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Review Article

The causal relationship between theory of mind and language

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Abstract

Neurological studies reveal that theory of mind is a part of social intelligence in human beings and a requirement for language acquisition. Appropriate use of language is one important aspect of social life. Theory of mind is defined as understanding mental representations, and effective language use relies on monitoring the probable mental states of the listener, and making inferences about the mental states of the speaker. As the ability to understand our own minds and those of others is central to what it means to be a human, considering theory of mind and language as separate abilities in human mind may make little sense. The aim of this article is to illustrate the possible cause-effect relationship between language and theory of mind and the mutual role they play in human social life, by adopting the Relevance Theoretic Pragmatics framework based on a definition of relevance and two general cognitive and communicative principles. As a remarkable part of assessing the theory of mind and its intimate relation with language lie in developmental psychology, a great deal is taken from research on child psychology.

INTRODUCTION

Philosophy of language has been trying to decipher and define the nature, origins, and usage of language. In general the philosophy of language for analytic philosopher is concerned with four central problems:

1- The nature of meaning, searching an explanation to what it means to "mean" something.

2- Language use, what speakers and listeners do in communication, and the role of language in communication and in socialization.

3- Language cognition, scrutinizing how language relates to minds of both the speaker and the interpreter (hearer).

4- The relationship between language and reality. For continental philosophers, the philosophy of language is studied as a part of logic, history, and politics, rather than considered separately as a topic [1].

There are other paramount concerns of the philosophers, such as how language and meaning relate to the truth and the world, and what kinds of meanings can be true or false, rather than which sentences are actually true.

Other major issues both philosophy of language and philosophy of mind deal with the questions; such as how much of language is innate, is language acquisition a special faculty in the mind or is it a part of general human intelligence, and connection between thought and language. An important area of study in this regard is to what extent language influences thought and vice-versa.

One theory describes the evolution of language from primate social intelligence, putting the main emphasis, first, on the evolutionary speed limit.

The theory puts the first emphasis on the amount of new information in the design of the human brain since his divergence from chimps which cannot be more than 5 Kbytes, equivalent to just one page of text. Therefore the computational faculties underlying language need to be based on some pre-existing mental capacities. The theory considers social intelligence a suitable basis for

the complexity and subtlety of language.

The second emphasis is on the use of language. Language is used for social purposes, and for changing what other people believe or intend. Therefore it must have close connections with social intelligence, particularly to theory of mind, that specific part of social intelligence which provides the ability of predicting other people's intentions and goals.

The third factor is related to neuroanatomy, observing that both language and primate social intelligence seem to be closely associated with the ventral prefrontal cortex which supports the idea that they must have a common evolutionary origin [2].

The other dominant contemporary theory about the origin of language suggests that the special module for grammar in the human brain has come up through genetic change which in turn has produced genetic instruction for that specific purpose. It means before genetic specialization for grammar, people had no grammar at all. They had no grammatical speech, no parsing for grammar, and no concept of grammar. They actually communicated, but their communication was totally ungrammatical, similar to the way birds and bees communicate, which was not language. This grammar module was autonomous which borrowed no structure or processes from any other capacities like vision, spatial navigation, understanding of force dynamics, parable, and so on. In the broad spectrum of distinguished scholars adhering this theory, we will see Noam Chomsky, Steven Pinker, and Paul Bloom, whose only disagreement on the subject is on the evolutionary mechanisms which were responsible for the genetic specialization for grammar. However, according to [3], this historical origin of language, developed entirely from an autonomous grammar model and built entirely from the special instructions in human child's brain, is wrong. He considers the possibility that parable was the origin of language. He thinks that the cognitive mechanisms independent of any analysis of grammar are account for origin of grammar. "The linguistic mind is a consequence and subcategory of the literary mind."[3]

There is no doubt that the use of language cannot be characterized in terms of grammar only. One use of language is to alter what other people know; if we had no idea of what they know and what they do not know, we could not use language. Therefore a complementary theory is needed to explain the linguistic performance. Pragmatics is the theory dealing with the language use. However, pragmatics itself embodies a wide variety of approaches under the same label, each with its own framework and interests.

