



Defining Communication and Language from Within a Pluralistic Evolutionary Worldview

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Abstract

New definitions are proposed for communication and language. Communication is defined as the evolution of physical, biochemical, cellular, community, and technological information exchange. Language is defined as community communication whereby the information exchanged comprises evolving individual and group-constructed knowledge and beliefs, that are enacted, narrated, or otherwise conveyed by evolving rule-governed and meaningful symbol systems, that are grounded, interpreted, and used from within evolving embodied, cognitive, ecological, sociocultural, and technological niches. These definitions place emphasis on the evolutionary aspects of communication and language, and they are here differentiated from four older paradigms that instead focus either on the referential or social aspects of language, or the informational or semantic aspects of communication. In contrast with these paradigms, the definitions proposed here for communication and language are in line with a pluralistic evolutionary worldview, one that necessitates the recognition that a multitude of units, levels, mechanisms and processes are involved in bringing forth communication and language.

Keywords Communication · Language · Information · Worldviews · Applied evolutionary epistemology

1 Introduction and Outline

This paper defines communication and language from within a pluralistic evolutionary worldview, one that is distinct from four older paradigms that have played determining roles in how communication and language have been conceptualized and studied throughout intellectual history. These older epistemological frameworks include the referential, social, informational, and semantic approach. The referential and the social approach pertain to how scholars traditionally understand language. The informational and the semantic approach refer to how scholars currently understand communication, either linguistic or non-linguistic in kind.

The different paradigms provide windows on the specific “Zeitgeist” of the age wherein they were first formulated. The referential approach to language dates back to ancient philosophical and religious worldviews that endorse the idea

that language provides knowledge, understood as justified true beliefs, about the world. The social approach to language originates in Renaissance and modern times when moral and social contract philosophers characterize language not as knowledge but as a communicative tool, one that bonds individuals into sociopolitical societies. Language studies have ever since also incorporated theories on communication. The informational approach to communication arises at the turn of the twentieth century, in conjunction with the invention of new media and computational technologies that define communication as the transfer of information. The semantic approach to communication originates from the middle of the twentieth century onward and investigates how the information transmitted during communication is established and attributed with meaning.

The first two paradigms predate the introduction of evolutionary theories, the latter two paradigms were originally formulated independently from the advances made in the evolutionary sciences. Consequently, neither of the older paradigms take evolution as the starting point for their theorizing on either language or communication. Here, instead, the older intellectual insights on communication and language are reevaluated from within

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an evolutionary worldview, and communication and language are redefined accordingly.

2 Defining Communication and Language as Evolutionary Phenomena

Acknowledging evolution as real, communication is here defined as the evolution of physical, biochemical, cellular, community, and technological information exchange (Table 1). Keywords that distinguish this definition from previous ones are “evolution” and “exchange”, and also the concept of “information” is reconceptualized. Communication has long been recognized to involve “information” “transfer” (Shannon 1948b), but the evolutionary origin of information has often remained unaddressed, and information transfer has been understood as a passive transmission of “data”. However, like all natural phenomena, also information evolved, and its origin and exchange can only be made sense of in the light of evolution. Here, five kinds of information are distinguished, physical, biochemical, cellular, community, and technological information. These kinds of information evolved out of one another, and all are the subject of communicative exchange. By emphasizing that communication involves the evolution and exchange of different kinds of information rather than the transfer of information, a more active role is attributed to communicating-informational entities and agents. In fact, the distinction between communication and information becomes fluid because the very identification of information as being of a specific kind can already be understood as communicative.

Language also needs to be understood from within an evolutionary worldview. Language is defined as those types of community communication whereby the information exchanged comprises evolving individual and group-constructed knowledge and beliefs, that are enacted, narrated, or otherwise conveyed by evolving rule-governed and meaningful symbol systems, that are grounded, interpreted, and used from within evolving embodied, cognitive, ecological, sociocultural, and technological niches. These definitions are now discussed individually.

2.1 Communication

Information exchange is a universal phenomenon. Physical objects from atoms to planets, quasars, or pulsars emit electromagnetic energy that travels in particles or waves as large as radio waves and as short as gamma rays. Through their act of radiation, these waves can induce actual physical alterations in recipient objects and subjects. X-rays, for example, can induce genetic mutations (Muller 1928), and humans have learned to use x-rays for gene studies as well as for medical imaging. Larger electromagnetic waves such as radio waves emit data on the mass and location of objects, and here too, humans, and perhaps other beings in the universe have learned to use these waves for the broadcasting of music and other signals (Korpela 2019). On the subatomic scale, quantum entanglement suggests that even elementary particles residing at different locations in the universe might exchange information, although Einstein dismissed this as “spooky action at a distance” (Born 1971), and also the no-communication theorem deems such unlikely (Ghirardi et al. 1988).

While the verdict is still out on quantum entanglement, on a level more familiar to us, atoms, molecules, and ions engage in chemical bonds (Pauling 1960) that give way to the formation of chemical compounds that underlie the formation of matter. Such bonding depends upon electromagnetic interactions that can, more or less, be understood from within quantum mechanics and quantum information theory (Bennett and Shor 1998; Nalewajski 2004).

On earth, at least, such physical and chemical communication processes have evolved further into cellular, community, and technological communication. Each of these communication levels depend upon information that evolved at previous levels, and this information becomes recycled, reinterpreted, and transformed into new types of being ranging from non-living, to living, to manufactured entities.

Communication understood as physical, biochemical, cellular, community, and technological information exchange can be considered as forming an interactional hierarchy (Gontier 2021). The levels of this hierarchy evolved consecutively over time, but since their existence, the different levels also interact reticulately (Fig. 1). Thus, in the communication hierarchy, biochemical communication follows physical communication in time, and it is actually

Table 1 Definitions for communication and language

Communication	The evolution of physical, biochemical, cellular, community, and technological information exchange
Language	Community communication whereby the information exchanged comprises evolving individual and group-constructed knowledge and beliefs, that are enacted, narrated, or otherwise conveyed by evolving rule-governed and meaningful symbol systems, that are grounded, interpreted, and used from within evolving embodied, cognitive, ecological, sociocultural, and technological niches

