha 2006).[10]

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10. A terrific example of the relation between trust and familiarity in a social species has been recently reported by Kern and Radford (2017), studying dwarf mongoose in So. Africa. This species practices cooperative breeding, whereby only one pair in the group breeds (at any given period), while the rest tend to the breeding pair and their young. A certain number of young adults migrate to other groups in an attempt to improve their chance of becoming the breeding pair. Those new immigrants seldom take sentinel duty, a position responsible for sending alarm calls to warn the foraging group of approaching predators. And when they take that duty, their alarm calls are ignored by the foraging locals. Only after ca. 5 months of residence in the new group are the new immigrants trusted enough for their alarm calls to be taken seriously. This social behavior of dwarf mongooses is reminiscent of Cheney and Seyfarth's (1990) observation that vervet monkeys discount the alarm calls of juveniles; that is, those whose mind does not yet approximate the adult's.

10.5.2 Empathy, altruism and cooperation

Probably the most compelling line of research about the naturalness – thus evolutionary and genetic basis – of human empathic pro-sociality comes from the comparative study of primates and human new-born. First, a long line of research in primatology and evolutionary anthropology suggests that our closest great-ape kin – chimpanzees and bonobos – as well as other primates are naturally *both* aggressive and warlike, on the one hand, and empathic and cooperative, on the other (de Waal 1982, 1989, 2013; Cheney and Seyfarth 2007). Further studies by de Waal (2013) suggest that chimpanzees also have an innate natural sense of fairness and equity in the allocation of rewards.

A second line of investigation has been probing the other-directed behavior of young children, long before they have been socialized to explicit adult ethical norms. Such studies have shown that children are spontaneously – naturally – disposed towards cooperation, empathy, and fairness; and that they have a rudimentary capacity for anticipating the minds of their fellow humans, both adults and children (Tomasello 2009). What is more, young children also seem to insist on enforcing social norms, thus equity and justice (Tomasello *et al.* 2012; Tomasello and Vaish 2013; Schmidt and Tomasello 2012). And lastly, that sociality and empathy in humans may have evolved in two stages:

- natural empathy with one's kin and intimates
- prescribed or enforced social norms

One way or another, the calculus of cooperation in the Society of Intimates has remain remarkably stable, and may be given as:

(7) **The Calculus of social cooperation**:
   a. You cooperate only with those you **trust**.
   b. You trust only those who **share your mind**.
   c. You share your mind only with **familiars**, those who are **like you**.
   ____
   d. Still, some non-kin can become familiar enough to also be 'like you'.

Components (7a, b, c) represent Tomasello's first stage, perhaps in the traditional Society of Intimates. The grudgingly-conceded (7d) may accommodate cooperation in the Society of Strangers. And it is likely that cooperation among 'alike' strangers (7d) is a less entrenched behavior in terms of evolved genetic mechanisms. Lastly, consonant with our earlier discussion of modes of information processing (Chapters 3, 5), the habits of trust and cooperation with those who share our mind and are 'like us' are probably automated and subconscious.

10.6 The conundrum of diversity and the mirage of multi-culturalism

10.6.1 Preamble

No society, however small and traditional, is ever 100% homogeneous. The natural replenishment of internal diversity is just as inherent in cultural populations as it is in biological species. What is more, as Sapolsky (2017) has noted, even in the smallest traditional Societies of Intimates one is simultaneously a member of **multiple identify categories** – gender, age-group, family, clan, tribe. Which one is more important? Which one overrides the others in the calculus of social behavior and self presentation? More to the point, in what context do we present each of our multiple selves?[11]

In the Society of Strangers, the conundrum of multiple affiliations is further exacerbated by the size and complexity of the social unit, as the number of meaningful social categories proliferates – city, neighborhood, profession, social class, education level, artistic taste, religion, ethnicity, color. Still, even the largest Societies of Strangers must maintain, like all social species, a balance between uniformity and diversity, between stagnation and speciation (Bonner 1988). A culture is thus, to paraphrase A. F. Wallace (1961), an *organized diversity* – but with a requisite minimum of shared mind, the *sine qua non* of communication, trust and cooperation.

Given what has been noted thus far, the current academic and political fixation – indeed infatuation – with 'diversity' and 'multi-culturalism' seems truly bizarre. This is especially true in a society with recurrent waves of immigration, with surviving indigenous populations that were nearly exterminated by a 'civilizing' imperial conceit, and with an emancipated population that was brought over in chains on slave ships. In such a society, striving for common grounds – or **cultural coherence** – is that much more difficult, but even more urgent.[12]

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11. With a nod to Jon Elster (ed. 1985).

