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PUCRS

VERITAS (PORTO ALEGRE)
Revista de Filosofia da PUCRS

Veritas, Porto Alegre, v. 69, n. 1, p. 1-15, jan.-dez. 2024
e-ISSN: 1984-6746 | **ISSN-L:** 0042-3955

http://dx.doi.org/10.15448/1984-6746.2024.1.46080

SEÇÃO: EPISTEMOLOGIA & FILOSOFIA DA LINGUAGEM

The Communication-Language Hypothesis for the Evolution of Consciousness

A Hipótese da Linguagem da Comunicação para a Evolução da Consciência

La hipótesis comunicación-lenguaje para la evolución de la conciencia

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Recebido: 22 abr. 2024.
Aprovado: 30 jul. 2024.
Publicado: 23 ago. 2024.

Resumo: O presente artigo se ocupa do problema funcional da consciência referente às questões do porquê a consciência evoluiu e se é relevante para os organismos. A hipótese defendida é que a consciência tem a função comunicativa capaz de recrutar a memória de trabalho, especialmente, os seus subcomponentes especialistas em linguagem, e o sistema cognitivo-computacional, que tem, em seu núcleo, uma estrutura sintática para codificar simbolicamente a informação implícita no organismo. Aos organismos que possuem esses recursos, foi conferida uma vantagem adaptativa, uma vez que tais organismos vivem numa organização socialmente interdependente e, assim, puderam comunicar aos outros organismos, com mais complexidade e precisão do que a comunicação comportamental não simbólica, os seus estados internos e implícitos, tais como o estado dos seus corpos, as suas intenções, os seus planos, e as características do ambiente. A metodologia possui duas fases: primeiro, uma abordagem teórico-conceitual, com base em variados modelos explicativos teórico-experimentais, na qual foram comparadas diferentes definições teórico-conceituais para a origem da consciência. Depois, modelos filogenéticos de estudos comparativos forneceram insights válidos sobre a consciência em animais humanos e não-humanos. Assim, o objetivo geral aqui consiste em postular uma definição conceitual de consciência. Os resultados sugeriram quais as condições necessárias para a emergência da consciência no tocante à memória de trabalho, atenção, representações de alta-ordem e linguagem. Concluiu-se que a pesquisa está em uma fase de brainstorming. Nessa fase, a hipótese é avaliada criticamente e submetida a testes de aproximação com diferentes modelos. Se for bem-sucedida, ela poderá ser aplicada experimentalmente no futuro.

Palavras-chaves: representações; cognição; linguagem; consciência; evolução.

Abstract: This article is about the functional problem of consciousness, which concerns the questions of why consciousness evolved and whether it is relevant to organisms. The hypothesis defended is that consciousness has a communicative function capable of recruiting working memory, especially its language specialist subcomponents, and the cognitive-computational system, which has at its core a syntactic structure, to encode implicit information symbolically. Organisms that possess these resources were conferred an adaptive advantage since such organisms live in a socially interdependent organization and, thus, can communicate their internal and implicit states to other organisms, such as the state of their bodies, their intentions, their plans, and the characteristics of the environment with more complexity and precision than non-symbolic behavioral communication. The methodology has two phases. The first is a theoretical-conceptual approach based on varied theoretical-experimental explanatory models, in which different theoretical-conceptual definitions for the origin of consciousness were compared. Later, phylogenetic models from comparative studies provided valid insights into consciousness in human and nonhuman animals. The general objective is to postulate a conceptual definition of consciousness. The results suggested the necessary conditions for the emergence of consciousness regarding working memory, attention, high-order representations,

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and language. The conclusion is that the research is in a brainstorming phase. In this phase, the hypothesis is critically evaluated and subjected to approximation tests with different models. If successful, it could be applied experimentally in the future.

Keywords: representations, cognition, language, consciousness, evolution

Resumen: El presente artículo aborda el problema funcional de la conciencia, que se refiere a la cuestión de por qué evolucionó y si es relevante para los organismos. La hipótesis defendida es que la conciencia tiene una función comunicativa capaz de reclutar la memoria de trabajo, especialmente sus subcomponentes especializados en el lenguaje, y el sistema cognitivo-computacional, que tiene en su núcleo una estructura sintáctica, para codificar simbólicamente información implícita en el organismo. A los organismos que poseen estos recursos se les confirió una ventaja adaptativa, ya que estos organismos viven en una organización socialmente interdependiente y, así, fueron capaces de comunicar sus estados internos e implícitos a otros organismos, como el estado de sus cuerpos, sus intenciones, sus planes y características ambientales con más complejidad y precisión que la comunicación conductual no simbólica. La metodología tiene dos fases, primero un abordaje teórico-conceptual basado en varios modelos explicativos teórico--experimentales, en el que se compararon diferentes definiciones teórico-conceptuales del origen de la conciencia. Más tarde, los modelos filogenéticos de estudios comparativos proporcionaron conocimientos válidos sobre la conciencia en animales humanos y no humanos. El objetivo general es postular una definición conceptual de conciencia. Los resultados sugirieron las condiciones necesarias para el surgimiento de la conciencia en relación con la memoria de trabajo, la atención, las representaciones de orden superior y el lenguaje. La conclusión es que este trabajo se limita a una fase preliminar de lluvia de ideas, en la que, tras sufrir ajustes críticos, tal vez esta hipótesis pueda probarse experimentalmente.