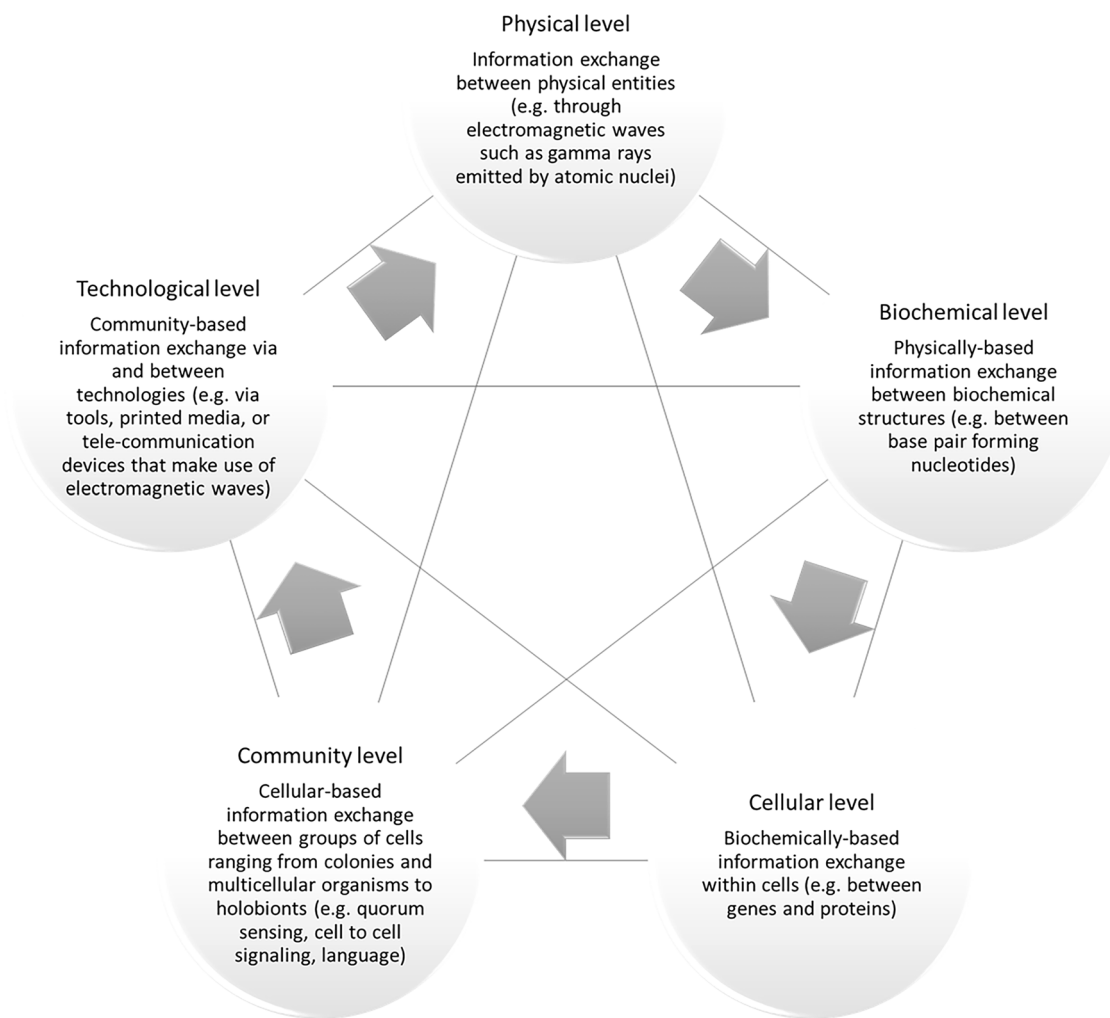


Fig. 1 The interactional communication-information hierarchy. The different levels of this hierarchy build upon and recycle older levels over time as shown by the thick arrows. Since their existence, the

different levels also interact reticulately in all possible directions as shown by the narrow lines

dependent upon a reorganization and reutilization of physical communication. Cellular communication is based upon both biochemical and physical communication, and cellular communication underlies community communication that in turn enables technological communication that again recycles parts of the older levels.

How is information exchanged at the different levels of the communication hierarchy? It is now well-known that molecules such as nucleotides, amino acids, sugars, and phosphates precede and underlie the evolution of life (Kolb 2019). These molecules are naturally occurring physical formations that are found inside and outside earth. Meteors from space, for example, contain numerous nucleobases (Callahan et al. 2011). The structure of these molecules can already be understood as embodying information.

On earth, at least, these molecules have additionally evolved complex chemical and biochemical interactions that underlie the formation of structures that embody, exchange, and relocate information in new ways. The transition from physical to biochemical information is best exemplified by RNA and DNA molecules. These are structures that actually contain the information needed to build the molecules they are composed of.

Cellular communication occurs at a following level of the hierarchy. Intracellular communication is always dependent and based upon biochemical communication that again spirals down to physical communication. Within cells, for example, DNA residing in the nucleus provides the information needed for amino acid composition in the ribosomes, and amino acids in turn underlie protein formation that

enables overall cell functioning. The process can also work in the reverse, where through epigenetic processes occurring during the lifetime of the individual cell, RNA travels to DNA and reverse engineers the genetic code. Processes like these are best characterized as a form of natural genetic engineering (Shapiro 2017, 2021), or as the harnessing of stochasticity (Noble 2021) whereby cellular organisms can learn and actively influence the future course of evolution.

Cells can also communicate with other cells, and these communications rapidly move to a community level, one where cell types or organismal and even species boundaries are easily crossed. Bacterial colonies, for example, can communicate through quorum sensing (Melke et al. 2010). This involves a biochemical process that is based upon molecules called autoinducers that signal population density. Quorum sensing enables individual members to coordinate behavior portrayed at the group level such as virulence or bioluminescence.

Prokaryotes can also communicate with non-colony members and exchange genes with other bacterial groups or with bacteriophages via processes of lateral gene transfer. In eukaryotes, organelles such as mitochondria and chloroplasts have a bacterial origin (Margulis 1991) and their acquisition and retention was the result of cell-to-cell information exchange. In cases like these, community communication involves reticulate interactions between cellular, biochemical, and physical levels that transcend the consecutively evolved levels of the communication hierarchy. Organelles, for example, now function as intracellular tools for energy householding.