Two main general trends can be identified as socio-cultural approaches and cognitive approaches. Socio-cultural approaches deal with the aspects of the selection and interpretation of linguistic forms that happen to be determined by social and cultural factors; such as politeness studies, research on conversational styles, rhetoric, discourse genres and register. The other branch of pragmatics deals with 'internal' factors, such as cognitive bases for linguistic performance, and the inferential processing leading to the final interpretation. According to [4], the explanations elaborated by socio-cultural pragmatics can be conceived of as *norms*, while those triggered by cognitive pragmatics are better understood as *principles.*

Norms can include two different, but related notions. On the one hand, they can refer to a common practice, the normal, usual, or habitual behavior which can be defined as a *custom of use.* On the other hand they can refer to a set of rules and regulations which are socially approved as patterns of behavior, the notion of norms as a *convention of use.* However, it is not so simple to draw a clear borderline between these two notions. Often common practice derives from socially accepted convention, because the behavior that diverts from previously established convention tends to be rejected. Yet, the distinction usually has some psychological reality. When norms are conventions, the individual usually perceives them as something 'external', something which is socially imposed that requires formal and explicit instruction. While in the case of being customary practices, norms represent internalized, unconscious patterns that the individual follows without even noticing that he is complying with an unwritten model. In general the widespread tendencies of behavior stem from both explicit and implicit social conventions, whether they represent conscious or unconscious patterns of behavior.

With cognitive approaches we find a different way of doing pragmatics. Their intention is to identify *principles*. A *principle* is the expression of the behavior of a system in a formalized way, yet it is a causal, mechanical explanation, rather than being a statistical generalization. It can be defined as a universal law, comparable to the universal status of the laws of physics.

Cognitive models of pragmatics put their main effort in discovering the principles that govern different aspects of use and understanding of language. Grice, one of the most influential figures in pragmatics opens ways to cognitive approaches. His cooperative principle, "Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged"[5], was proposed as a general law on human rationality. Emphasizing on this rationality Grice himself says: "I would like to be able to think of the standard type of conversational practice not merely as

something that all or most do *in fact* but as something that is *reasonable* for us to follow, that we *should not abandon*" [5].

Relevance Theory [6] also puts the emphasize on principles as generalization about the way our minds work in social interactions. Two cognitive and communicative principles are offered. The first, cognitive principle, ("Human cognition tends to be geared to the maximation of relevance") is a generalization about the way our minds work, and the second principle, communicative principle, (Every act of ostensive communication communicates a presumption of its own optimal relevance") deals with the interpretation of the intentional communicative behavior. It means understanding intentions and the ability of interpreting them is the basis of making communication. Therefore cognition-oriented theories try to find the biological or cognitive bases that underlie communicative behavior.

Although Grice's cooperative principle and maxims still remain as the foundations of pragmatics in most of the linguistic text books [**7]**, the neo-Gricean framework has also been influential in psycholiguistics [8] and the philosophy of language [9].

As mentioned above, in considering the role of language in social interactions, the nature of social conventions has to be studied. According to David Kellogg Lewiss [10], a convention is a rationally self-perpetuated regularity in behavior, which opposes Grice's view of convention as the speaker's meaning. Grice divides conventions as conversational and conventional "implicatures". Grice coined the term of implicature, a technical term referring to what is suggested in an utterance, even though neither expressed nor strictly implied by the utterance. In other words, both literal and nonliteral aspects of communicated linguistic meaning are determined by principles that refer to physical or social context in which language is used. Among these aspects are conversational and conventional "implicatures". The central issue here is understanding intentions. Grice claims that:

1- an essential feature of most human communication, both verbal and non-verbal, is the expression and recognition of intentions.

