(DIS)EMBODIED LANGUAGE

César Meurer
Universidade Federal do ABC

Abstract: The connection between language and the body has become a significant topic of research over the last decades. On the one hand, those who hold that language has an embodied nature endorse a close link between linguistic and sensorimotor processing. As a result, language processing is understood as an online activity, i.e., as something that stands in relationship to the local environment and engages in here-and-now tasks. On the other hand, for those who contend that language is fundamentally disembodied, linguistic processing is a matter of mental manipulation of amodal symbols according to a set of rules. On this view, language is an offline activity and is considered to be something that grants us interesting cognitive advantages due to its independence from sensorimotor contingencies. This paper [i] offers a comprehensive presentation of these two views; [ii] highlights a crucial challenge for each of them: the scaling phenomenon and the grounding problem, respectively; and [iii] argues that all attempts to overcome these two challenges have major shortcomings.
Keywords: Embodiment, Symbolic cognition, Abstract language, Conceptual representation.

Resumo: A conexão da linguagem com o corpo tornou-se um tópico de pesquisa significativo ao longo das últimas décadas. Por um lado, aqueles que sustentam que a linguagem tem uma natureza incorporada endossam uma estreita ligação entre o processamento linguístico e o processamento sensório-motor. Como resultado, o processamento linguístico é visto como uma atividade *online*, ou seja, como algo que se relaciona com o ambiente local e se envolve em tarefas do aqui-agora. Para aqueles que afirmam que a linguagem é fundamentalmente desincorporada, por outro lado, o processamento linguístico é uma questão de manipulação mental de símbolos amodais de acordo com um conjunto de regras. Nessa visão, a linguagem é uma atividade *offline* e é enaltecida como algo que nos proporciona vantagens cognitivas interessantes devido à sua independência das contingências sensório-motoras. O presente artigo [i] oferece uma apresentação abrangente dessas duas visões; [ii] destaca um desafio crucial para cada uma delas: o 'scaling phenomenon' e o 'grounding problem', respectivamente; e [iii] argumenta que todas as tentativas de superar esses dois desafios apresentam grandes deficiências.
Palavras-chave: Incorporação, Cognição simbólica, Linguagem abstrata, Representação conceitual.

Language is a central component of human existence. With the unfolding of the so-called 'cognitive revolution', a variety of efforts are being made to better understand what language is, as well as its place and role in cognition.

In recent years, the view according to which *(1) Language has an embodied nature, and hence is meaningful only for embodied subjects* has found empirical support. On this view, we will see in Section 1, language is fundamentally an online activity that enables us to proceed interactively in a shared scenario. Critics of the embodied view contend that *(2) Language has a disembodied nature, and hence*

enables us to enjoy symbolic distance from surrounding environment. Section 2 presents key ideas of the view on which language is an offline activity that grants interesting cognitive advantages precisely due to its independence from sensorimotor contingencies.

The impasse between (1) and (2) has generated three lines of research: (a) embodied theorists are typically focused on explaining the so-called 'scaling phenomenon'; (b) disembodied theorists are in search of a solution to the 'grounding problem'; (c) "ecumenical" theorists have been suggesting that language may be both an online and an offline activity. In Section 3 I offer a critical overview of these efforts and argue that they all have major shortcomings.

1. Embodied language

Those who claim that *(1) Language has an embodied nature, and hence is meaningful only for embodied subjects* endorse a close link between linguistic and sensorimotor processing. As a result, language is understood as an online activity, i.e., as something that stands in a relationship to the immediate local environment and is engaged in here-and-now tasks. This view fits into the embodied approach to cognition.[1]

Some proponents of embodied language argue that language is *radically* embodied, claiming that "linguistic understanding just is an enactive simulation" (WEISKOPF, 2010, p. 297), or that "any instance of linguistic communication grounds it's meaning in the subject's bodily experience" (CAIANI, 2011, p. 486). At the neural level, this account stresses that "language makes direct use of the same structures used in perception and action" (GALLESE and LAKOFF, 2005, p. 473) or, in a slightly different formulation, that "the same neural structures involved in making sensory, motor and emotional experiences are also involved in understanding linguistic material related to those experiences" (BUCCINO et al., 2016, p. 72). For our purposes, it is worth noting the following: this "isomorphism" between language and sensorimotor processing subscribes what Meteyard et al. (2012, p. 793) call 'full simulation', that is, "the re-creation of direct experience through the modulation of activity in primary sensory and motor areas"; semantic content has to be modal in order to use the same neural substrates of perception and action.

[1] 'Embodied cognition' labels the idea that human cognition is rooted in perception and action. As Gallese and Sinigaglia (2011, p. 512) put it: "many features of cognition are causally or even constitutively related to the physical body and the bodily actions of an agent".

Other theorists conceive language as *moderately* embodied, i.e., as something that "requires, but is not identified with enactive simulation" (WEISKOPF, 2010, p. 298). Although the idea of a dependence relationship with sensorimotor processing is preserved, it is no longer a matter of isomorphism but of a bidirectional interaction. Indeed, moderate embodiment holds that language and sensorimotor processing are consistently linked and influence each other: "Semantic content will be able to influence processing in primary [sensory and motor] areas, and vice versa, [...]. Interactions may be more or less potent depending on the strength, number and activity of the connections; and may be influenced by task demands" (METEYARD et al., 2012, p. 792).