Cell-to-cell communication in eukaryotic organisms such as protists, fungi, plants, or animals, also always relies on biochemical signaling (Helmreich 2001). In multicellular organisms with brains, for example, cell-to-cell communication amongst neurons occurs via neurotransmitters which are chemical signals encoded by genes. Within neurons, these chemical signals are converted into electrical signals that define action potentials. Neural networks send messages via the spinal cord to the body's nerves that control the muscle and organ cells. In such multicellular structures cell types, organs, and even organismal boundaries are easily crossed because the cells also communicate with the organism's microbiome and virome that comprise numerous bacterial types and viruses that live in and outside the host's body.

Eukaryotes are best characterized as holobionts (Margulis 1991), composite organisms comprised of a host biont and bacterial and viral symbionts that together function as a new ecological unit. Within the holobiont community commonly known as a human organism, for example, neuronal networks, the respiratory and the gastro-intestinal tract, and the integumentary system that includes the skin, hair, nails, or exocrine glands, communicate via a series of biochemical signals with the organism's microbiome and virome, and

this community communication induces change in all parties involved. Community communication along the microbiota-brain-gut axis, for example, is currently implicated in overall neural development or degeneration, as well as mental health and disorders, or mood and personality display (Cryan et al. 2019). Also the lungs and the upper respiratory tract are inhabited by microbial communities that besides the classic pulmonary and nasopharyngeal diseases provide direct health benefits to their host, by increasing immunity, for example, or smell (Dickson et al. 2016). How that happens is always based upon biochemical and cellular communication pathways. Community communication reaches deep into the physical and biochemical level, where neurotoxins and chemicals encountered during the lifetime of the holobiont can affect and alter these pathways.

Per definition, every holobiont is thus already a community made up of different bionts. Communication can also occur between holobionts. Canine barking, for example, conveys information that can become interpreted and understood by conspecifics as well as by other animals such as felines or humans. Ethologists and veterinarians, in this regard, distinguish between different types of barks that each have different meanings (Yeon 2007). Vice versa, experiments with dogs have demonstrated that these animals can also learn aspects of the communicative system of other holobionts. They can, for example, learn to associate human words with entities in the world (Kaminski et al. 2004).

Many of these holobiont communities, moreover, are able to exchange information via technologies. Chicken, for example, use their beaks not merely as eating tools. Pecking behavior (Lewis 2022) signals and effectively establishes social rank and power, and beaks thus become transformed into communicative tools and actual weapons. Another example is avian male nest building, which functions as a signal for health and parental disposition (Moreno 2012). Humans, for example, are known to make tallies, quipu, or other mnemonic devices that extend their cognition (Clark and Chalmers 1998). Artifacts like these communicate meaning, either to the maker or to the user or interpreter of the artifacts. In these examples, community-based ecological, sociocultural, and cognitive resources are transformed into technical devices that embody and underlie information exchange. Humans are now even able to utilize physical phenomena such as radio waves for long-distance communication. Technological communication transcends the evolution of the communication hierarchy over time, and technological communication can occur reticulately with the other levels of the hierarchy.

The evolution of communication is thus characterizable as an interactional hierarchy. Over the course of natural history, this communication-information hierarchy has evolved from the physical to the technological by building upon, reusing, and transforming accomplishments of intermediate levels, and by interacting reticulately amongst these levels.

The levels interact spatially, not only linearly or bidirectionally, but also reticulately, in a network-like fashion. On a physical level, for example, by converting hydrogen into helium, the sun creates energy that radiates outward as electromagnetic radiation (light). This solar radiation heats up the earth and the physical objects contained by it, and the heat produced influences air pressures that underlie phenomena such as wind formation. Plant pollen and pollinating insects including butterflies, wasps, and honey bees surf these winds that consequently become transportation devices. Insects have evolved the capacity to see within the ultraviolet light spectrum and flowering plants emit these lights that subsequently become cues and signals, and why not tools, to communicate on the location of their pollen. A complex co-evolutionary symbiosis is established, one that makes use of various levels of the communication-information hierarchy.

Reticulate interactions demonstrate how physical or biochemical signals can become transformed into communicative tools at a cellular and community level. Communication operates at different levels simultaneously, and the establishment of communication does not always need to pass through and level up or down the different strands of the hierarchy. Rather, numerous reticulate interactions occur between the different strands.

2.2 Language

Language can be defined broadly as a form of community communication that occurs between holobionts. Defining language as a subdivision of communication diverges from more traditional views that understand language as different from communication. On such accounts, communication is understood as a social act, and language is argued to be distinct from communication because it enables private linguistic thought that enables knowledge and that requires intentionality rather than social sharing (Wittgenstein 1953, §243, and for a discussion see Nielsen 2008).

Instead, language is here defined as a subdivision of communication because language is dependent upon the evolution of communication understood as information exchange, while information exchange does not necessarily require language. On the contrary, the previous section detailed how information can be exchanged non-linguistically and broadcasted a-socially and unintentionally.

Natural history demonstrates that there exist numerous kinds of community communication, ranging from quorum sensing to language. In all cases, community communication is always physical, biochemical, and cellular-based, and community communication often also leads to technological communication. Quorum sensing, for example, is a tool used by bacteria to establish virulence, and language can be used as a tool for enculturation or indoctrination.

What kind of information then, in particular, is exchanged by language through physical, biochemical, and cellular-based community communication?

In language, the information exchanged comprises evolving individual and group-constructed knowledge and beliefs (the *content* of language), that are enacted, narrated, or otherwise conveyed by evolving rule-governed and meaningful symbol systems (the *form* of language), that are grounded, interpreted, and used from within evolving embodied, cognitive, ecological, sociocultural, and technological niches (the *origin* of language).

The *content* of language is traditionally conceptualized as being about an individual's rational beliefs and ideas, or its empirical sensations, perceptions, and emotions. But content-wise, language also expresses the beliefs and desires of others, much of which is acquired either in space, from conspecifics, or it was acquired over time, by ancestors who passed it on to future generations. Knowledge can be a common denominator for all linguistic statements, and this knowledge refers to individual as well as group-constructed, embodied and cognitive knowledge. Scientific research here is teaching us that the evolution of such knowledge is minimally dependent upon the evolution of physical, biochemical, cellular, and community communication.

In evolving languages, the phylogenetically and ontogenetically acquired knowledge is per definition symbolic, because no knowledge stands in direct one-to-one correspondence with the physical or sociocultural world, simply because there is always the act of information exchange and thus of interpretation and translation. Acquired knowledge becomes communicated via equally evolving rule-governed, syntactic and meaningful symbol systems that define the *form* of language.