Palabras clave: representaciones; cognición; lenguaje; conciencia; evolución.

Introduction

The Communication-Language Hypothesis for the Evolution of Consciousness (CLEC) asserts that at least one of the functions of consciousness is to enable communication. It is not a case of stating that this is the only and exclusive function of consciousness, but rather an attempt to justify that the conscious mechanism serves this function. Besides that, the working hypothesis (CLEC) concerns the problem of the function of consciousness. Firstly, it is essential to formulate the problem approach and then present the working hypothesis in more detail.

In the literature on "Consciousness Studies", the problem of consciousness undergoes different approaches: some researchers (NAGEL, 1974; JACKSON, 1982; HORGAN, 1984; SEARLE, 1984; CHALMERS, 1996; DENNETT, 1998; VARELA & THOMPSON, 2003; CHURCHLAND, 2005; GALLAGHER & ZAHAVI, 2012) ask questions related to the descriptive problem of consciousness trying to answer the question about the unequivocal characteristics of consciousness, such as first-person data, phenomenal structure, qualitative character, subjectivity, unity, intentionality and flow of consciousness (VAN GULICK, 2012; VAN GULICK, 2014). Additionally, there is the epistemological problem, which refers to the explanatory question of consciousness and the epistemological gap (LEVINE, 1983). Thus, the explanatory problem concerns the question of models and theories that are most successful in detailing how consciousness comes into existence from a neuronal-corporeal substrate and avoids reductionist strategies (VAN GULICK, 2012; VAN GULICK, 2014). Therefore, the succint presentation of these two versions of the "Problem of Consciousness" is justified, as it is essential to emphasize to the reader the importance of distinguishing the functional version of the problem, rather than the descriptive and explanatory problems to which this work pertains.

Objectively, the working hypothesis relates to the problem of the function of consciousness. The functional question of consciousness can be concentrated on the question of how consciousness evolved (Why does it exist?) and aims to offer an answer, at least in the initial research phase. The functional version of the problem refers to two general inquiries, first, the question about the origin of consciousness (FEINBERG & MALLATT, 2016; DENNETT, 2017; DAMASIO, 2018; LEDOUX, 2019; GRAZIANO, 2019) and second, about the role that it plays in the organism (CARRUTERS, 2000; VAN GULICK, 2012; VAN GULICK, 2014, WU & MORALES, 2018) and whether this makes any difference to the organism that has such a property (DAMASIO, 2018; LEDOUX, 2019). Given this, questions about the causal function of consciousness are approached according to the working hypothesis; therefore, consciousness is related to other faculties such as emotions and cognition, animal communication and language in human animals (BLOCK, 1995; DAMASIO, 1998; DEHAENE ET AL., 1998; CARRUTERS, 2000; PINKER, 2003; ROSENTHAL, 2008; EDELMAN, ET AL., 2011; COHEN & DENNETT, 2011; BOLHUIS ET AL., 2014; DENNETT, 2017; DAMASIO, 2018; GRAZIANO, 2019; LEDOUX, 2019; FRITH, 2019).

The working hypothesis states that the conscious mechanism translates the internal states of the organism, for instance, bodily states, into linguistically constructed external states, such as extrinsic symbolic representations capable of being transmitted to other organisms. In other words, to constitute the symbolic representation, consciousness initially recruits Working Memory (WM), specifically, its subcomponents that specialize in processing information of a symbolic nature, such as the Phonological Loop (FL) and Visuospatial Sketchpad (VSSP), through the Central Executive (CE) and the Episodic Buffer (EB), and subsequently, the Cognitive-Computational System (CCS), which has a hierarchical syntactic structure at its core. The attentional mechanism plays a role in enabling the selection of relevant content in working memory. In this way, symbolically encoded information is distributed locally within the organism, in this case, highlighting the role of frontoparietal networks (FPN), attention and default mode networks associated with working memory, top-down attention, language and consciousness. As a result, explicit representations are translated into verbal behavioral signals according to specific combination rules, forming oral language expression. In other words, the conscious mechanism coordinates the translation activity carried out, first, by working memory and, later, by the cognitive-computational system. Consciousness coordinates the exchange of symbolic information between systems and the starting and ending of cycle activities. The final result of the symbolic coding phases is the extrinsic representations communicated to other organisms and understood by those with the same coding/decoding system. The symbolic representation conferred an evolutionary advantage, as organisms could exchange information about the environment and their internal states.