12. Israel is perhaps the most extreme example of such immigrant society, where the most urgent initial task has been that of linguistic and cultural integration.

10.6.2 The wages of excess diversity

It is indeed striking how few instances of successful consensual government have been attested throughout the 10,000-year history of complex societies of strangers, be they in Mesopotamia, Egypt, Europe, China, India, the Americas or elsewhere. The few brief attempts in recorded Western history amount to an intermittent 100 years in Athens, with ca. 90% of the population – women, slaves, the poor, resident aliens – excluded from the franchise; followed by a sputtering 100 years in Rome, with similar restrictions on the franchise. Then, after a gap of ca. 1,700 years, the current halting, precarious 200-odd years in post-Enlightenment Western Europe and North America.

One of the most vexing issues in large-scale, hierarchic societies of strangers is their *legitimacy*. In small-scale societies of intimates, this has been a moot point. In such societies, governance and cooperation, however rigid their social calculus may be, are above all *consensual*. But the Society of Strangers is another kettle of fish, one which 8 million years of socio-cognitive evolution had hardly prepared us for. For how *could* one cooperate with non-familiars and non-intimates, or cede leadership to those one doesn't know or trust? Over the course of primate, Hominid and human evolution-cum-history, the answer has been, invariably – one *could not*. One never *chooses* to cooperate in societies of strangers. One is coopted, tricked or forced. And while mitigating mechanisms of *de-alienation* have always existed (see Chapter 4), the historical record of consensual societies of strangers is dismal.

To acquaint – or re-acquaint – ourselves with the wages of excess diversity, consider first **Rwanda**. For a hundred years, a repressive Belgian colonial regime kept the lid on the traditional hatred between the high-caste minority Tutsi pastoralists, originally migrants from the north-east, and the majority Hutu cultivators; both speaking the same Bantu language (known as either Kinya-Rwanda or KiRundi). Liberation and free elections then took the lid off. What followed is the genocide of 1984.

Consider next **Iraq**, where the early Caliphate, centuries of Ottoman and British rule and then a repressive native dictatorship kept the lid on a simmering diversity of Shi'a, Sunni, Kurd and assorted smaller groups. Then we overthrew Saddam and ushered in democracy. The resulting mayhem is still ongoing.

Consider next **Yugoslavia**, where centuries of coercive regimes – Tzars, Ottomans, Habsburgs, Tito's communists – ruled with iron fist, keeping a tight lid on the boiling cauldron of diversity and mutual hatred of Orthodox, Catholics and Moslems. Then came 'democracy', with Bosnia and Kosovo in its wake. The pieces are still being sorted out.

Consider **Syria-Lebanon** next, where centuries of Otomans, French colonial rule and Ba'ath Party dictatorship kept the lid on the simmering diversity of Sunni, Shi'a, Kurd, Christian and Druz. Then we stooped in to insinuate the wonders of democracy. The ensuing carnage is still ongoing.

Consider next **Afghanistan**, an ancient cradle of tribal diversity ruled for centuries by a succession of repressive powers, from Gengis Khan all the way to Russia's communist henchmen and the Taliban. In 2001, we brought them democracy and free elections. The resulting genocidal free-for-all is still going on.

Consider next **South Sudan**, where various imperial ventures dating back to ancient Egypt gave way to a repressive Arab rule by the Moslem north. Next, democratic independence engendered by the best post-colonial liberal instincts and supervised by the U.N. unleashed a murderous reprise of the traditional rivalry between the Dinka and Nuer, with no end in sight.

Consider last my all-time favorite, the **ex-Belgian Congo**, a simmering cauldron of ca. 80 tribal societies of intimates, thrown together in a rush by King Leopold as his personal fief to rape and pillage and plunder. Ever since independence (1960) and the ensuing succession of indigenous tin-horn dictators (Kasavubu, Lumumba, Mobutu, Kabila père, Kabila fils), the so-called Democratic Republic of Congo has been a hell-hole of bush wars, rebellions and cross-ethnic mayhem, with no end in site.[13]

There is a caveat here, there always is. *Major stressors* always seem to precipitate – or exacerbate – violent conflagrations in societies of strangers (Diamond 2005).Thus for example, both the Syrian civil war and the Rwanda genocide followed closely on the heels of major peaks of climate change, environmental degradation and population explosions. Likewise the ever-exploding Afghanistan, or the never-ending strife in the sub-Saharan Sahel. The Yugoslavia crisis of the 1990s was exacerbated by the abusive political leadership of post-Communist Serbia. The long-simmering clamor for independence in the Basque and Catalan *autonomías* of Spain owes much of its bitterness to decades of the repressive Franco regime. And the current Catalan drive for independence certainly did not benefit from Spain's inept handling of its economic crisis.