Scholars in different fields have by and large agreed that it is the use of symbols and grammar that makes human language innovative. Tomasello (2003, p. 94) in psychology, for example, argued that "Human communication is most clearly distinguished from the communication of other primate species by its use of (1) symbols and (2) grammar." Hurford (2004, p. 552) in computational linguistics, stated that "There are two features of human language (including manual sign language) that are simply absent from natural communication systems of any other species. One is learned arbitrary symbols, and the other is recursive, semantically compositional, syntax." And Bickerton (2007, p. 511), from within linguistics, endorsed that "Symbolic units and syntax are the only real novelties in human communication...".

These views however are outdated. Structures from gene complexes to entire holobionts can be understood as rule-governed and symbolic of knowledge that evolved over the course of evolution. What is specific about language is not symbolism or syntax per se, but how these become conveyed. In language, knowledge is acted out or *enacted*

(Maturana and Varela 1980) and *narrated* (Ferretti 2022). Spoken language (Lieberman 2007), for example, makes use of the various units that make up the supra-laryngeal vocal tract, facial muscles, and sound waves to produce syntactic symbols. Co-verbal gesturing (Morgenstern and Goldin-Meadow 2022) and sign languages (Corballis 2010) are dependent upon facial expressions as well as hand and arm gestures that together produce syntactic symbols. In pantomime, the entire body is used to communicate (Żywiczyński et al. 2021). All of these features require complex neurological and cellular control, and their very emergence depends upon evolved gene-regulatory networks that orchestrate anatomical form, that each follow a syntax of their own, and that each stand as symbols for complex features. Body and brain moreover hold complex communicative interactions with the environment (Varela et al. 2017; Newen et al. 2018). Scientific research here too is teaching us that these acts are minimally dependent upon the evolution of physical, biochemical, cellular, and community communication.

The content, form, and act of languages are in turn evolutionarily grounded in evolving embodied cognitive (Deacon 1997; Clark and Chalmers 1998; Bertolotti and Magnani 2017; Sinha 2013), sociocultural (Odling-Smee et al. 2003), ecological (Lewontin 1970), and technological (Heylighen 2021) niches where they *originate*. These constructed, cumulative, and transgenerational niches demonstrate community-level evolution (Sukhoverkhov and Gontier 2021) that in turn relies on biological, ecological, and sociocultural, and thus extra-genetic inheritance (Richerson and Boyd 2005; Jablonka and Lamb 2020).

It is important to point out that the above gives a definition of what language is, but it does not explain exactly how language evolved beyond the recognition that the content, form, act, narration, and origin of language are always dependent upon the evolution of communication understood as information exchange at multiple levels of evolving hierarchies. The exact units and levels, how they form hierarchies, and how they evolve, by which mechanisms and processes, remain poorly understood. Here, an applied evolutionary epistemological approach can help with identifying these elements (Gontier 2017, 2018). This point is revisited in the last section of this paper. First, we inspect how language and communication has been defined in older, non-evolutionary worldviews.

3 Four Older Worldviews Definitive of Intellectual History

The evolutionary approach to communication and language proposed here differs from the referential and social approach to language, and the informational and semantic approach to communication (Fig. 2). These older approaches

to language or communication are indicative of changing worldviews on how scholars in intellectual history have understood the relation between humans and the physical and social world.

3.1 The Referential Approach to Language

The referential approach to language is associated with schools that endorse ontological monism, realism, idealism, and rationalism. These schools assume the existence of a direct relationship between object and representamen, which means that objects and the words (or thoughts) used to refer to them, when properly named in accordance with the essence of things, are in congruence with one another. Ideally this enables a one-to-one correspondence between language, thought, and things in the world.

The referential approach to language is typical of ancient cosmologies as they were developed by Sumerian and Egyptian civilizations, Ionic and Hellenic philosophy, the three Semitic religions (Judaism, Christianity and Islam), and Eastern lifeways including Hinduism, Buddhism, Jainism, Taoism, and Confucianism. Ancient cosmologies understand language as a uniquely human capacity that enables reasoning understood both as thinking and knowing. Language is what differentiates humans from other creatures in the world, and it often is conceptualized as enabling insight or participation into true, divine, or otherwise sacred knowledge.

In ancient Egypt, for example, Toth as the spokesman of Ra and the god of speech, writing, and numbers is one of the main lawgivers because he possesses insight into true and sacred wisdom (Derrida 1983). Also the Sanskrit of the Vedas is considered a sacred and philosophical language that enables reasoning about the cosmos in Hinduism, Buddhism, and Jainism.

In ancient Greek philosophies, the *logos* (understood interchangeably as language, thought, reason, and order) enables humans to understand the cosmos because language opens up a relationship between humans and the world. Plato (1921, pp. 389a–390e) for example, in his dialogue *Cratylus*, has Socrates explain how with language, “artisans of names” are able to call things by their proper names, according to their essence. As “name-makers” they are “lawgivers” (389a) that name things “fitted by the nature of each object” and with the eye “fixed upon the absolute or ideal name” (389d). Language is thus thought to refer to the true essence of things, and the unearthing of this relationship is what distinguishes true knowledge (*epistêmê*) from mere opinions (*doxa*), and what enables individual intellects to somehow connect to a hypothesized world soul that can be understood as universal true knowledge (what later would be called the noosphere).

