Making Tools and Planning Discourse: the Role of Executive Functions in the Origin of Language

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ABSTRACT

In this article we propose that executive functions play a key role in the origin of language. Our proposal is based on the methodological assumption that some of the cognitive systems involved in language functioning are also involved in its phylogenetic origin. In this regard, we demonstrate that a key property of language functioning is discourse coherence. Such property is not dependent on grammatical elements but rather is processed by cognitive systems that are not specific for language, namely the executive functions systems of action planning, control and organization. Data from cognitive archaeology on the making of stone tools show that the processes requested to produce Prehistoric tools imply action organization operations similar to those involved in the processing of coherence. Based on these considerations, we propose that executive functions represent the link between stone tool making and language origins and suggest that they allowed our ancestors to develop forms of proto-discourse governed by coherence.

Keywords: discourse coherence, executive functions, language evolution, neuropsychology, pragmatics, stone tools making.

1. Introduction

In this article we propose a hypothesis on the role of executive functions in language origins in reference to a precise methodological assumption: the idea that some of the systems and cognitive skills involved in language functioning are also involved in its phylogenetic origin. In this regard, we show that the proper functioning of language is tied to a key pragmatic property: discourse

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coherence. Through discussion of a collection of neuropsychological and neurolinguistic studies, we show that such property is essential for effective communication, and its processing does not rely on the grammatical systems that manage the combination of the internal constituents of the sentence, but rather on the executive functions responsible for action control and organization. On the basis of these considerations, we argue that an evolutionarily plausible model of language has to be founded on the primacy of pragmatics on grammar and that a key role in the dawn of language has been played by the development of executive functions underlying discourse coherence. Data from cognitive archeology indicate that the expansion of executive functions is closely linked to the evolution of prehistoric lithic industries and that the processes requested to produce these tools imply action organization operations similar to those involved in the processing of coherence. Based on this, we propose that a key moment in the evolution of language has been the exaptation for communication purposes of executive systems originally tied to action control and that such exaptation allowed our ancestors to develop a communicative system based on forms of proto-discourse governed by a principle of coherence. Building language up from the systems related to the control of actions and which are responsible for the crucial properties of communication–such as discursive coherence– constitutes a way to anchor the advent of human verbal faculty to the communication systems of other hominins preceding *Homo sapiens* in human phylogeny, giving rise to a model of language origin in line with the principles of gradualism and the continuism of the Darwinian naturalistic tradition.

2. Methodological and theoretical assumptions

The assumption at the basis of this article is that the processes underlying language comprehension and production and those which are at the basis of language origins are closely related. From this point of view, studying how language works (how it is processed; what the cognitive systems are that make possible verbal production and comprehension) is an extremely worthwhile way to make a hypothesis about how language may have originated (cf. Ferretti & Adornetti, 2012; Ferretti & Adornetti, 2014). This assumption does not apply to any model of language: it is valid only for certain cognitive systems and for specific communicative properties that such systems manage. In our view,

for example, it does not apply to theoretical models based on grammar, such as Chomsky's Universal Grammar (UG). This is for two basic reasons: the first is specific and is tied to the Chomskyan paradigm; the second is more general and is linked to the idea that the essence of language is the grammatical competence (not necessarily identified with UG).

The specific reason has to do with the incompatibility of UG with the principles of gradualism and continuism of the Darwinian tradition (cf. Corballis, 2011). Indeed, according to Chomsky the computational device at the base of syntax (the device that allows the operation "Merge") is unique to *Homo sapiens* and «has not evolved in any significant way since human ancestors left Africa, approximately 50. 000–80 000 years ago [...]. *The human language faculty emerged suddenly in evolutionary time and has not evolved since*» (Berwick et al., 2013, p. 89, our emphasis; cf. also Chomsky, 2010). Corballis (2013) defines this idea as miracoulus (see also Deacon, 2010) and writes:

> The idea that language emerged suddenly is comforting to those eager to demonstrate human uniqueness and mental superiority. [...] Nevertheless, from an evolutionary point of view the notion that a faculty as complex as language could have emerged in a single step is deeply implausible. (Corballis, 2013, p. 35)