The arguments that support the hypothesis are introduced in the following sections. First, an argument is presented about the preconditions for the emergence of consciousness. Emotional expressions are relevant because they are more direct than the body's language in informing others about its internal states (DAMASIO, 1996; PANKSEEP, 1998; PRINZ, 2004). In this way, symbolic coding is an improvement that guarantees more specificity for the information transmitted, even if it loses velocity. In addition, advanced communication systems in non-human animals maintain their properties shared with human animals but receive the addition of cognitive-computational systems (HAUSER, 1996; STEGMANN, 2009; ADAMS & BEIGHLEY, 2013; MILLIKAN, 2013). Besides that, mental representations are important in a comparative phylogenetic argument about the evolution of consciousness, as they allow relevant functions such as the integration, availability, and conceptualization of symbolic information (LAU & ROSENTHAL, 2011; FEINBERG & MALLATT, 2013; BROWN *et al.*, 2019). Next, working memory performs the encoding of symbolic structures, distinguishing between them (BADDELEY & HITCH, 1974; BADDELEY, 2000; BADDELEY, 2003), while the cognitive-computational system of the syntax merges these symbolic structures, forming tangles of sentences (HAUSER *et al.*, 2002; PINKER, 2010; BOLHUIS *et al.*, 2014). Furthermore, the properties of language confer greater complexity on consciousness and are crucial for the higher-order forms of consciousness states (EDELMAN, 1992; DAMASIO, 2010). However, all of this comes into play in the practical life (know-how) of the hunter-gatherer hominid, making it possible to expand and diversify their cooperative social relationships (including nonkin) (TOOBY & DEVORE, 1987; PINKER & JACKENDOFF, 2005; PINKER, 2010; COSMIDES & TOOBY, 2013).

1 Emotional Expressions and Animal Communication

In more detail, internal states are modifications of the body based on its regulators (drivers), the reinforcement and reward mechanism, and emotional responses, whose origin can be internal or external. Such emotional states refer to internal physical states and are modified, according to the internal convenience of the organism, forming the body to act in the external environment through behavior, understood as an action in the external environment whose specific purpose is one's benefit of the organism. Information about such internal states is represented implicitly, non-symbolically, and distributed throughout the organism (DAMASIO, 1996; PANKSEEP, 1998; PRINZ, 2004).

Emotions are a form of recording events in the body-brain system that inform the organism about the current state (PRINZ, 2004), but they are also a form of action program (DAMASIO, 1996) that prepares the organism for adaptive action (PANKSEEP, 1998), altering the body-brain processes towards homeostatic balance (DAMASIO, 1996). Thus, in addition to being a state of recording events in the body-brain, emotions are considered as systems that trigger responses that unfold in a relatively short period (ADOLPHS, 2013) with which an organism determines the significance of a stimulus or event, whether advantageous (beneficial) or disadvantageous (harmful) based on its valence and magnitude. Thus, emotional responses include representations of states of external (for example, visual) and internal (for example, visceral, somatic, endocrine) perceptions that generate innate and acquired responses (DAMASIO, 1994).

In addition to the concepts of arousal, the concepts of valence and magnitude are central to understanding the role of emotions and motivation for the organism (ENGELMANN *et al.,* 2009; PANKSEPP, 2010; CARRUTERS, 2018; CARVALHO & DAMASIO, 2021). In effect, valence seems more like a non-conceptual representation of value for the motivational role of the organism (CARRUTERS, 2018). The functional role of the valence mechanism is to inform the organism of the value of the current state of the body as good or bad for it. In this case, the positive valence motivates the organism to pursue the object or event valued as "good", whereas the negative valence motivates the organism to reject and avoid it (CARRUTERS, 2018). Besides that, the valence mechanism operates within gradient dimensions and would not operate alone, in the sense that the organism would be under the influence of a single value (PANKSEEP, 2010).

Likewise, motivation is a force that compels behavior to occur to satisfy some need (BERRIDGE, 2004). Within this context, if someone is cold, dehydrated, and lacking energy, then the humoral, visceromotor, and somatomotor responses are appropriate responses triggered automatically to generate the motivational behavior of seeking a heat source and drinking water (BERRIDGE, 2004). In turn, the principal incentive motivation concept is magnitude (ENGELMANN & PESSOA, 2007), in which, if its value is manipulated, thus the motivational incentive will also alter behavior (ENGELMANN *et al.,* 2009). According to this perspective, the magnitude mechanism is a crucial property of behavior, as how motivation shapes behavior is closely linked to reward and punishment (ENGELMANN *et al*., 2007; ENGELMANN & PESSOA, 2009). Furthermore, this would explain how organisms can direct internal contents to the world, including cases of emotional expressions capable of communication (DAMASIO, 2018). Although this information is not represented at the elementary level, such information can be encoded as a first-order representation (FOR) and, subsequently, the encoding involves high-order representations (HOR) and executive functions when the organism needs to make decisions (DEHAENE *et al*., 2006; LAU & ROSENTHAL, 2011).