2- utterances automatically create expectations which guide the hearer towards the speaker's meaning.

In developing his claims, Grice laid the foundations for an inferential model of communication, an alternative to the classical code model [11]. According to the code model, a communicator encodes her intended message into a signal, which is decoded by the audience, using an identical copy of the code, while the inferential model suggests that a communicator provides evidence of her intention to convey a certain meaning. There is no doubt that verbal communication involves an element of decoding, and an utterance is a linguistically piece of evidence. Nevertheless, the linguistic meaning recovered by decoding is just *one* of the *inputs* to a non-demonstrative inference process which will happen after the speaker's meaning is interpreted by the hearer.

Grice's Co-operative principle and four maxims is a kind of processing the inputs which occurs consciously, very rationally and in a complex way.

The Cooperative Principle

"Make your contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged

The Maxim of Quality

Try to make your contribution one that is true, specifically:

Do not say what you believe to be false

Do not say that for which you lack adequate evidence.

The Maxim of Relation (Relevance)

Be relevant

Be brief (avoid unnecessary prolixity)

Be orderly"

The Maxim of Quantity

Make your contribution as informative as required (for the current purposes of the exchange)

Do not make your contribution more informative than is required

The Maxim of Manner

Avoid ambiguity

Avoid obscurity of expression" [12].

The sort of complex, rational, conscious reasoning process that Grice provides to calculate conversational implicatures is in contrast with psychological fact that children are involved in inferential communication in preverbal stages [13].

Relevance theory, on the other hand, locates the source of inferential communication not in a socially acquired principle of cooperation or a series of maxims that rational communicators must follow, but derived from an 'exceptionless generalization about human psychology:' [13]. Human cognition allocates our perceptual and inferential systems to the most relevant information available. One good evidence for this psychological approach is seen in the cases of

metaphor, irony and other genres used aesthetically which are not derived from not speaking Maxims, but directly follow the considerations of relevance (14). Therefore, Sperber & Wilson's non-maxim-based approach is centered on a mega-principle: the principle of relevance:

Cognitive Principle of Relevance

Human cognition tends to be geared to the maximisation of relevance [6].

It is through this human orientation towards cognitive efficiency that we can metarepresent the mental states of others and acts accordingly. This is the tendency which is applied in communication by covertly and overtly invoking specific thoughts to the hearer, knowing that the hearer has exactly this expectation. Ostensive attempts at communication, deliberately provide evidence of one's intention to lead the audience towards a certain conclusion. That is how it creates expectations of relevance, meaning that the hearer *will spend* the effort necessary for comprehension because the linguistic stimulus automatically and simultaneously targets the attention, and triggers a process of interpretation. The specific principle for ostensive communication is

Communicative Principle of Relevance

Every act of ostensive communication communicates the presumption of its own optimal relevance [6].

The fact that an utterance creates some expectations of relevance helps us to understand how hearers may identify the intended interpretation. Actually the mutual expectations can serve to limit the search space. In communicating the thoughts the sender only conveys as much information as is needed in any given context, so that the audience can recover the intended meaning from what was said or written as well as from the context and implications. In this conceptual model, the author takes into account the context of the communication and the mutual cognitive environment between the sender and the receiver. In other words, what the sender thinks, the receiver already knows. Therefore, the sender says just enough to communicate what he/she intends, relying on the receiver to fill in the details that were not explicitly communicated. [1]. According to Sperber and Wilson, an explicit procedure which is based on the criterion of relevance, would be powerful enough to exclude all but one interpretation. The hearer considers the first interpretation which seems consistent with this criterion as the intended interpretation, and stops processing. This is guaranteed by the Relevance-theoretic Comprehension Procedure and the Presumption of Optimal Relevance:

Relevance-theoretic Comprehension Procedure

Follow a path of least effort in computing cognitive effects

a) Consider possible interpretations in order of accessibility

b) Stop when your expectations of relevance are satisfied

Presumption of Optimal Relevance

a- The ostensive stimulus is relevant enough to be worth the addressee's effort to process it

b- The ostensive stimulus is the most relevant to compatible with communicator's abilities and preferences [6].