In our opinion there is a second general reason that makes the hypothesis that the origin of language has to do with the advent of grammatical competence problematic. According to several authors (e.g. Arbib, 2005; Tomasello, 2008), in fact, grammar emerged because of a need to construct a code in order to make more efficient sophisticated forms of communication that *already* were in possession of our ancestors. In this sense, grammar is a late product in the evolution of language: if you want to give an account of the *origin* of language, grammar is not a good point to start with. When the aim is the study of language from an evolutionary perspective, it is necessary to overturn the traditional view proposed in Chomskyan linguistics. From the generativist perspective the main study of linguistics is syntax; semantic features are added when grammar is not sufficient to ensure understanding; pragmatics is essentially a container that stores all that is left out by the syntactic and semantic analysis. Nevertheless, as Gärdenfors (2004, p. 245, see also his article in this volume) points out:

> When communication first appears, it is the communicative act in itself and the context in which it occurs that are most important, not the expressive form of the act. As a consequence, the pragmatic aspects of language are the most fundamental from an evolutionary point of view. [...] when the goal is to develop a theory of the evolution of communication, the converse order—pragmatics before semantics before syntax—is more appropriate. In other words, there is much to find out about the evolution of communication before we can understand the evolution of semantics and syntax.

From such theoretical considerations, in this paper we argue that in order to propose a model of language's evolutionary origins plausible, it is necessary to move from the syntax based paradigms to those that are pragmatic based. We show that this transition is closely related to the transition from sentence (the essence of language in syntactic-centric perspective) to discourse. In particular, our proposal is that a key role in the origin of human verbal skills is played by the cognitive devices involved in the processing of a specific pragmatic property emerging at the level of discourse: coherence. In support of this proposal, in the following paragraphs we show that 1) coherence is an essential property for effective communication that emerges at the discourse level, rather than on that of individual sentences, and this does not depend on syntactic and grammatical elements; 2) that cognitive systems responsible for coherence are the executive functions involved in action planning, control and organization; 3) that these systems have evolved in the course of human phylogeny in the context of making stone tools and that the operations underlying the production of these tools are similar to those required for processing of coherence. On the basis of these considerations, we argue that the hominins preceding *Homo sapiens* during evolution were cognitively equipped for the development of a communication system based on proto-discursive forms governed by a principle of coherence.

3. The crucial role of coherence in human communication

Coherence generally can be defined as the conceptual organizational aspects of discourse at the suprasentential level. More specifically, coherence is the way through which arguments in a discourse are structurally organized towards a

goal, plan or a general theme (Glosser & Deser, 1990). When is a discourse coherent? The theoretical models that equate language with grammar and linguistic processing with sentence processing (cf. Pickering, Clifton & Crocker, 2001) explain discourse coherence in terms of the linear relations of cohesion between consecutive sentences (e.g. Daneŝ, 1974; Halliday & Hasan, 1976; Reinhart, 1980). The most influential work on cohesion is the volume *Cohesion in English* by Halliday and Hasan published in 1976; the two authors define cohesion as the relations of meaning existing within a text that «enable one part of the text to function as the context for another» (Halliday & Hasan, 1989, p. 489, quoted in Bublitz, 2011 p. 38). In a text cohesion relations are accomplished through grammatical and lexical elements. Grammatical cohesion includes elements such as reference, substitution, ellipsis and conjunctions; lexical cohesion is based on reiteration (e.g., repetition, synonymy) and collocation (co-occurrence of lexical item). What is important to emphasize for the purpose of our argument is that in this perspective cohesion is a *necessary* condition for discourse coherence. Consider in this regard the following text:

(1) After the forming of the *sun* and the *solar system*, our star began its long existence as a so-called dwarf star. In the *dwarf phase* of its life, the energy that the *sun* gives off is generated in its core through the fusion of hydrogen into helium (Berzlánovich, 2008, p. 2).

In this text the sentences are connected through lexical cohesion: the lexical cohesive relations hold among the lexical items *sun*, *solar system*, *star*, *dwarf star* and *dwarf phase* in the text.

The model by Halliday and Hasan has been criticized over the years primarily because of its insistence on conceiving cohesion as a necessary property for the creation of unity in texts (for a discussion, see Tanskanen, 2006; Giora, 2014). Several researchers demonstrated that cohesion was not necessary at all to make a text appear a unified whole (e.g. de Beaugrande & Dressler, 1981, p. 3; Brown & Yule, 1983, p. 195; Enkvist, 1978; Giora, 1985; Sanford & Moxey, 1995). To this end, Enkvist proposed the following example:

(2) I bought a Ford. The car in which President Wilson rode down the Champs Élysées was black. Black English has been widely discussed. The

discussions between the presidents ended last week. A week has seven days. Every days I feed my cat. Cats have four legs. The cat is on the mat. Mat has three letters (Enkvist, 1978, pp. 110-111).