According to the working hypothesis, consciousness is a mechanism capable of translating the expression of the organism's internal states into external states available to other organisms inserted in the same ecological niche. In this way, it is necessary to distinguish between the communication of internal states behaviorally and through vocalizations. In animal signaling, an organism expresses implicit behavioral information to other organisms capable of interpreting it. At a basic level, behavioral expression is fast and is directly related to the information it represents, for instance, exposed teeth represent aggression, a lowered posture represents submission, and mating dances represent motor coordination (LACHMANN, 2013). At a higher level, there is a second type of communicative behavior of expressions of emotions that allow the emission of vocal sound signals (TOMASELLO *et al.*, 2003).

Communicative behavior involving the exchange of signals understands animal signaling as any behavior or structure that alters the behavior of another organism and that evolved due to this effect. Behavioral signaling, for example, the exchange of light signals (LEWIS e CRATSLEY, 2008), or vocal signaling, the emission of alarm signals (MARLER e EVANS, 1996), are also emotional expressions that reflect the current state or interests in the organism, such as willingness to mate (LEWIS e CRATSLEY, 2008) or presence of a predator (MARLER e EVANS, 1996). Furthermore, advanced communication systems are studied by considering their structures and properties and whether they have characteristics shared with human language (HAUSER *et al.*, 2002; PINKER & JACKENDOFF, 2005). Thus, researchers (HAUSER *et al.*, 2002; TOMASELLO, 2014) argue whether there are properties and devices exclusive to human language, especially syntax (HAUSER *et al.* 2002). In this sense, the main argument is that syntax is not present in advanced communication systems in non-human animals, as it is the core that integrates the cognitive-computational system, together with the internal (conceptual) and external (perception and motor control) interfaces (BOLHUIS *et al.*, 2014).

Finally, advanced communication systems in human and nonhuman animals occur in ecological and social contexts. The Neo-Darwinian approach argues that natural selection has perfected both manipulation and mind-reading, in this case, both partners should, on average, benefit from the exchange, implying a kind of symbiosis (PINKER, 2010).

2 Mental Representations

The notion of internal representation can range from molecular structures (BECHTEL, 2001) to the notion of representation as a collection of neural substrates and information about the organism and the environment that can be topographically separated and organized, occurring in various initial sensory cortices (visual, auditory and others) (LAMME, 2004). Thus, these representations are dispositional and distributed across several higher-order associative cortices (DAMASIO, 2010). In such manner, internal representations range from implicit information that is stored in the organism in a distributed way, as occurs in associative learning (KANDEL, 2001), to the more elaborate forms of internal representation present in multicellular organisms that correspond to records about the state of your body/brain and the environment (PRINZ, 2004). Above this, there are also highly sophisticated forms of internal representations, such as those high-order representations that refer to previous informational and cognitive processes (LAU E ROSENTHAL, 2011).

In other words, internal representations deal with biological and informational processes within the organism (BECHTEL, 2001; PICCININI e SCARANTINO, 2010). In their more basic forms, representations record past events that occur in the organism-environment interaction (EICHENBAUM *et al.*, 1988; MOSER *et al.*, 2008), building dispositional representations that enable quick action (DAMASIO, 2010). In intermediate forms, some species even exhibit more complex forms of behavior that depend on cognitive abilities (LAU e ROSENTHAL, 2011). In the latter case, cognition refers to the ability to form representations to guide flexible behavior – as when the organism uses a mental spatial map when planning a route and using the plan to drive to the destination (LEDOUX, 2019).

The topic of the evolution of internal representations must begin with the most elementary forms of implicit representation. Implicit mental representations, at a more elementary level, refer to records (DAMASIO, 1996; PRINZ, 2004) that are representations of the immediate physical world and are not the same as this information, while high-order representations describe a more advanced way of forming mental representations in the absence of direct perceptual information from the environment, such as when referring to representations that indicate primary objects (FEINBERG e MALLATT, 2018).

The simplest way to process sensory information from stimuli is in elementary reflexive reactions, that is, the ability to use internal representations in conjunction with instrumental learning is the basis of associative learning and was a significant change in the repertoire of behavioral tools of animals (LEDOUX, 2019). It endowed the possessing organism with a new ability to base current responses on memories about the past consequences of successful learning by trial and error (LEDOUX, 2019).