Unlike Grice's reasoning process, this comprehension procedure is automatically and unconsciously applied. One indication of this is the fact that children get involved in inferential communication very early.

Inference in language understanding takes pieces of information obtained from linguistic decodes as the input, and combines them with other contextual assumptions to yield new pieces of information. But the system itself does not contribute any information of its own. What inference does is to process representations. Therefore, it is a processing device, a computational mechanism that operates on representations taken from different sources. Inference is an ability shared by all mankind, which makes it a good candidate for being introduced as a universal system.

The social ability is, on the one hand, a universal device for social categorization designed to produce a set of representations on social relations and interactions; the system is 'tuned' to the culture settings, but the device itself is universal. On the other hand, the social ability can also be understood as the set of representations generated by the system, their content being determined by the culture-specific input data.

If this view is correct, we can come to the conclusion that there must be difference between universality and culture-specificity, distinction between *representation* and *computation*, that is, between *data* and *operations* on data [4].

At this point norms and principles take the leading role again. They express two different sorts of regularities. Norms are generalizations on representations, i.e. on data, while principles are generalizations on computational mechanisms, i.e. on operations. Thus, they both are needed in a system in which computational devices and representations are the basic components.

What is social intelligence:

Social intelligence is defined as cooperative system needed sometimes to deal with peers in social group, and if necessary to compete with them. All social mammals have some system of ranking within the groups, the ranking order that puts each individual in his/her definite position in the group. The order usually starts from the strongest male downwards. It is recognized by all members of the group and has a crucial effect on who gets what, such as food, shelter, and mates [15]. Of course, there is a great competition for ranking among individuals because of special opportunities allocated to the higher ranks in terms of "positive effects and fitness and reproductive potential" [15].

For many land mammals species, the decision for ranking is made in one-on-one confrontation by strength and fitness. However, for primates this is not the case. Primates do not just depend on their individual strength and fitness. They always try to find the right allies. Therefore, the competition for primates, not only occurs between individuals, but also between alliances. In any competition each combatant will call on his or her allies, and the contest will be decided by the relative strength of the two alliances. A primate would be socially successful and obtained high rank if he had chosen the right alliances [15].

Whatever the reason, we know from many observations that most primates have an acute social intelligence, not found in other land mammals [16]. They recognize one another in individuals, know all about each others' kin, and rapidly learn simple rules about who will do in what circumstances. Therefore, possessing social intelligence requires primates

1- to represent in their minds information about social situations in terms of past, present, and facts including relationships and connections between members of the group such as " X is Y's baby".

2-be able to learn, and represent internally, the causal regularities whereby one social situation leads to another, for example, "if X screams, Y will react"

3-and finally "to combine their knowledge of the present social situation with their knowledge of causal regularities to predict what may happen next" [15].

These three abilities enable primates better predict social events, an evidence indicating they have greater social intelligence than other land animals. As mentioned above, social intelligence needs to use internal representations of social situations. These representations should be matched almost completely to the social domain. This carries one of the most specific characteristics of language, as the meaning representation for language, and also theory of mind, defined as understanding other people's mental states. Therefore, there could be a possibility that theory of mind is an extension of social intelligence and essential for the use of language [15]. So, it can be possible that language is an outgrowth of primate social intelligence, which is a distinct faculty of primate mind, not found in other land mammals. In other case of existence of a dedicated faculty of primate social intelligence, both theory of mind and language might have evolved as an extension of this faculty.