In this text the sentences are connected through the mechanism of repetition. However, the set of sentences, despite the abundance of cohesive ties, is not perceived as a coherent whole. Indeed, this text is characterized only by *local coherence*, but not *global coherence* (cf. Glosser & Deser, 1990). Local coherence refers to the conceptual links between consecutive individual sentences or propositions. Instead, global coherence is the manner in which discourse is organized with respect to an overall goal, plan, theme, or topic. As the previous example has shown, cohesion (i.e., grammatical and lexical devices) is responsible for local coherence, not for that global: the cohesive bonds between adjacent sentences do not guarantee the overall coherence of the discourse. Consider, instead, the following text:

(3) George's high pass was headed to the right. The forward shot at once without dribbling and made a goal. The referee declared the kick off-side (Enkvist, 1978, p. 111).

Unlike (2), there are not cohesive ties between adjacent sentences in (3). However, the text (3) is pragmatically appropriate because the topic under discussion is clear. These examples show that the linear concatenation of sentences based on cohesion is not a necessary condition of the overall coherence of the discourse because: a) it does not ensure the overall coherence of the discourse; b) it is possible to have coherent discourse even in the absence of cohesive ties.

However, it can be argued that Enkvist's text in (2) is simply an artificial construction that does not reflect how human beings communicate with each other. This is not wholly true. Indeed, neurolinguistics and neuropsychological research showed that in several neurological patients there is a dissociation between the abilities that underlie sentence processing (microstructure or microanalysis) and those that underlie discourse processing (macrostructure or macroanalysis) (e.g., Davis et al. 1997; Marini et al. 2008). Specifically, results of several studies support the idea that global coherence does not depend on the skills involved in the processing of individual sentences and on the skills implied in the processing of local coherence. Particularly relevant to

the purposes of this paper are the studies on the discursive capacities of individuals with traumatic brain injury (TBI). TBI subjects generally do not present serious difficulties processing individual sentences (they have no problems processing lexical items and grammatical aspects) and local coherence, but they have deficits in the organization of global discourse (e.g., Coelho, 2002; Coelho et. al., 2012; Davis & Coehlo 2004; Galetto et al., 2013; Strauss Hough & Barrow, 2003; Marini et al., 2011; McDonald 2008). Consider, for example, the following transcript of a discourse of a TBI patient (C), with a therapist (T) (Perkins 2007, p. 86):

C: I admit this government we've got is not doing a good job but the unions are trying to make them sound worse than what they are
T: mm
C: they . they . cos I'm a Tory actually but I do vote . if there's a . er . a communist bloke there I will vote communist but . it all depends what his principles are but I don't agree . with the Chinese communism . and the Russian communism
T: right
C: but I believe every . should be equal but . I'm not knocking the royal family because you need them
T: mm
C: and they they they bring people in to see take photos

Despite the local sequential links between trade unions–government, government–Tory, Tory–communist, communism–Chinese/Russian communism, communism–equality, equality–Royal Family, Royal Family–tourist attraction, C shows a form of *topic drift*: he is unable to monitor what has already been talked about or to relate each individual utterance to some overall coherent plan or goal. In general, the studies on TBI patients showed that global coherence does not rely on the grammatical and lexical skills underling the processing of the single sentences: producing a coherent discourse does not correspond to put a well-formed sentence after another.

4. Discourse coherence and executive functions

Studies on TBI subjects are particularly relevant for our purposes because they shed light on the cognitive systems underlying discourse coherence processing. According to several scholars the problems of coherence of TBI patients are due to the deficit of executive functions that generally affect these patients (e.g., Biddle et al., 1996; Marini et al., 2014; McDonald, 2008; Perkins, 2007; for a discussion see Adornetti, 2013, 2014).[1]

The expression *executive functions* (EF) is an umbrella term that encompasses a wide range of cognitive and behavioral skills (Alvarez & Emory, 2006; Banich, 2009; Barkley, 2012; Jurado & Rosselli, 2007). From a general point of view, it is possible to characterize executive functions as the higher-order cognitive processes, mainly mediated from the areas of the prefrontal cortex (the anterior portion of the frontal lobes), that are needed to guide behavior toward a goal in non-routine contexts and in complex and conflicting situations (Banich, 2009; Gilbert & Burgess, 2008). According to Lezak (1982), executive functions allow the formulation of goals, planning, and carrying out plans effectively. Welsh and Pennington (1988, pp. 201–202) defined executive functioning as the capacity «to maintain an appropriate problem-solving set for attainment of a future goal».