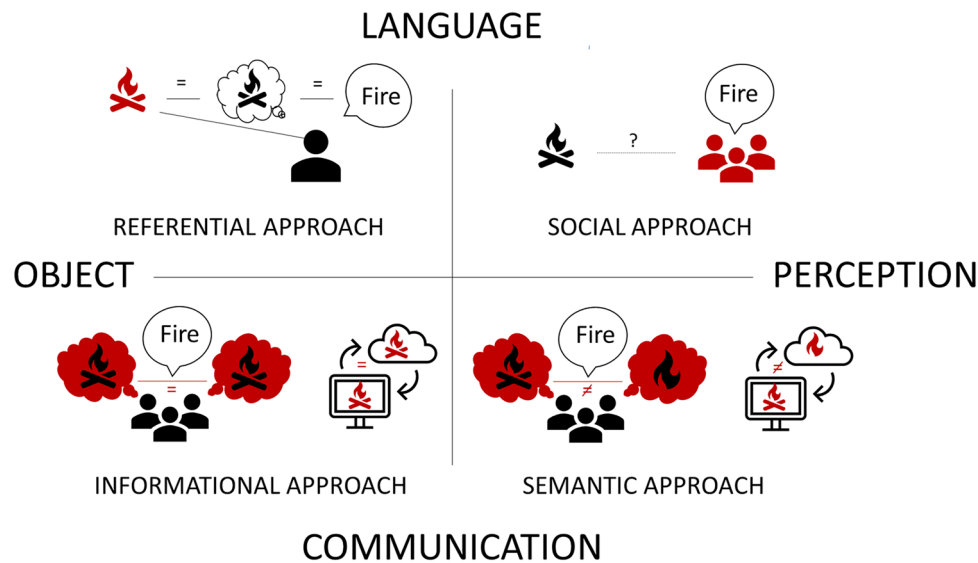


Fig. 2 The referential and social approach to language, and the informational and semantic approach to communication. The upper two quadrants pertain to how scholars in intellectual history have understood language. The referential approach assumes that language manifests or represents knowledge about objects in the world that is knowable through reason. The social approach instead understands language as emerging from social conventions maintained by community members. The lower two quadrants pertain to how scholars have understood communication. The informational approach

understands communication as the transfer of information understood as data or messages. The semantic approach focusses on how meaning and understanding is established during communication. The approaches also intersect. The referential approach to language and the informational approach to communication are both object-based (the left two quadrants), while the social approach to language and the semantic approach to communication are both focused on perception or how objects are attributed with meaning and interpreted by knowing subjects (the right two quadrants)

The view that language enables insight into sacred knowledge is also foundational for Judeo-Christian religions. The *Book of Genesis*, for example, which is a book shared by both Judean (in the *Pentateuch*) and Christian communities (in the *Old Testament*), details how the Judeo-Christian deity creates the universe by saying the words “Let there be light.” Creation thus becomes understood as a speech act. Adam, created in the image of the Judeo-Christian god, is said to receive his soul from the deity, and following ancient Greek thinking, it is the intellectual part of the soul that enables reasoning by language. The gift of reason and language subsequently enables Adam to acquire sacred knowledge and to participate in the divine plan, which he does by naming the animals (Genesis, 2: 19–20). Adam in this regard is similar to Plato’s *onomatourgou* that names with insight into the essence of things. Religious scholars would subsequently and for many centuries attempt to reconstruct this “Adamic language” that was supposedly spoken by both Adam and the Judeo-Christian deity because this language was thought to provide true knowledge of the world, if not to have actual creating powers (Gontier 2009).

In the Christian *New Testament*, the *Gospel of John* (1,2–1,5) opens by saying that “In the beginning was the Word, and the Word was with God, and the Word was God. The same was in the beginning with God. All things were made by him; and without him was not anything made that

hath been made.” Interesting here is that in the original version of the gospel, which was written in ancient Greek, the Word was written as the *Logos*.

Finally, also in the *Qur’ān*, language is considered a gift from Allah (e.g. Surah 41:21: Allah gave us speech, as He gave speech to all others”).

Today, themes studied by these intellectual traditions continue to be analyzed from within the schools of analytical philosophy as well as the philosophy of mind. In the former tradition, scholars examine the truth value of linguistic propositions or how able (formal, logical) languages are in providing factual knowledge about the world. In the latter, scholars examine how this knowledge relation between language and the world is mediated by cognition, and cognition itself becomes understood as a language of the mind (e.g. Fodor’s 1975 *mentalese*). To maintain the congruence between language and reason, this stance often assumes a psychic unity of mankind (Bastian 1881) as well as a universal human capacity for language (e.g. Chomsky 1965, 1972).

3.2 The Social Approach to Language

The social approach to language associates with epistemic schools of nominalism, empiricism, historical particularism, and relativism. The social approach to language develops from the Renaissance onwards and later becomes endorsed

by moral philosophers, linguists, anthropologists, sociologists, and early students of natural history research. These scholars all understand language as a natural and communicative system that functions as a social means to bond individuals into sociopolitical societies.

Examples are the moral philosophers known as social contract-theoreticians, including Hobbes (1651), Smith (1762), Hume (1739), Herder (1778), and Rousseau (1781). These scholars study language not as a divine gift that enables one to express true and factual knowledge about the world, but as the means to socially and culturally bond individuals into society. Language results from social conventions and it establishes a social contract that enables humans to distance themselves from a natural, biological state and to become citizens of an artificial, sociopolitical society. How and if language relates to objects in the physical world is understood as secondary and even as nonsensical. Rather, the emphasis within this approach is placed on how language arises from social conventions, and how language enables individual and cultural identity formation.

On a darker side of history, research on the sociocultural aspects of language originally resulted in the formulation of historicist and racist thought. Because spoken language was conceptualized to be an expression of the highest good and the common will of people, languages were used as a means to categorize and measure hypothesized “levels of civilization”. Languages spoken in industrialized societies such as Latin, French, German or English, for example, were erroneously considered superior to Asiatic or native American tongues, and non-industrialized nations were understood as “underdeveloped” when compared to European cultures.

Scholars in this tradition would furthermore commence research on the origin and nature of a “primordial” natural or biological language. Rousseau, for example, argued that biological organisms in a “natural state” would communicate with gestures and uncontrollable “cries of passion”. Early historical linguists of the nineteenth century, such as Wilhelm von Humboldt (1836), Frederic Farrar (1860), and Auguste Schleicher (1861/1862) would also look into the nature of a hypothesized “ur-”language, and investigate from which bodily organs such a proto-language would develop. This would eventually found research first on the historical origin, and later also on the evolution of language.

In his *Origin of Species*, Darwin (1859) would compare the historical diversification of languages with the diversification of species, which would inspire Schleicher to understand language diversification as exemplar of Darwinian evolution. Haeckel (1874) was directly influenced by both scholars when he drew the first actual phylogenetic tree diagrams (Gontier 2011).

Early evolutionary research on language was also more often than not mistaken. For one, reconstruction methods of original (Adamic) languages remained artificial rather

than historical because they remained inspired by religious ideas. Secondly, research on biological precursors to language often resulted in erroneous comparisons of language with other forms of animal communication that especially Max Müller (1866) critiqued as “Bow-wow”, “Pooh-pooh”, “Ding-dong” and “Yo-he-ho” theories. Thirdly, both lines of research often continued to be formulated in racist jargon.