Theory of mind

The mechanism central to theory of mind is some mechanism or set of mechanisms used to form inferences and predictions about the intentional actions of our social partners. These inferences and predictions should be reliable and done quickly [17]. This can only be described as the use of decision heuristics, kind of cognitive shortcuts that enable us to make evaluations on the basis of one or a few simple rules or clues. In this way we will be able to avoid the time and information processing costs of reviewing all the options by limiting our decision space to consider only the most appropriate options [18]. The spot that actually theory of mind and language come into contact at, that is, understanding the intentions of other people and selecting the most appropriate options. Theory of mind underlies all conscious and unconscious cognition of human behavior [19]. Thus it resembles a system of Kantian categories of social perception. In other words, the fundamental concepts by which people grasp social reality. But the framework not only classifies perceptual stimuli; it also directs further processing of the classified input, including inference, prediction, and explanation [20].

Of course, humans are not born with a fully mature theory of mind, so the developmental precursors of it can reveal components of cognitive system. The conceptual framework, intentionality, and mind develop out of perceptual discrimination in infancy, between birth and about 18 months. We can see the capacity to imitate at birth [21]. But children's perceptual sensitivity to self-propelled movements and to goal directed actions appear around 9 months [22]. By 14 months we see the ability of changing the actions into the meaningful units with relevant intentions [23]. And by 18 months the ability of inferring intentions appears. The perceptual discrimination, and early concept formation leads to the conceptual understanding of desire, by age 2; and belief, by age 3.

Understanding of false belief appears by 4, which according to many psychologists is the watershed of theory of mind development [19]. At this point children understand that different people represent the world in different ways, and therefore can believe or know

different things. The concepts of this emerging framework are interconnected, with intentionality concept acting as an organizing node [24,25].

With the emergence of this conceptual and processing framework, a balance is created between two counteracting forces. The child understands both self-other differentiation and self-other coordination. Therefore, among the functions of theory of mind, the achievement of social coordination, of both behavior and mind, seems critical.

In the light of the current developmental evidence, it seems highly unlikely that humans have evolved these two fundamental faculties, language and theory of mind, independently in their mind [23].

DISCUSSION

In observing language as a mirror image of the cognitive capabilities of human beings, linguistic scientists have been approaching it from different angles. One traditional definition of language is a factor in account of communication. Communication, by definition, involves at least two participants, that is, the function of two brains, and the role of language in particular as a mediating factor between two brains. There is of course a neural process going on in the brain, and language is a means for that neural process to affect the neural process occurring in the other brain. Ultimately, communication is about one brain trying to replicate some kind of neural pattern into another brain. The very natural phenomenon of communication may seem like a miracle. Two or a group of beings that engage in changing each other's brain.

In defining the process of thoughts being communicated from one person to another, two broad views have been offered. The first view suggests that communication becomes possible through the use of strict coding and decoding. In this approach the speaker or the author encodes his/her thought and transmits them to the audience. The audience receives the encoded message and decodes it to arrive at the meaning the speaker or the author intended. This is usually referred to as code model of communication [4]. However, the other view does not consider the human verbal communication so simple. According to this view context almost always plays a part in communication, as do other factors such as the sender's intentions, the relationship between the sender and receiver and so forth.

Two questions raise. Where does language come from? How does language do what it does to our brain connections?

An influential contribution to the linguistic field is provided by Chomsky [25-26] is the claim that modeling knowledge of language using a formal grammar accounts for the "productivity" or "creativity" of language. In other words, a formal grammar of a language can explain the ability of a hearer-speaker to produce and interpret an infinite number of utterances, including novel ones, with a limited set of grammatical rules and a finite set of terms.

If language is such an efficient tool for learning that shapes an entire system of thought in a few years, then it must be certainly be useful to survival and evolution [27-28].

Linguists Sapir and Whorf suggest that language limits the extent to which members of a "linguist community" can think about certain objects. In other words language was prior to thought. Whorf extending the view of his teacher, Sapir, suggests that language and thought influence each other. Language is used to express thought, it has an influence in the way the speakers understand the environment. Language influences the thought because it contains what Sapir has called "a hidden metaphysics" [29], which is a view of the world, a culture, a conceptual system, an implicit classification of experience. Whorf restated Sapir's view in his principle of "linguistic determinism". In other words, grammatical and categorical patterns of language embody cultural models. "Every language is a culturally-determined system of patterns that creates the categories by which individuals not only communicate but also think" [30].