Ledoux (2019) uses the concept of internal representations as a function of the organism to guide external behavior while an instrumental action, based on mapping the characteristics of the environment (temperature, oxygen levels, among others), to make predictions about his future and the environment. In this way, Ledoux (2019) highlights the ability of organisms to remember and learn from past situations. This ability did not even require a central nervous system and was already present in organisms long before the Cambrian Explosion, such as in unicellular protists (such as bacteria).

Nonetheless, more sophisticated forms of representation exist, such as FOR (BLOCK, 2011) and HOR (LAU e ROSENTHAL, 2011). The FOR´s function represents the properties of the internal and external stimuli, as occurs when, for example, a visual scene is processed in the brain. FORs involve the primary and secondary visual areas and, according to defenders (LAMME, 2004; BLOCK, 2011), is a sufficient condition to engender phenomenal consciousness. However, the HORs represent the FORs and would be responsible for informational encoding and attentional focus (DEHAENE *et al.,* 2006), maintained by the fronto-parietal networks and working memory (LEDOUX e BROWN, 2017), as an additional representation that would account for conscious access to phenomenal consciousness (LAU e ROSENTHAL, 2011). Given the involvement of working memory and top-down selective attention, HORs are related to consciousness and higher-order functions, such as decision-making (DEHAENE e CHANGEAUX, 2005; LAU e ROSENTHAL, 2011; Brown *et al.,* 2019). Taking this into consideration, HORs are important for the working hypothesis because HORs, which are maintained by heteromodal/parallel informational coding (DEHAENE and CHANGEAUX, 2005; DEHAENE *et al.,* 2006) in working memory and selective attention (LEDOUX and BROWN, 2017; LEDOUX, 2019), are encodings of external and internal contents of the organism, in which symbolic coding occurs to form explicit representations capable of communication.

3 Working Memory and Symbolic Coding

Working memory (WM) plays a pivoltal role in various aspects of human life, such as learning, understanding speech and writing, prospective and future planning, and explicit forms of reasoning. WM also significantly overlaps with fluid general intelligence. Furthermore, there has been some comparative investigation of WM capabilities between species (MACPHAIL, 1995), although much remains unknown about the evolution of this non-co-specific capacity (EDELMAN, 2009a; EDELMAN e SETH, 2009b; BIRCH, 2019; BIRCH *et al.,* 2020). In this sense, there are a series of aspects or components of normal WM function in humans, including abilities to sustain (GOLDMAN-RAKIC *et al.,* 1990), rehearse (GILBERT and WILSON, 2007) and manipulate (TONG, 2013) representations active (KOLATA *et al.,* 2007), with a subscription limit of three to four items (HAUSER *et al.,* 2000) or blocks of information (BADDELEY and HITCH, 1974; BADDELEY, 2000; BADDELEY *et al.,* 2001). Additionally, the dependence of WM on attention, especially on the focus of attention, needs to be explained regarding the species that share this type of WM (EDELMAN, 2009a;

EDELMAN and SETH, 2009b; BIRCH, 2019; BIRCH *et al.,* 2020)."

The language component of working memory is the Phonological Loop (PL) (BADDELEY *et al*., 2018). The PL subcomponent processes linguistically encoded auditory and verbal information. PL is subdivided into two parts: on the one hand, a type of short-term phonological storage with auditory memory traces that are subject to rapid decline (phonological storage) and, on the other hand, a rehearsal component (rehearsal process) that can recover declined memory traces (BADDELEY, 1992; BADDELEY et al., 1998). In addition to the already known processes of phonological similarity effect (PSE), which occurs when words that sound similar are confused, word-length effect (WLE), referring to the fact that it is more difficult to memorize a list of long words, and articulatory suppression effect (ASE), which shows that the best performances can be achieved if a list of short words is memorized (BADDELEY et al., 1998), PL also encodes information separating symbolic structures such as noun, adjective, subject and verb (SPEIDEL, 1993; GATHERCOLE, 2006; BADDELEY *et al.,* 1998). One of the original aspects of the text is to say that WM does not only disrupt symbolic information (SPEIDEL, 1993), as exhibited in cases of Specific Language Impairment (SLI) (GATHERCOLE, 2006), and that PL is also involved in lexical acquisition (BADDELEY *et al.,* 1998). However, WM can encode different types of symbolic structures before syntax application. Such symbolic structures are then recoded by the cognitive-computational system that merges them (BOLHUIS *et al.,* 2014).