13. I was in Lubumbashi, Katanga province, in late 1967 on a wild goose chase, trying to track down two of my favorite, hopeless romantic escapades – Ché Guevara's doomed revolutionary excursion (1965–1966) into Kivu province to the north, and the earlier mercenary mis-adventure of the OAS remnants during the Katanga cessation, following their defeat in the Algerian war in 1961. In December 1967, the post-colonial chaos was boiling over. It still is.

One may even argue that the current political paralysis right here at home has been greatly exacerbated by the accession to power of our current Molestor-in-Chief. But whatever the source of the stress, fissures, breakage and dissolution of societies of strangers invariably follow the familiar fault-lines of pre-existing diversity. And whatever their provenance, extremely diverse large-scale polities almost invariably face the choice, or so it seems, between coercive central governance a la Egypt, Rome, the Soviet Union or China, and free-for-all sectarian violence.[14]

10.6.3 Color is, well, visible

As noted earlier, small-scale societies of intimates employ multiple criteria of external appearance, among them skin color, to tease apart members from non-members. The assumption among current champions of diversity and multi-culturalism that skin color is the premier identity-defining criterion seems well supported. Given our history of enslaving black Africans and exterminating 'red' Indians, a history compounded by the post-Reconstruction Jim Crow and the still-ongoing struggle for justice and equity, all this is hardly surprising. Still, it is important to point out, as Sapolsky (2017) did, that our simultaneous membership in multiple identity categories raises a fundamental issue – which one matters more, and in what context?

In 1967–68 I was doing my field work in Zambia, then barely three years past its liberation from British colonial rule. At the University and various spots around Lusaka, finding a social niche was not a trivial endeavor. The social circle we soon fell in with was instructive: British and American academics, holdover British-colonial administrators, Canadian and American Peace-Corps volunteers. And – surprise – the exiled black rebels from South Africa, Southern Rhodesia (Zimbabwe) and Biafra; as well as expatriate black Americans in search of their *roots*. An eclectic mix if there ever was one, we were thrown together out of sheer necessity – the local Africans, speakers of 70-odd Bantu languages, would not socialize with us. As far as they were concerned,

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14. The oft-mentioned rare exception that proves the rule, Switzerland, arrived at its peaceful arrangement of loosely-bound cantons after centuries of religious wars. And the arrangement is still predicated on an extreme linguistic and cultural segregation of the cantons. In a similar vein, it is not exactly an accident that the four countries that registered the highest on the 'index of happiness' in a recent survey were the four least-diverse cultures in Europe – Finland, Norway, Denmark and Holland.

the black South-Africans, Rhodesians, Biafrans and Americans belonged with the rest of us white expats. They spoke our language (English) and shared our Western education.[15]

10.6.4 Tale of two cultures[16]

In the early 1980's, my friend Ed Sadalla, a social psychologist at ASU, conducted a simple-minded experiment. He recruited a socially diverse group of subjects and asked them the following question: Given the two diets below, which one do you prefer: (1) a *health-food diet* (lots of fruits and vegetables, grilled or stir-fried fish or chicken, fruit juices or skim milk, whole-wheat bread, brown rice). Or (2) an *all-American diet* (deep-fried or mashed potatoes, steak, sweet sodas, canned sweet-peas, white bread, fatty milk products).

Dividing the original group into two sub-groups according to their food-preference, my friend then proceeded to ask them for their:

- education level (highschool diploma or less vs. one or more college degrees),
- employment (blue-collar vs. white-collar or beyond),
- preferred alcoholic-beverage (beer vs. wine),
- preferred music (county or pop vs. classical or jazz),
- politics (conservative vs. liberal).