The opponents of the idea of "language – first" position of Sapir-Whorf is "knowledge – first" position; the notion that thought has priority over language, which can be found in the work of, for example, Paul Grice.

According to Wilson [31], Grice pioneered the belief in utterance interpretation as a variety of inferential mindreading, with its origins in a general metapsychological human-evolved ability to recognise intentions behind actions. "Interpreters arrive at the speaker's meaning following a non-demonstrative inference which involves hypothesis formation and evaluation." [31]. The cooperative principle and conversational maxims select the best hypothesis about the intended interpretation.

Make your contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

The relevance theoretic account is based on the second claim of Grice in relation to the expectations which guide the hearer towards the speaker's meaning. Grice described these expectations in terms of his Co-operative principle and the four maxims. A rational hearer will choose the interpretation that best satisfies

those expectations [5**].** The relevance theorists accept utterances raise expectations of relevance, but question several of other aspects of Grice's account, including the need for co-operative principle and four maxims. The central claim of relevance theory announces that the expectations of relevance raised by an utterance are precise and predictable enough, to guide the hearer towards the speaker's meaning [31].

The communicative intention:

(The intention to inform the audience of one's informative intention) [32].

According to Relevance theory, the identification of explicit context is inferential and guided by the communicative principle through recovery of implicatures. The relevance-theoretic comprehension procedure, "Follow a path of least effort in computing cognitive effects: test interpretive hypothesis in order of accessibility, and stop when your expectations of relevance are satisfied" (Relevance theory. P. 261), applies at both explicit and implicit levels. Grice's analysis of over communication as involving the expression and recognition of intentions treats comprehension as a variety of MIND-READING, or THEORY OF MIND (the ability to attribute mental states to others in order to explain and predict their behavior). The link between mind-reading and communication is confirmed by a wealth of developmental and neuropsychological evidence.

As noted above inferential comprehension typically involves several layers of metarepresentations,

while in regular mind-reading a single level is generally enough. This discrepancy between the metarepresentational capacities required for inferential comprehension and regular mind-reading is particularly apparent in child development psychology. It is hard to believe that two-year-old children, who fail on regular first-order false belief task, can recognise and understand the peculiar multi-leveled representations involved in verbal comprehension, using nothing more than a general ability to attribute intensions to agents in order to explain their behavior. For these reasons, it is worth exploring the possibility that, within the overall mind-reading module, there has evolved a specialized sub-module dedicated to comprehension, with its own proprietary concepts and mechanisms [32, 33]. In the terms of Sperber [24], a child with limited metarepresentational capacity might start out as a naively optimistic interpreter, who accepts the first interpretation he finds relevant enough regardless of whether it is one the speaker really intended.

Relevance theory is a cognitive psychological theory, treating utterance interpretation as a cognitive process.

Therefore in final review of causal relationship between language and theory of mind, we find language an important vehicle through which theory of mind skills are expressed and put into use. Behavior explanation which is fundamental in understanding other minds, are to a significant extent embedded in conversation (34). Even though some causal judgments might be pre-verbal (35), the judgments that take into account other peopl's minds seem to follow a more sophisticated conceptual framework which can not be pre-verbal (36). The same is also true about mental state inferences, like showing empathy or considering another person's perspective, rely on verbal reasoning and understanding and interpreting representations (37). Thus in considering theory of mind as a high-level skill of making sense of other people's minds, language is inevitably enmeshed in it (38).