Besides the primary function of the Central Executive (CE) of coordinating the activity of both FL and VSSP simultaneously, the CE is also involved in the output of coded linguistic information to the cognitive-computational system, given that CE is concerned with controlling tasks and changing guidance (BADDELEY *et al.,* 2001). Moreover, WM is related with focus attention (FoA) to divide attention between two simultaneous tasks and switch attention from one task to another, and finally, to integrate working memory and LTM (DESIMONE, 1996; BADDELEY *et al.,* 2001; CHUN & TURK-BROWNE, 2007; MACCABE *et al.,* 2010; CHUN, 2011; MYERS *et al.,* 2017; PANICHELLO & BUSCHMAN, 2021). The FoA hypothesis in WM predicts that the selection of information to be kept in WM is not just a form of selecting one part of information as an exclusion of one part from all other parts, but it is the selection of a set of information whose function is to maintain several separate items in WM simultaneously and include these items in the various subcomponents of WM (OBERAUER, 2019). In this sense, FoA allows the encoding in WM of symbolic representations that occur in an organized way in PL by CE to be selected for input into the cognitive-computational system. However, there are other roles of top-down attention, as it is still involved in forming external models of the world in the organism (overt attention) and the self-model of plans, intentions, and actions (GRAZIANO, 2019).

4 Supplementary Language Coding and Consciousness

The working hypothesis seeks to define a conscious mechanism deeply linked to communication. From this perspective, the conscious mechanism can strictly connect with language. In the hypothesis definition, the conscious mechanism translates the internal states of the organism in the form of symbolic representations through a syntactic manipulation system to generate new symbols. The organism translates internal states into external ones to communicate them to other organisms with the same system able to decode the signals for understanding. Therefore, it is noteworthy that the working hypothesis is interested in language structures, such as syntax, which constitute the specific symbol combination rules for symbolic transformation and decoding for linguistic expression, and understanding arising from WM responsible for the prior coding of symbolic structures.

The computational-cognitive system comprises an internal and an external interface. The computational system, with its syntax, generates internal representations and maps them inside the external sensorimotor interface through the phonological system and within the conceptual-intentional interface through the semantic (formal) system (BOLHUIS *et al.,* 2014). At its core, the cognitive-computational system has a single cognitive symbolic processing operation that recruits two syntactic elements, "a" and "b", integrating them to form a set {a, b} recursively. Consequently, this system, as part of the generative grammar research program, provides explicit consideration for the structures of language – the rules for symbolic transformation – that explain what has been called the "Basic Property of Language": a finite computational system that produces an infinite number of expressions, each of which has a defined interpretation in semantic-pragmatic and sensorimotor systems for the conjugation between thought and sound (BERWICK; CHOMSKY, 2015).

The design of a linguistic structure involved three basic components: 1) syntactic rules and symbolic representations, together with the lexical items, would constitute the basis of the language system; 2) an external sensorimotor interface, through which mental expressions are connected to the world and 3) an internal conceptual-intentional interface that connects mental structures to the world. Hence, the recursive capacity of the cognitive-computational is the core of grammar, which is how a finite syntax can manipulate symbols, according to the coding/decoding rules, to produce an infinite set of symbols that form words (CHOMSKY, 2000; BERWICK *et al.,* 2013). This recursive mixing, in human language, is at the computational mechanism that builds new syntactic objects "Z" (e.g., "ate the apples") from already constructed syntactic objects "X" ("ate") and "Y" ("the apples").

According to the working hypothesis, symbolic manipulation is managed and performed by executive functions, specifically, WM and its subcomponents, with selective attention helping to decide on relevant items and coordination. WM encodes symbolic representations individually, which informs the cognitive-computational system that merges these linguistic items. The conscious mechanism is responsible for coordinating this process.

5 The Working Hypothesis

The central axis of the CLEC Hypothesis is the relationship between the verbal noetic conscious mechanism (LEDOUX; BROWN, 2017; LEDOUX, 2019) as coordinator of both WM and its subcomponents (BADDELEY; HITCH, 1974; BADDELEY, 2000), which encode specific symbolic structures such as verbs, subjects, complements, and the cognitive-computational system (HAUSER *et al*., 2002; BOLHUIS *et al.,* 2014), which merges these symbolic structures, constituting more complex symbolic structures such as sentences. Such complex symbolic structures are translated into extrinsic representations transmitted to other organisms that are high-order representations (LAU; ROSENTHAL, 2001; BROWN *et al.,* 2019). The innovative and original element of the working hypothesis is precisely to establish an interaction between the WM, the Cognitive-Computational System and the Conscious Mechanism of Verbal Noetic type. Thus, the CLEC Working Hypothesis states that the conscious mechanism evolved for the communicative function of transmitting the organism's internal states to other organisms through symbolic coding/decoding.

According to CLEC, the conscious mechanism recruits and controls WM and the Cognitive--Computational System to perform this function. The functioning of the verbal noetic conscious mechanism with WM occurs through the CE that coordinates the action of PL and VSSP, which are the subcomponents specialized in symbolic manipulation. This process of re-coding internal states, while representations of body states about emotional records and responses, occurs according to a recursive system, a type of Cognitive-Computational System possessing a hierarchical syntactic structure at its core. The syntactic structure combines symbols to form words, sentences, and speeches by mixing symbol units to build increasingly rich and complex sequences.