Among the different skills of which EF are composed, a crucial role for the organization of behavior is played by action planning. This ability allows creating and performing goal-oriented behaviors through the identification and the appropriate organization of the elements necessary to achieve a goal. Action planning involves different stages and processes ranging from the conceptual formulation of the plan (identification of the ultimate goal; splitting the final goal into sub-goals; prediction of the consequences of the actions required to achieve the sub-goals) to its execution. The several stages of action planning take place in different areas of the frontal lobes: the more rostral (anterior) frontal regions are involved in the processing of more abstract goals and more temporally extended actions; in the most caudal (posterior) regions

[1] TBI patients are not an entirely homogeneous group from a cognitive point of view: the areas of the brain most frequently damaged after a brain injury are the frontal and parietal regions, but on the basis of the type and the mechanical characteristics of the trauma other areas of the brain can be injured. Therefore, the subjects may suffer from disturbance of various nature. Particularly relevant for our purposes are the neuro-behavioral disorders resulting from brain injuries in the frontal and prefrontal lobes. Such injuries, in fact, impair the executive functions and this has important consequences on the discursive abilities of TBI. In this paper we discuss the studies on TBI with prefrontal and frontal injuries.

more concrete information is processed and is more closely linked to the actual motor response (Badre, 2008; Badre & d'Esposito, 2007). Particularly important for the construction of global coherence are the phases of the conceptual formulation of the plan. Research conducted on healthy subjects through neuroimaging techniques have shown that areas most clearly involved in these planning tasks are the dorsolateral prefrontal regions (e.g., Baker et al., 1996; Fincham et al., 2002; Tanji et al., 2007). Crescentini and colleagues (2012), for example, used functional magnetic resonance imaging (fMRI) during the execution of the test of the *Tower of Hanoi* (one of neuropsychological tests used to evaluate planning skills)[2] on healthy subjects and showed that the dorsolateral prefrontal cortex (especially in the right hemisphere) is activated preferentially during the initial stages of planning and this activation is related to the generation and evaluation of abstract sequences of responses that have to be implemented. To successfully make plans (to perform goal-oriented behaviors), a constant monitoring of the task in progress is also needed. Monitoring can be defined as «the capacity to hold abstract coded representations of events that are expected to occur, so as to mark their occurrence or non-occurrence (i.e. monitor their relative status in relation to each other and the intended plan)» (Petrides, 2005, p.789). This capacity, of which the main neural substrate is the right lateral prefrontal cortex (see Stuss & Alexander, 2007; Vallesi & Crescentini, 2011), is needed to calibrate the effects of actions on the environment, to detect possible errors, to enable corrective action where there is a mismatch between the behavioral responses (effects) and the mental representations (goals and expectations) of those responses, and to reorganize the following steps.

Significant research has shown that TBI subjects, because of injuries in specific areas of the prefrontal regions, have difficulty in managing the conceptual aspects involved in the planning of goal-oriented behaviour and that, as a consequence, these difficulties are reflected in the execution of the corresponding actions (e.g. Duncan, 1986; Eslinger & Damasio, 1985; Zalla et al., 2003). Zalla and colleagues (2001) have shown that TBI patients with injury in the anterior and in dorsolateral regions of the prefrontal cortex have

[2]The *Tower of Hanoi* test is a mathematical game/ puzzle which consists of three pegs and a number of discs of different sizes which can slide onto any peg. The puzzle starts with the discs neatly stacked in order of size on one peg, smallest at the top, thus making a conical shape. The object of the game is to move the entire stack to another peg, obeying the following two rules: only one disc may be moved at a time; no disc may be placed on top of a smaller disc.

difficulty in the formulation and evaluation of a coherent and well-structured conceptual plan and that these difficulties impair the execution of the action. Similarly, Kliegel and colleagues (2004) have found that TBI patients are not able to plan and carry out actions that require the formulation and execution of complex intentions (prolonged in time).