In 1866, the French linguistic society banned all publications on the reconstruction of universal languages as well as research on the evolution of language (Lock and Peters 1999). Linguistics would subsequently abandon diachronic research on language in favor of synchronic research of which Ferdinand de Saussure (1967, 2006) is commonly considered a founding father. Echoing Aristotle, de Saussure argued for the arbitrariness of the sign, and he would continue to understand the content of language as resulting from social convention.

De Saussure (1967: §52-53, p 25) furthermore distinguished the *langage* (the physical, physiological, and psychological faculty of language) from the *langue* (that part of the language faculty that is based upon necessary social conventions needed to practice language) and the *parole* (individual speech). “Mais qu’est-ce que la langue? Pour nous elle ne se confond pas avec le langage; elle n’en est qu’une partie déterminée, essentielle, il est vrai. C’est à la fois un produit social de la faculté du langage et un ensemble de conventions nécessaires, adoptées par le social pour permettre l’exercice de cette faculté chez les individus. Pris dans son tout, le langage est multiforme et hétéroclite: à cheval sur plusieurs domaines, à la fois physique, physiologique et psychique, il appartient encore au domaine individuel et au domaine social; il ne se laisse classer dans aucune catégorie des faits humains, parce qu’on ne sait comment dégager son unité. La langue, au contraire, est un tout en soi et un principe de classifications. Dès que nous lui donnons la première place parmi les faits de langage, nous introduisons un ordre naturel dans un ensemble qui ne se prête à aucune autre.”

The ideas on the social and conventional aspects of language would be echoed in social and cultural anthropology. Here, going back to the works of Herder (1778) and Bastian (1881), scholars would counter racist and historicist thinking by on the one hand considering the different languages as historical particular which disables any form of staging. On the other hand, they would understand the faculty of language as a human (biological) universal capacity resulting from the psychic unity of mankind. These views were effective in countering false racist theories, but they would widen the nature-culture divide. On the nature side, the biological and cognitive capacity for language would become picked up by Chomskyan and biolinguistics (Givón 2002; Jenkins 2000; Puppel 1995) that consorted not with the social but with the cognitive turn in linguistics as well as with the school of philosophy of mind that traditionally was part of

the referential approach to language. On the cultural side, research on different languages would bring forth ideas on the superorganic (Kroeber 1917) as well as linguistic relativity (e.g. the Sapir-Whorf hypothesis, Koerner 2000). In recent years, scholars have attempted to close the gap by introducing co-evolutionary theories that rejoin nature with culture.

3.3 The Informational Approach to Communication

The informational approach to communication associates with positivism, objectivism, materialism, physicalism, scientism, and quantification. Communication theory evolved at the turn of the twentieth century out of the rise of new information technologies such as the telegraph and telephone as well as research on the nature of intelligence and counterintelligence during the two world wars. Claude Shannon (1945) outlined a mathematical theory of cryptography that once declassified was published three years later in the *Bell Technical Journal* (Shannon 1948a). The document schematized how Shannon understood the transfer of information as going from a sender to a receiver. This founded his general theory of communication (Fig. 3, Shannon 1948b).

A year later, Shannon reprinted the paper in a book co-authored by Warren Weaver who added a chapter on mathematical theories on communication (Shannon and Weaver 1949). More focused on communication than on information, Weaver defined communication as “the procedures by which one mind may affect another” which happens in the case of communication by human language or behavior, and “the procedures by means of which one mechanism affects another mechanism” which happens in the case of communication by technologies (Shannon and Weaver 1949, p. 3). Communication is thus recognized to extend living organisms, and in that regard, communication can be non-linguistic, non-cognitive, and a-social.

The framework became used extensively in the biological and the behavioral sciences on the one hand, and the computational sciences (von Neumann 1948) and artificial

Fig. 3 Claude Shannon’s (1948b) theory of communication. Communication occurs when information is transferred between distinct entities through a “communication channel”, going from a “sender” that “encodes” a “message” into a “signal”, to a “receiver” that “decodes” the “signal” into the “message”. “Noise” might perturb the quality whereby the signal is “transmitted” in which case there is information decay or “entropy”

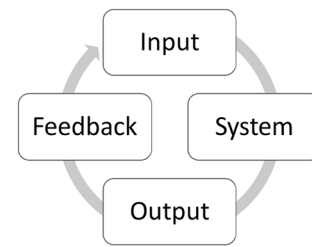
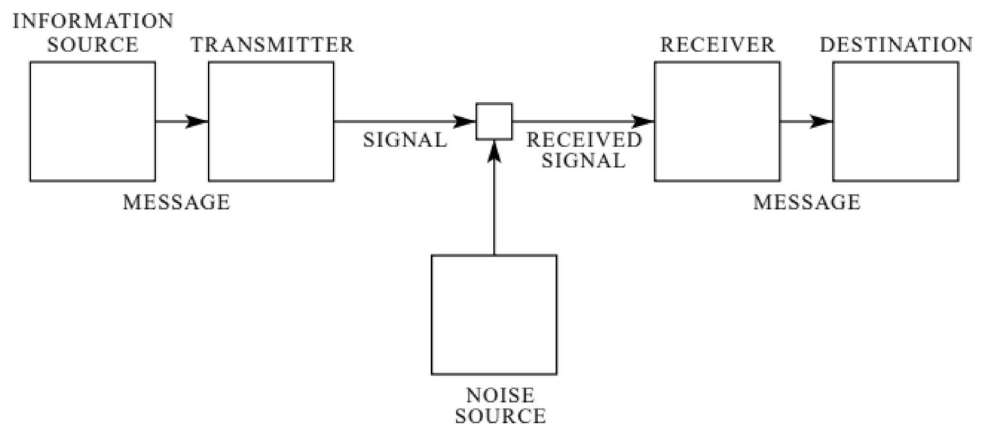


Fig. 4 A self-regulating open system maintained by a feedback loop between output and input

intelligence studies (Turing 1950) on the other. In both cases, information and communication theory also developed in close association with general systems theory (von Bertalanffy 1930) and with cybernetics (Wiener 1948/1965). This caused for scholars to understand organisms or technologies as partly open and partly closed systems that receive an “inflow” and produce an “outflow” of matter and energy that sometimes via a “feedback loop” returns onto the system which enables self-regulation (Fig. 4). The theory proved a major breakthrough for the understanding of agency (Sharov and Tønnessen 2021; Corning 2022; Vane-Wright 2019).