As a symbolic re-coding, these symbol sequences constitute representations over non-symbolic HORs. Thus, these representations are also of higher-order states, but in a symbolic manner, as they are re-coded over non-symbolic HORs, which are encoded over FORs. Through this feature, the conscious mechanism makes it possible to re-code information, neurally encoded, into externally understandable codes. Language, therefore, can represent an infinite number of internal states with an infinite level of complexity and details expressed symbolically.

In this way, consciousness serves as a mechanism focused on internal processes and representations. However, this conscious mechanism makes it possible not only for the organism to be aware of internal states and as the owner of these internal states, but also in a way that the internal state can be represented externally to be communicated. According to the working hypothesis, language co-evolved with consciousness, but it is not essential for consciousness because emotional sensations represent states that require only a low level of consciousness. Therefore, language depends on consciousness, whose function is to represent an infinite number of states with infinite levels of complexity and detail. This ability allows for a new degree of consciousness when thinking about its higher-order forms.

6 Language and High-Order Consciousness

According to the working hypothesis, consciousness or its primitive and intermediate forms, does not depend on language; in fact, it is language that depends on consciousness. Furthermore, the verbal noetic conscious mechanism enables symbolic representations by coordinating the activity of working memory and the cognitive-computational system. The co-evolution of consciousness and language can be seen as a two-step process. The first step was the function of translating internal states into external states; the second step, however, was marked by the evolution of more sophisticated forms of consciousness, such as those associated with higher-order states, and language. The argument is that language enriched these forms of consciousness. Hence, the preliminary types of consciousness anticipate the evolution of language, but once these two faculties co-evolve, they influence each other, and then language co-evolved with consciousness enhancing it (EDELMAN, 1992; DAMASIO, 1998; DAMASIO, 2010; DAMASIO, 2018; LEDOUX; BROWN, 2017; BROWN *et al.,* 2019).

High-order states of consciousness (CARRUTERS, 2000) are a possibility of expressing the internal states of an organism in a more complex way, that is, in a more integrated, concise, and specific way if encoded symbolically (BERWICK; CHOMSKY, 2015) to be transmitted to other organisms that have the same organization. Having the same organization means having the same cognitive architecture (Working Memory and Top-down Attention), the same symbolic system (Cognitive-Computational System), and the same conscious mechanism (Noetic Consciousness) to decode such extended conscious states (DAMASIO, 2010), such as high-order states of consciousness (EDELMAN, 1992), and autonoetic consciousness (BROWN *et al.,* 2019) that scrutinize a version larger than discrete non-conscious states. Internal states portray, not only the current state of the organism (DAMASIO, 1994; PRINZ, 2004) but also its past and expected future (LEDOUX; BROWN, 2017). In SMH's view, high-order states depend on the gradual construction of an "autobiographical self" as a set of memories of the individual's unique past and expected experiences (DAMASIO, 2010). The HOTEC's point of view includes a self-schema within autobiographical memories (LEDOUX; BROWN, 2017). Both models' high-order forms, the autobiographical memories and the self-schema, depend on WM. Additionally, language provides complementary assistance by enabling categorizations that enrich conscious states (DAMASIO, 1998).

Thus, according to EMs (FEINBERG; MALLATT, 2016; DENNETT, 2017; DAMASIO, 2018; LEDOUX, 2019; GRAZIANO, 2019), when the most basic forms of consciousness originated from the events that followed the Cambrian Explosion (538.8 million years ago) -such forms were still a long way from the current sophistication of consciousness in human animals. In particular, it was possible to describe, using language, complex representations of intentions, narratives, and expectations as well as the beliefs and emotional states behind actions, past or intended future.

However, the working hypothesis argues that when non-verbal and verbal noetic consciousness began (LEDOUX, 2021), organisms were on the way to gradually surpassing the critical threshold (PINKER & JACKENDOFF, 2005). Previously, organisms used behavioral expressions to "communicate" with other organisms, without using words of verbal communication, about what was happening to them and the environment (DAMASIO, 1996; ENGELMANN; PESSOA, 2007). However, emotional responses could later be conceptualized in detail through indirect and not-so-fast computations to be communicated to other organisms and even answer questions that had never been asked before, such as whether there is an individual perspective for what is perceived and about an individual appropriation of internal states, without detaching from life (DAMASIO, 2018; LEDOUX, 2019; GRAZIANO, 2019).