When the responses were analyzed, the results were predictable – and coherent: Preference for the all-American diet correlated almost perfectly with less education, blue-color employment, and preference for beer, country music and conservative politics. And the converse with preference for the health-food diet. What my friend had demonstrated was the **clustering of features** that,

15. There was among us a Blackfoot woman who came to Lusaka with the Canadian equivalent of our Peace Corps, CUSO (Canadian University Service Overseas). Like us shunned by the African natives, she wound up socializing with us. She once told me: "What am I doing with you? I'm a Native, I'm not like you, not one of you!" "Well", I told her – at the time wholly innocent of the unique identity burdens of Native Americans, and still 15 years short of coming to the Rez – "you speak our language, hey? Got educated at the university like the rest of us? Ain't much darker than me? Drink the same Scotch whiskey?" Tall and husky and statuesque that she was, she could hardly restrain herself from decking me with a true Western hay-maker. She would have, too, easy.

16. The materials in this section owe much to Givón (2017a).

to this day, define the two main American sub-cultures. For his pains he also received the Golden Fleece award from then-senator William Proxmire (D-Wisconsin.), bestowed upon the most useless government-funded research project of the year.

More than a decade earlier, in 1967, Lila and Henry Gleitman, two psychologists from Penn, conducted a study on the major dialect boundary in American English (measured by several grammatical features), as correlated to level of education. Their subjects were divided into four groups: (a) secretaries; (b) lower-division undergraduates; (c) upper division undergraduates; and (d) graduate students. The linguistic dividing line, it turned out, grouped the secretaries and lower-division undergraduates on one side, and the upper-division undergraduates and graduate students on the other. Your education level, it seemed, correlated with the American dialect you spoke. It took at least two years of college to cross the language divide.

My friend's cultural intuitions were recapitulated more recently in three books, Charles Murray's *Coming Apart* (2012), Joseph Stiglitz's *The Great Divide* (2015), and J. D. Vance's *Hillbilly Elegy* (2016). Between those three, they fairly predicted the outcome of our 2016 presidential election, as well as our growing social, cultural and political incoherence.

10.6.5 **Gender, again**

As anyone who studied conflict, war and aggression will tell you, our natural – evolved, innate – propensities for either cooperation or aggression are not distributed in a gender-neutral way. Already in the early dawn of the Society of Intimates, males have been shown to be consistently more competitive, aggressive, violent and warlike; while females are consistently more cooperative and empathic. This *socio-behavioral di-morphism* has also been noted in our primate kin.[17]

Of the multiple strands of diversity in the human tapestry, all now clamoring for recognition, redress or prior victimhood, gender diversity is by far the oldest, most widespread and most deeply entrenched – biologically, neurologically, cognitively and culturally. Not only are women smaller and less aggressive, more empathic and more cooperative, they are also universally repressed,

17. For primates, see de Waal (1982, 1989); Cheney and Seyfarth (2007); Wrangham and Peterson 1996), *inter alia*. For humans, see Hrdy (1999, 2009) Potts and Hayden (2008); Marlowe (2010); *inter alia*.

controlled and exploited by their male kin. And while the roots of this systematic diversity of power reach back to the primate and hominid Society of Intimates, gender inequality has been amplified a hundred fold in large-scale societies of strangers, with a patriarchy obsessed with property, paternity and inheritance – and power. Indeed, it may well be that gender diversity is not only part of our predicament, but perhaps the hidden crux of a solution. To cite again Potts and Hayden (2008):

> "…The evolutionary perspective we take here highlights the fact that aggression is predominantly an activity of young males… Women have never shared men's propensity to band together spontaneously and sally forth to viciously attack their neighbors… One way to reduce the risk of violence is to empower women and maximize their role in society…" (2008, pp. 13–14)

10.7 Is there a way out?

10.7.1 Back to nature-vs.-artifice

As noted earlier (Chapter 9), toward the tail end of the Enlightenment, the old argument that had been raging for over two millennia of Western Civilization came to its final impasse: Were humans moral, empathic, co-operative and pro-social by nature (*physis*) or by artifice (*nomos*)? Speaking for the traditional majority represented by both Plato and Aristotle, Hobbes (1651) pronounced us by nature selfish and warlike. Speaking for the minority represented by Epicure and Lucretius, Rousseau (1762) counted us by nature peaceful and empathic. Then Adam Smith (1776, 1789) and Charles Darwin (1859, 1972) sealed the discussion for good by suggesting an *adaptive middle*, whereby we were by nature *both* selfish and empathic, thus prone to a hybrid type of natural selection.