As argued above restricting theory of mind capacities merely to high-level and conscious processes would be misleading. The developmental literature indicates that there are some theory of mind capacities which happens before early language competence, such as classification and self-propelled movement (39), eye-gaze tracking, imitation (40), recognizing goal-directed actions (41), and demonstrating intention-relevant behavior (27). Although these skills do not demonstrate reasoning about mind, they at least can be considered *early* forms of mental state inference which provide the basis for more *explicit* mental state forms. Indeed, many linguistic scientists believe that having the ability to infer others' communicative intentions is a precondition for language (32). Some even take a further step claiming that, in using a symbol by an organism, a convention is, in principle, involved. Because the symbol user must assume that others interpret the symbol the same way as the symbol user does (42). If we accept this definition for symbol, and if language uses such symbols, then it follows that theory of mind precedes language (19**)**.

On the other hand, there is evidence that metarepresentation, itself may be dependent on language. According to Harris (43), child's transition from appreciating desires to appreciating both desires and beliefs come with engagement in conversation. In other words, children in their conversation first use desire verbs, and after about a year begin to feature belief verbs, alongside desire verbs.

Even if we accept the notion that advancements in language open ways to advancements in theory of mind, it occurs fairly in mature level of language as well as theory of mind. The findings on early stages of development show that theory of mind skills are more likely precede than to follow language skills(19**)**. Therefore, the best conclusion would be that the direction of influence will flow from theory of mind to language in early stages of development, and then takes

a two ways flow from language to theory of mind and vice versa in later stages.

It is obvious that treating language and theory of as monolithic entities will not do, as the elementary components of both faculties influence one another in gradual escalation [20].

Considering the current developmental evidence, we come to the positions that neither theory of mind precede language, and nor language precede theory of mind. So would it be possible that two faculties have co-evolved?

One potential driving force for the co-evolution of language and theory of mind can be a strong and external factor that had an impact on both faculties. Because of the different environmental challenges, such as climate changes, wildlife disruptions, increased group size, hostile encounters with other hominid groups, migration that early hominids encountered, they found need for greater social coordination. Under the condition that food is tight, and life is in danger, and groups become larger, creating social coordination and organization are considered as fundamentals for survival. On the other hand, among the contemporary functions of language and theory of mind, social coordination is the most salient function they share [20].

Of course social coordination by itself cannot explain the emergence of two adaptations, but there can be an explanation that one of the faculties emerged first in a primitive form and facilitated a primitive form of the other, and soon advances in one faculty resulted in advances in the other repeatedly.

On the basis of what discussed above, it seems reasonable that a primitive theory of mind emerged prior to the emergence of language.

In reviewing this primitive theory of mind, (45) provides evidence on primate theory of mind that chimpanzees have the ability to predict behavior, but no clear understanding of the mind as the underlying source of observed behavioral patterns. They also show skills of joint attention and imitation, and an inferential sensitivity to some mental states which are associated with action. This can be considered as the basis for a basic theory of mind [20], postulates it as the following:

a- a capacity for imitation a mechanism that matches other's behavior to self's internal states and provides a necessary condition for inferences about those internal states in others;

b- a capacity for joint attention (representing oneself and another person attending to an object); and

c- an inferential sensitivity to some mental states associated with action (approximating a desire or goal concept).

The emergence of the three elements can be in the listed order. They may build on each other until they reach a stage possibly comparable to a 9-12 months baby. This is also the stage when language learning begins [19].

In human evolution the emergence of these three components may have been separated by a few million years.

So, in considering a theory of language evolution we may conclude that social intelligence has to use internal representations of social situations to understand the environmental events and problems and to be able at deal with them. These representations are well suited to serve as the meaning representation for language. Theory of mind is the ability which enables us to understand other people's intentions and predict their actions and behavior. It is the ability that helps us to understand other people's mental states, therefore essential in using language. Language and social intelligence are linked to the prefrontal cortex. There could be great possibility that language has evolved as an extension of social intelligence. Language is inseparable from theory of mind, neurologically, cognitively, and functionally. In an escalation process language and theory of mind have fueled each other in evolution and development. The two faculties enhance socialization and social coordination in human beings in a spiral manner.

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