The problems that TBI patients have at the level of action organization are the basis of the discursive pragmatic deficits of which they suffer. Biddle and colleagues (1996), for example, explicitly put in relation the disorders of global coherence of TBI with their deficits of action planning. According to the authors:

> The narrative impairments of the population of adults and children with TBI in this study appeared to be the results of problems with planning, production and monitoring discourse. [...] It is possible that the disruptions evident in the narrative of the children and adults with TBI were related less to a language impairments that to difficulties with the executive processes utilized in discourse production. (Biddle et al., 1996, p. 463)

The existence of a causal relationship between executive dysfunctions and narrative deficits of TBI has also been proposed by Coelho (2002). Interesting results in this regard have also been obtained by Coelho et al. (2012) who have demonstrated the existence of a causal relationship between coherence deficits and executive dysfunctions at the level of brain areas. Indeed, the authors have shown that TBI patients with lesions on the left dorsolateral prefrontal cortex (the main neural substrate of conceptual planning skills) have difficulties in managing the global coherence of discourse.

To sum up this section: discourse production relies on the ability of the speaker to organize the verbal utterances towards of a general purpose (the global theme of discourse) by identifying the correct sequence of steps needed to reach it. During the execution of the plan, that is to say during the discursive production, a constant monitoring and control of the task is needed to avoid inserting irrelevant material into the overall previously planned theme (cf. Adornetti, 2013; Ferretti et al., 2013, p. 329-330). Then, the deficit of discourse coherence of TBI can be considered as the linguistic manifestation of a more general cognitive problem that concerns, first, the level of action organization and only secondly the level of organization of language.

5. Making tools and planning (proto)discourses

The basic tenet of this paper is that the discourse coherence is an essential property both of language functioning and of its genesis and evolution. By putting at the basis of the origin of language such property, we believe it is possible, in fact, to explain the transition from simple expressive systems without a grammar and a shared code between speakers and listeners (as it is legitimate to assume the primordial forms of human communication were) to gradually more complex systems. Our hypothesis is that a key moment in the evolution of language was the exaptation for communication purposes of the executive functions originally tied to action control and that such exaptation has given birth to proto-discursive forms of communication governed by coherence.

Figure 1: Oldowan chopper (from Johanson & Edgar, 1996).

Figure 2: Acheulean hand axe (from Johanson & Edgar, 1996).

A first step to validate this hypothesis is to show the existence in extinct hominis of the cognitive skills underlying coherence in modern human beings. Interesting evidence in this regard comes from cognitive archeology (cf. for a general presentation of cognitive archeology Coolidge et al., 2015; Mahaney 2014; Wynn 2002). Indeed, archeological records indicate the timing and

context of distinctively human elaborations to the executive control functions, including the gradual emergence of increasingly complex action control (Stout, 2010; Stout, 2011; Stout et al., 2008; Uomini & Meyer, 2013). A key moment of this emergence has been the development of stone tool-making industries, especially the transition from the earlier Oldowan industry (from 2,6 Mya to 1,5 Mya) to the later Acheulian industry dating from around 1.7 million years ago with *Homo ergaster* and *Homo erectus*. Using fMRI[3], Stout and colleagues (2008) have shown that the making of Oldowan tools (stone tools consisting of nothing more than sharp stone flakes struck from river cobbles: see Figure 1) implies, in particular, the involvement of the posterior parietal areas (responsible for objects recognition), and ventral premotor areas (managing manual grasping). However, there is no significant activation of the prefrontal cortex. This means that Oldowan industry is characterized by a complex motor-manipulative activity, but limited executive capacities of action planning and organization. An increase in the development of the capacities of action control has been the emergence of the Acheulian industry 1.7 million years ago. The characteristic Acheulean tool is a two-sided hand axe (see Figure 2). This artefact is built by modelling a large stone on both sides until an almond-shaped symmetrical and regular stone is obtained. According to Stout (2010) this technique requires a more complex level of hierarchical control than individual flake removals, which must be subordinated to the broader goal of shaping the piece and seems to entail the involvement of the lateral prefrontal cortex. This area, in fact, allows humans to assemble the individual removal in wider coherent chunk action (Koechlin & Jubault, 2006) and to manage relations of increasing abstraction during the execution of the action (Badre & D'Esposito, 2007), namely to relate the individual flake removals with the realization of the general shape of the nucleus. Such operations, as we have seen, are also crucial for producing organized discourses.