Solving a complex puzzle demands, first and foremost, that we understand it in all its intricacies, nuts and bolts, warts and blemishes. There are a number of potential solutions to our enduring dilemma of consensual governance in large-scale societies of strangers. The first two are only too familiar.

10.7.2 The religious option

Ever since the advent of large-scale statist religion, be it Judaism, Christianity, Islam or Confucianism, Churches, Mosques, Temples and Synagogues have been peddling assorted versions of Divinely mandated morality, most often backed up by the coercive power of a state. As inducement, they offered a variety of Divinely sanctioned carrots or sticks – a pleasureful Heaven or a fiery Hell. Divinely backed morality was invariably rooted in the Hobbesean view of human nature – we are all natural sinners in urgent need of saving from ourselves.

The three Abrahamic religions ascribed our natural predilections to an *Original Sin*.The Biblical Jehovah's way of dealing with His wayward creation was to counter their natural sinfulness (*physis*) with God's legislative fiat (*nomos*).

In the Classical Chinese version, the 6th-Century BC near-contemporaries Lao Tse and Confucius presaged the traditional Western dichotomy. Lao Tse opted for a brand of natural morality reminiscent of Epicure's.[18] While Confucius, deeply enmeshed in the top-down politics of the mega-state, opted for the tried-and-true statist paternalistic morality, presumably rooted in the lessons of recent history – the chaos of the Warring States.[19]

Blind faith, self-righteousness, fear of damnation and hope of salvation are great motivators. But whether successful or not in its prescribed sphere, divinely mandated morality has proven to have one fatal drawback: Almost invariably in the annals of large-scale religion, the attractive incentives were offered only to the faithful on the inside ('us'), and were counter-balanced by a vehement, abusive demonizing of *The Other* on the outside ('them').

10.7.3 **The state's option**

The state solution, secular or otherwise, has remained essentially unchanged since Solon's Athens, or Confucius' China – legislate, adjudicate, enforce. Both the Enlightenment and our own Founding Fathers had great faith in this framework, the Social Contract. But however consensual on paper, our Society of Strangers – much like Athens – began by excluding from the franchise the vast majority of *them*: women, slaves, the poor, the Native, the foreign. And while the franchise has been greatly expanded since, the strains and stresses on our democratic experiment are showing – perhaps most acutely, in my personal

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18. Lao Tse's ethics is complex, and closely integrated with his cosmology, metaphysics and epistemology. The main ethical injunction in the *Tao Teh Ching* is *Wu Wei* ('no-do'), meaning not acting arbitrarily against the universal drift, the *Tao*. Both Lao Tse and his fellow early Taoist Chuang Tse repeatedly derided Confucius' statist religion and its injunctions and rituals (*Li*). For some details, see the Retroduction to my translation of the *Tao Teh Ching*.

19. For an extensive discussion see Arthur Waley's Introduction to this translation of the *Analects* (1938/1989).

memory and reading of history, in the current finger-pointing stalemate between the two main sub-cultures; in the angry clamor of the discontent; in the fierce competition among past and future wronged for prior designated victimhood; and in the fiercely tribal politics of identity.

10.7.4 The neuro-scientist's option

Perhaps the most audacious – and paradoxical – solution has been advanced recently by Robert Sapolsky (2017). Audacious because it cleaves to our most optimistic liberal hopes and dreams – from Aristotle to Rousseau to Adam Smith to Jefferson – that somehow, by hook or crook, the best angels of our nature will prevail. And, what is more, that this can be done by relying on the neural circuits that underlie our rational, conscious, deliberate, executive attention. These neural circuits are anchored, according to some models, in the dorso-lateral pre-frontal cortex (DLPFC; see ch.3). And the hope is that we can somehow train them to override the more ancient, reflexive, pre-rational sub-cortical circuits, the old core that was designed by evolution to make us respond rapidly, subconsciously, reflexively and emotionally to perceived threats from designated *others*; respond with fear and fury and aggression.

But herein lies the conundrum: The anchor of our neurology may not be in the executive attention, but rather in the limbic-thalamic-ACC core (Mesulam 2012). Indeed, early on in his book Sapolsky reviews the experimental data purporting to show that just a few milliseconds before our DLPFC circuit is activated to render conscious, rational, executive decisions, the automated, subconscious limbic-amygdala circuit is activated first. But more to the point, how do we train consciously our subconscious core? And how different would such an exercise be from Freudian psychoanalysis?