Although formulated outside the emerging evolutionary framework, the new terminology became very attractive for the new evolutionary sciences because it enabled scholars to avoid the “black box” the brain was at that moment in time, and to objectively approach the study of animal (communicative) behavior (Watson 1913; Skinner 1938).

The adoption of information theory jargon in early ethological research (Altmann 1974; Dawkins and Krebs 1978; Maynard Smith 2000) helped pave the way for understanding language as a communication system that is based upon information transfer that shares evolutionary continuity with animal communication. Early comparative psychological work, for example, including attempts to learn sign language and artificial languages such as Yerkish to non-human primates (Gardner et al. 1989; Rumbaugh 1977), were often inspired by the rising fields of psychology (Skinner 1957)

that originally endorsed a behavioristic, instructionist and most of all an informational approach to communication.

Today, these schools are often criticized for exclusively focusing on the study of behavioral outputs, and for not investigating how the brain lies at their origination. Nonetheless, their focus on observing and describing how and when communicative behavior is portrayed in human and other primate species during ontogeny was quite innovative in comparison to linguistic schools of thought that at the time merely investigated languages from a formal point of view, without taking either ontogeny or phylogeny into account.

The idea that language enables communication understood mostly as social information transfer is a premise that furthermore founded the field of evolutionary linguistics (Tomasello and Call 2007; Dunbar 1998; Hurford et al. 1998; Steels 2006). Pinker and Bloom (1990), for example, tried to synthesize the former schools by arguing that the biological faculty of language evolved by means of natural selection to enhance better social communication, understood as information transfer, at the sociocultural level. In

this regard, Pinker and Jackendoff (2005, p. 223), for example, argued that “[...] the language faculty evolved gradually in response to the adaptive value of more precise and efficient communication in a knowledge-using, socially interdependent lifestyle”.

3.4 The Semantic Approach to Communication

The semantic approach associates with schools of semanticity, pragmatism, phenomenology, symbolic interactionism, interpretivism, constructivism, subjectivism, enactivism, and qualitative research. The semantic approach to communication adds a cognitive turn to the informational approach, by examining how information becomes established and attributed with meaning by cognitive agents (Fig. 5).

How information is understood by the receiver can differ from the intention of the signaler, and this research avenue therefore takes intentionality and overall semiosis or meaning-making into account as it is studied in the fields of (bio)semiotics (Sharov and Tønnessen 2021) and semantic

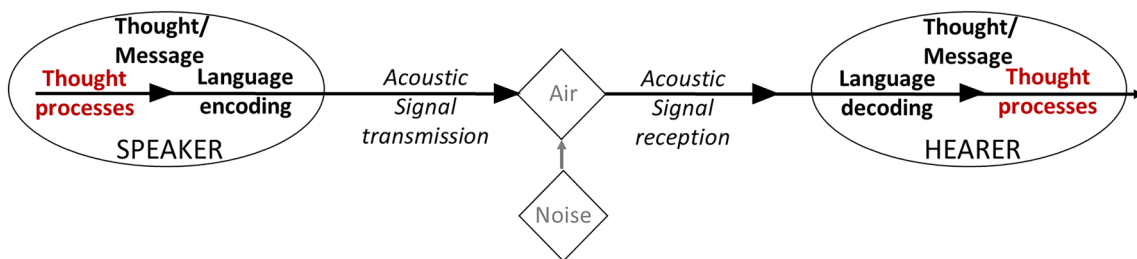
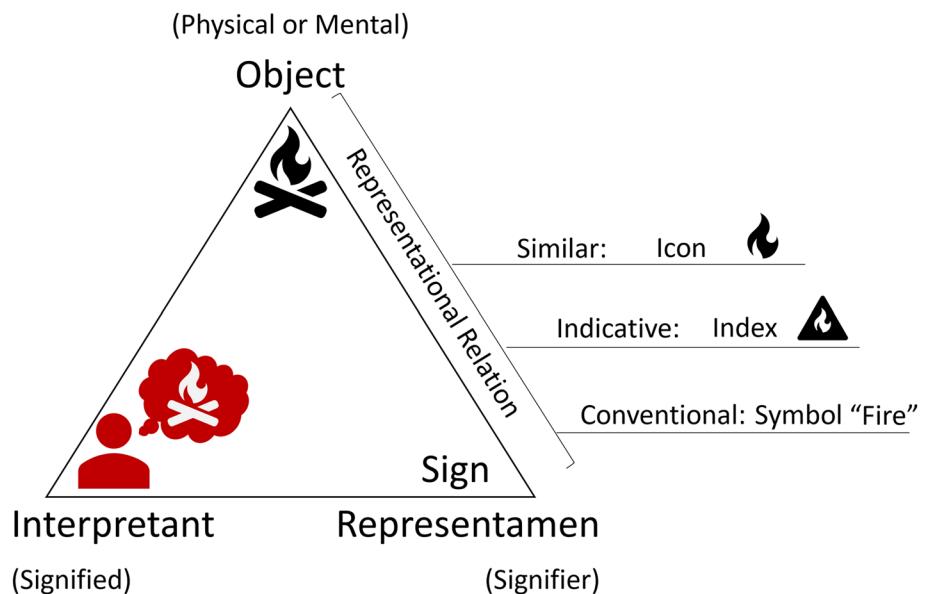


Fig. 5 Communication in light of the semantic-pragmatic approach. After Sperber and Wilson (1995, p. 4). Sperber and Wilson add a cognitive dimension to the Shannon-Weaver model of communication.

Communication requires interpretation and thus thought, and this brings in research on intentionality and theory of mind as well as context of use

Fig. 6 Charles Saunders Peirce’s theory of signs. The representational relation between object and sign can take on three forms: signs can be similar to the object they signify (icons), signs can indicate the object (indicative signs), or they hold a conventional relationship to them (symbols). Most of all, the object-sign relationship requires an interpretant, a cognizing object that interprets the meaning of signs



linguistics (Jackendoff 1983). It also links to pragmatics (Kempson 1977; Levinson 1983; Mey 1993; Verschueren et al. 1995; Carston 2002), because it examines how the meaning of words changes depending upon their use in discourse.