On the basis of these considerations, our hypothesis is that the hominis who made Acheulean tools have developed systems of communication based on protodiscourses governed by a principle of coherence. The point, of course, is to clarify what is meant by "discourse" in such circumstances (in circumstances where there were no sentences because there was not a grammar that regulated their formation) (see on this point Ferretti, this volume). An interesting

[3] In the experiments were observed the brain activations of modern human beings who had been asked to produce stone tools through the process of chopping characteristic of prehistoric lithic industries.

characterization in this regard is provided by Linell (1998) who claims it is possible conceive discourse as a connection of sequences of communicative actions performed through verbal and nonverbal strategies. As Bowie (2008) stresses, a conception of this kind allows to give an account of the continuity from communicative exchanges using simple resources (such as single words or gestures) to those that use complex grammatical conventions: the discourse understood as connected sequences of communicative actions can be constructed exploiting any communication resource that participants are able to manage and does not dependent on sentence or on a particular level of grammatical complexity. Our hypothesis is that coherence (which primarily concerns the level of action organization) has had an important function in structuring these sequences of communicative actions. From this point of view, coherence can be conceived as a functional equivalent on the level of pragmatics of syntax.

The hypothesis of discourse as a sequence of communicative actions is, in our view, compatible with the proposal made by different scholars for whom a crucial stage in the evolution of language has been that in which hominins used to communicate through forms of mimesis (Collins, 2013; Corballis, 2011; Corballis, this volume; Donald, 1991; Zlatev, 2008; Zlatev, this volume). Donald (1991, p. 168) defines mimesis as «the ability to produce conscious, self-initiated, representational acts that are intentional but not linguistic». It may assume various forms: pantomime, imitation, ritualized behaviors, etc. A mimetic act is a performance that reflects the perceived event structure of the world and has three behavioural manifestations: rehearsal of skill (the actor imagines and reproduces previous performances to improving them); re-enactive mime (patterns of actions of others are reproduced in the context of play); non linguistic gesture (an action communicate an intention through resemblance) (see Donald, 2012, p. 180). The underling cognitive process can be broken down into a standard sequence: construction of a plan of action; execution of an approximation of the action; comparison, in imagination, of the performed act to the intended one. According to Donald (e.g. 2012, p. 182), the strongest argument for the early emergence of mimesis in hominin evolution is that mime and non-linguistic gesture come free with skill, because the neuro-cognitive mechanism and the computational process are the same. Thus, the archaeological evidence of refined tools is evidence of a mimetic capacity in our ancestors. Specifically, according to Donald (1991), mimesis arose with the emergence of *Homo ergaster*, the hominin who first introduced

the Acheulean industry. This conception of mimesis fit very well with the idea of proto-discourse presented earlier. In fact, like (proto)discourse, mimetic communication also involves the capacity to organize temporally action sequences directed to the accomplishment of a specific communicative goal. Indeed, the proposal of Donald (2001, pp. 263-266) is that:

> Mimesis is the result of evolving better conscious control over action. [...] Mimetic capacity was primarily the result of merging the executive brain with the action brain, when the hominid executive brain system extended its anatomical territory into the frontal and subcortical regions that control voluntary action.

The evolution of forms of proto-discourse governed by coherence may have been forced by the need of human mind to produce stories and narratives (e.g., Boyd, 2009; Gottschall, 2012). According to several scholars, narrative has played an important adaptive function in human evolution because it offers a way to simulate an experience (representing the human social, physical and mental environment) and to draw conclusions about the real word (cf. Bower & Morrow, 1990; Gottschall, 2012). As Sugiyama (2001, p. 224) states:

> The interactions of story characters, for example, can be seen as models of the human social environment that enable an individual to observe local consequences of a wide variety of actions (e.g., incest, marital infidelity, homicide). These models can be used both to acquire information and to refine knowledge before putting it into actual practices.

What is important to stress is that narrative does not require a complex grammar to operate (indeed narrative does not require language at all: cf. Boyd, 2009, p. 159). But grammar, of course, makes storytelling more accurate and efficient. For this reason, it is possible to speculate that the need to share the information included in stories in a more precise way has brought grammatical structure to the communicative system. In this sense, pragmatics (in the form of coherent proto-discourses) precedes and is the condition for grammar to emerge.

Conclusions

In this article we argued that a particularly fruitful way to account for the origin of language is to analyze the systems and cognitive skills involved in its actual functioning. We suggested that a key role in the advent of human language was played by the executive functions involved in the processing of a specific pragmatic property: discourse coherence. Through the results from cognitive archeology, we showed that these systems have evolved in the course of human phylogeny in the context of the making of stone tools and the operations requested to produce these tools overlapping with those requested to process coherence. On the basis of these considerations, we have hypothesized that our ancestors developed forms of proto-discursive communication governed by a principle of coherence. In a scenario of this kind, the origin of human verbal skills is primarily a matter of pragmatics rather than of grammar.

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