10.7.5 Hyper-sociality or A.I.?

O. E. Wilson (2012) has suggested that perhaps we have much to learn from the ants and the bees and the way they manage to run millions-strong social units smoothly and efficiently, with relatively little internal contention. However, their hyper-sociality is genetically encoded and largely automated, and the vast majority of their populations – the working stiffs, the warriors, the drones – are near-identical genetic clones. Their self-sacrifice and *kin altruism* in foregoing reproduction are thus altogether involuntary.

In a somewhat similar vein, my son Nathaniel, a code writer and computer game afficionado, has suggested that on-line virtual reality communities may be the ultimate answer to the conundrum of shared mind in the Society of Strangers. In such communities, transparency and honesty are guaranteed by fully-automated A.I. codes. Likewise, a common reality is mandated by the Program's explicit *shared meaning* and rigid *code of conduct*. Whatever diversity of mind the participants may bring to the digital table, they leave it behind when they enter the fully-specified virtual reality. Though of course, it is not clear who would care to live in such a dystopic Brave New World.[20] Free will, it seems, however messy, is still a choice ingredient of joy.

10.8 Final note

It is not clear if the clamoring factions in our crowded societies of strangers could ever find enough reciprocal empathy to restore the balance between excessive diversity and requisite commonality. What is most worrisome, I suppose, is our recurrent obliviousness to the lessons of both evolution and history. That is, our blindness to the adaptive compromise struck so long ago by both social species and cultural populations, a compromise by which they have been managing the delicate balance between diversity and commonality, and between selfishness and empathy.

It may well be that our sporadic experiments in large-scale consensual Democracy are doomed, and have been doomed from the very start. Unless we can somehow find a way of building commonality and coherence of mind in our large-scale societies of strangers, the two choices we seem to be facing are both regressive:

- regression to the consensual Society of Intimates
- regression to a coercive Society of Strangers

Evolutionary regression is well known but relatively rare – think marine mammals, flightless birds, or tiny marine worms that lost their complex internal structure. Our obsession with eternal progress doesn't help either, nor does our addiction to endless growth and development and the environmental devastation that comes in their wake. What is more, in both biology and culture, the farthest you pursue a developmental path, the more entrenched and rigid the structure becomes and the more difficult it is to reverse course. The Society

20. Huxley (1932). A recent report on the digitilization of Estonia, a small, culturally-homogeneous country, suggests that perhaps some societies are desperate enough to give this venture a shot (Heller 2017).

of Strangers is not yet biologically ingrained. But the oft-touted flexibility and reversibility of cultural evolution seem, on close inspection, somewhat illusory.

A less radical possibility, lastly, is regression to extreme *localism* within the extant framework of the Society of Strangers. That is, a systematic downward devolution of functions, powers and decision-making mechanisms to smaller and smaller social units, where a measure of familiarity, intimacy and trust is still possible. Whether such a solution to our current predicament is at all feasible, given the deeply entrenched social, economic, legal and political power structure, remains an open question.

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General index

Y

Z

Coherence, connectivity and the fitting together of smaller parts into larger structures and a coherent whole is the hallmark of complex biologically-based systems. As a structure-internal constraint, coherence makes it possible for the parts to work together as a whole. As an external constraint, it lets complex system evolve and adapt to novel contexts. As a constraint on information processing, it makes new knowledge accessible to the maturing, learning or evolving mind-brain. As a constraint on cultures, it enables members of social groups to be empathic and cooperative. As a constraint on language and communication, lastly, it allows the mind of speakers to be accessible to the mind of hearers.

Part I explores first the role of coherence in the evolution of complex biological design, from precellular to mono-cellular to multi-cellular to multi-organ sentient beings. The complex hierarchic design of the mind-brain is explored next, probing the coherent organization of major brain systems – perception, attention, motor control, memory and language. In surveying the coherence of cultures next, the first-evolved Society of Intimates is viewed as the model for social cohesion, empathy, trust and cooperation. Part II deals with language and communication, touching upon the coherent organization of semantic memory, event clauses and clause chains, and the central role of grammar in coherent communication. Part III deals with three general issues. First, the role of coherence in organized science. Second, the eternal seesaw of selfish vs. social motivation in coherently functioning cultures. And last, the frail balance between homogeneity diversity in large-scale Societies of Strangers.

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