Semantic-pragmatic research links to Wittgensteinian “language games”, Foucauldian “regimes”, or Kuhnian “paradigms.” Scholars look into the use, context, and consequences of language discourse, as well as to research on the overall cognitive and sociocultural context wherein speakers formulate language. This in turn links to *umwelt* (von Uexküll 1921) or niche construction theory (Odling-Smee et al. 2003), research on we-intentionality (Sellars 1974), and 4-E cognition theories that understand cognition as embodied, embedded, extended, and enacted.

An early advocate of the semantic-pragmatic approach was Charles Saunders Peirce (Peirce 1931–1935) who expanded upon de Saussure’s distinction between the signifier and signified. With his theory on the nature of signs, Peirce added a third player to the object-sign relationship, namely the cognizing agent that interprets the meaning of signs (Fig. 6).

The semantic approach critiques the informational approach for assuming information transfer to somehow be direct (although fallible) and disembodied. Such assumptions raise questions about the fragmentation depicted in Fig. 3, and whether or not the communicative agent, humans in particular, can be dissociated from the message, or from the speech act whereby the message becomes encoded.

Information is not always this fragmentable. A pregnant lady (Fig. 7), for example, embodies that message and she broadcasts that information, often beyond her control. By focusing on the quantifiable aspects of information transfer, the nature of the communication channel and the nature of signals or signs are neglected.

Scholars in media and communication studies have also been debating the nature of the *medium*. McLuhan (1964, p. 1) understood media as “extensions” and he also famously argued that “the medium is the message/massage” (McLuhan et al. 1967). He understood the wheel, for example, as “an extension of the foot”, the book as “an extension of the eye,” clothing as “an extension of the skin,” the electric circuit as “an extension of the central nervous system”, etc.

“She is
pregnant”



Fig. 7 The embodiment of information

As a forerunner of theories on *extended cognition* (Clark and Chalmers 1998) as well as *niche construction theory* (Lewontin 1970), McLuhan emphasized the role media have in altering the environment. McLuhan et al. (1967, p. 41):

“Media, by altering the environment, evoke in us unique ratios of sense perceptions. The extension of any one sense alters the way we think and act—the way we perceive the world. When these ratios change, men change.”

McLuhan et al. (1967, p. 68) furthermore pointed out that “the new electronic dependence recreates the world in the image of a global village”. The new information technologies enable mass communication across such vast distances that it connects the entire world in such a way that a new and global community is formed.

Emphasizing the *semantic* aspects of communication requires research on the *sociocultural situatedness* of communication. The interpretation/perception of a message always depends upon the context wherein it was produced, and this is always also culturally informed.

Research on semantics here shifts to pragmatics. The focus lies on how meaning changes during speech acts (Austin 1962) and overall language use. Beyond word meaning, a further distinction can be made between the way words are used during conversations and the actions that follow from such speech acts. The word “donkey” for example, conventionally signifies a hooved animal, but it can also be used as an insult, the consequence of which is to denigrate someone.

Grice (1968) in this regard distinguished utterer’s and sentence-meaning, from word-meaning. Conversational implicature (Grice 1989) differs from what is said. Pragmatics brings in research on the speaker’s meaning, the utterance meaning, and the hearer’s interpretation and this relies heavily on notions such as intentionality and theory of mind.

Semantic-pragmatic theories have been formulated to better understand human language discourse, meaning-making, and comprehension. Much of this research was formulated outside of the field of evolutionary biology because scholars place emphasis on the here and now of intentional-pragmatic communication rather than on how it evolved. Nonetheless, connections have been made with evolutionary theory.

Millikan’s (1984, 1989) biosemantics theory, for example, argues that words or thoughts have proper functions because they were selected to be about something. Words refer to what they were selected to refer to. And the pragmatic relevance theory of Sperber and Wilson (1995, pp. 260–272; Sperber and Wilson 1986; Wilson and Sperber 2012), who understand communication and comprehension as a process of inference and intentionality, argue on evolutionary grounds that the inferential process is guided by expectations of relevance. Human cognition is assumed to have evolved to process information optimally, with a minimum amount of

effort. Thus, for information to be communicated and understood, the information needs to be relevant.

The semantic-pragmatic approach developed specifically to deal with intentionality typical of human language, and the theories are therefore difficult to apply to research on animal communication. Discussions on the matter can be found in Scott-Phillips (2015), Moore (2017), Bar-On (2021), and Warren and Call (2021).

4 Toward an Applied Evolutionary Epistemological Approach to Communication and Language

The different approaches to language and communication do not only diversify, several points of convergence also exist between them. The informational approach to communication somewhat mimics the referential approach typical of classical language research. Both approaches are object or signal-focused, and both assume a direct and even a truthful transmission of knowledge or information. The semantic approach to communication somewhat mimics the social approach to language, because both emphasize the intentional aspects of communication, and they thereby recognize the overall situatedness and embeddedness of communication in sociocultural, cognitive, and embodied practices.

Nonetheless, none of the four older approaches discussed take the fact of evolution as starting point for analyzing either language or communication. The referential and social approach to language predate evolutionary thinking, and the informational and semantic approach to communication originally developed outside of the evolutionary sciences. Scholars have *post factum* tried to apply their theories to the question of how language and communication evolved in humans and other animals, but comprehensive theories remain forthcoming.

Because of the multiple components involved in the evolution of communication and language, a pluralistic framework is needed that is able to identify, analyze, and assess the various units, levels, mechanisms and processes that underlie the evolution of these phenomena. Applied evolutionary epistemology (AEE) can provide that framework and delineate guidelines for a more evolutionary-informed study of communication and language.

AEE defines evolution as that what occurs when units evolve at levels of ontological hierarchies by mechanisms and processes. Numerous units can be identified to underlie both communication and language, ranging from gene-protein networks, to anatomical, behavioral, or cognitive traits, and traits that typify the symbolic systems (Gontier 2017, 2018). Units that underlie communication have here been shown to minimally evolve at a physical,

biochemical, cellular, community, and technological level. Language is a form of community communication that relies on the exchange of knowledge (founded upon information exchange) that is enacted, narrated, or otherwise conveyed by rule-governed and meaningful symbol systems, and these minimally evolve at cumulative and transgenerational levels ranging from embodied and cognitive to ecological, sociocultural, and technological niches. Much work remains to be done on the mechanisms and processes that underlie their origin and change through time (Zywiczynski et al. 2017).

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Declarations

Conflict of interest The author declares not to have any conflict of interest.

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