If the most advanced levels of consciousness function as a guiding compass for the contents of internal states by evoking autobiographical memories and including a self-schema in them, when these contents are represented symbolically, they are considered richer than only taken from an individual perspective of the self as their owner and acting on them (DAMASIO, 2010). Thus, the co-evolution of human consciousness and language seems difficult to separate from the exceptional degree of human sociability and cultural development (PINKER, 2010). It is difficult to explain human cultures without considering the higher-order states of consciousness behind the new instruments and practices of culture and discounting the contributions of language to the development and transmission of cultures.

In synthesis, as previously argued, once higher-order consciousness begins to emerge along with language, a self can be constructed along with social and affective relationships. In this way, firstly, the subjective world depends on language. Secondly, language provides the symbolic expression of conscious states that can be transmitted to other organisms, carrying more information in increasingly complex symbolic structures, information richer in detail. Even this can be left recorded in extensions of the mind that go beyond the present, forming a culture.

7 Know-How, Social Life and Cooperation

The communicative function of consciousness enabled competitive and collaborative advantages for organisms that owned this system for translating internal to external states. Considering that the conscious mechanism evolved following ecological pressures (FEINBERG; MALLATT, 2016; DENNETT, 2017; DAMASIO, 2018; LEDOUX, 2019) then, organisms needed to adapt to new environmental conditions (TOOBY; COSMIDES, 1989; PINKER, 2003). Those who managed to adapt to the needs of a new ecological-social and cooperative context increased their chances of survival, as it was advantageous to have a mechanism of consciousness that translated internal states into external ones (PINKER, 2010). In a context of interdependent social life, in which the organism could transmit its internal states of the body-mind (such as plans, intentions and stories) (DAMASIO, 2010; WEB & GRAZIANO, 2015) a more diverse and detailed way to organisms that have the verbal noetic conscious mechanism (LEDOUX, 2019) and the cognitive-computational mechanism with a hierarchical syntactic structure at its core (BOLHUIS *et al.*, 2014) capable of decoding symbolic information a new universe of possibilities emerged, for instance, when it was possible to transmit useful know-how about daily life, build new social ties, and symbiotic relationships (PINKER, 2010).

These conscious and linguistic adaptations co-evolved with each other and with life and social history, such as greater parental investment in offspring, cooperative relationships between non-relatives, and the distension of social relationships even with external groups. But all this was only possible through language. A more complex communication system allowed the thinking about the future of multiple generations, childhoods, and longer life expectancy and it even made "abstract thinking" about the afterlife possible. By this means, language penetrated beyond the human dimensions linked to the accumulation of local knowledge (know-how) but also encompassed social conventions and the transmission of thoughts about different cultures. Thus, these cognitive skills were adaptations to the niche that brought advantages in encoding symbolic representations from increasingly complex mental structures.

Final Considerations and Future Perspectives

The working hypothesis argument is that consciousness evolved for communicative purposes. To translate internal states into external ones, the conscious mechanism first coordinates the activity of working memory, which encodes internal and intrinsic representations into symbolic representations, for example, encoding the different parts of symbolic structures such as pronouns, adjectives, verbs and nouns, and subsequently, the activity of the cognitive-computational system, which has a hierarchical syntactic organization at its core, responsible for merging partial symbolic structures and forming more complex symbolic structures that carry more information about the internal and external states of the organism. This translating process would be advantageous for the organism that owns this configuration, as it can transmit information from the external environment, its ecology and social life, and the internal environment, the states of its body-brain complex.

Additionally, an important argument is that consciousness precedes language. The most rudimentary forms of consciousness and even more intermediate forms (at least noetic consciousness) are evolutionarily before language. However, once language and consciousness co-evolve, language imparts greater complexity to higher-order forms of consciousness. Likewise, another important point is that, although language can be used for manipulation and influence, characterizing a disharmonious inter/intraspecific ecological relationship, advanced communication systems and language depend on harmonious intra/interspecific ecological relationships, such as socially interdependent life and cooperation.

Therefore, the working hypothesis will enable future investigations regarding other interfaces and parallel phenomena. One of them is to understand how the model would explain the interaction between conscious and non-conscious symbolic processing or about the nature of symbolic representations and the underlying informational and neural processes. For example, which type of neural coding operates at each level of symbolic processing, like whether symbolic processing and neural coding are related to mono and hetero-modal, local and distributed information processing.

The goal is to advance the problem of how consciousness evolved, how its building blocks were formed, what structures, functions and abilities the species shared, and what life was like from organisms to ecologically and socially integrated modern humans. According to the state of the art in the area, the working hypothesis is in a pre-paradigmatic phase involving brainstorming, comparison with alternative models, approximations between more refined models, and experimental testability. Thus, the working hypothesis allows us to advance further phylogenetic investigations, and their results is imperative to generate operational definitions practical to applied science.

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The texts in this article have been proofread by Mais H Consultoria Linguística Internacional and submitted for validation by the author before publication.