At the empirical level, the case for embodied language has been made in several ways. In what follows, I provide a brief overview of recent empirical studies focusing on (a) action-verbs, (b) nouns of graspable objects, (c) adjectives expressing pleasant and unpleasant motor features, and (d) emotion-related linguistic items. (For more detailed overviews see BERGEN, 2015; KASCHAK et al., 2014; SCOROLLI, 2014).

Friedemann Pulvermüller's work is especially important when it comes to understand the embodied nature of action-verbs. Thanks to him and his team, we know that our brain recruits motor and pre-motor areas almost immediately (150-170ms) after a visual or auditory stimulus of that type (action-verb) is presented (for a slightly dated review, see Pulvermüller, Shtyrov and Hauk, 2009). In more recent work, they report data that confirm this early recruitment in both hand- and foot-related action-verbs (MOLLO, PULVERMÜLLER and HAUK, 2016). Using repetitive Transcranial Magnetic Stimulation – rTMS, Tremblay, Sato and Small (2012) temporarily impaired the left ventral premotor cortex (PMv), an area known to be related to hand action, and found that healthy subjects in this condition became unable to understand sentences expressing hand actions. This evidence, they say, strongly suggests that "motor processes help mediate the semantic encoding of language" (TREMBLAY, SATO and SMALL, 2012, p. 319; for a review on the link between language deficits and motor impairments, see COTELLI et al., 2018).

Nouns referring to graspable objects seem to have a similar embodied status. Here are some findings: using fMRI, Rueschemeyer et al. (2010) compared the activation of the fronto-parietal sensorimotor systems regarding words denoting volumetrically manipulable objects (objects that *can* be picked up to move, e.g. bookend, clock) *versus* words denoting functionally manipulable objects (objects that *must* be picked up to use, e.g. cup, pen). "The results show that functionally manipulable words elicit greater levels of

activation in the fronto-parietal sensorimotor areas than volumetrically manipulable words" (RUESCHEMEYER et al., 2010, p. 1844). This suggests that semantic representations of objects do somehow reflect the functional use of those objects. Gough et al. (2012) report on an experiment in which participants had to read different kinds of nouns (graspable and non-graspable objects, artifacts and natural objects). In line with the embodied view of nouns, they found that words referring to graspable artifacts are associated with significantly greater areas of the motor system. In another paper (MARINO et al., 2014) they show that viewing photos and reading nouns of graspable tools modulates motor responses in a similar way. In their words, "the modulation of the motor system during object observation overlaps with that related to noun processing" (p. 01). In a recently published paper (BUCCINO et al., 2017), they report data showing that fluent speakers of a second language (Italians who are fluent in English) process graspable nouns expressed in that language (English) in the same way that they do in their native language (Italian).

Gough, Campione and Buccino (2013) conducted an experiment with transcranial magnetic stimulation (TMS) and motor evoked potentials (MEPs) recorded both from a muscle of the hand (the first dorsal interosseus – FDI, which is involved in grasping actions) and from a muscle of the forearm (the extensor communis digitorum – EC, which is involved in releasing). The participants of that experiment had to read words of three types: adjectives that denote a positive property as for interactions with a potential object having that feature (e.g. spherical, malleable, soft etc.); adjectives that express a negative property (boiling, thorny, sharp etc.); and words without any meaning, created by random combination of letters (e.g. nmldt, rgbdc, crdpl etc.). Their data show "an interaction of adjective type (positive, negative) and muscle (FDI, EC), the effect being driven by a significant difference for negative adjectives" (GOUGH, CAMPIONE and BUCCINO, 2013, p. 54). These findings, they insist, "support and embodied view of language [...] and may hardly be reconciled with a view of language as amodal" (p. 58).

Emotions seem to be rooted in bodily experience as well. According to Winkielman et al. (2015), this has been demonstrated along two main lines of research: the first and largest one "has established that the somatosensory-motor elements of emotional experience [...] contribute to higher order emotional processing", and the second one "has established that when people use emotional metaphors, such as those relating physical distance to emotional engagement or those relating temperature to emotional engagement, they make use of their capacities for sensing heat and appreciating physical distance" (p. 156-157). Furthermore, emotion-related linguistic items – sometimes called

'emotion words' – appear to be embodied as well. An experiment by Havas, Glenberg and Rinck (2007), for instance, has shown that the comprehension of emotion-related linguistic items is linked to and influenced by facial expression (smiling or frowning). That experiment – a sentence judgment task – "measured the time needed to comprehend sentences describing emotionally laden events when the participant was in a matching or mismatching emotional state" (p. 437). Participants' emotional states were manipulated by means of the following technique: they had to hold a pen in their mouth using either only the teeth (which produces a smiling facial expression) or just the lips (which in turn produces a frowning expression). The sentences, displayed individually on a computer monitor, had to be classified as "pleasant" or "unpleasant" by pressing different buttons. "Pleasant sentences were read 54msec faster when participants were smiling (pen-in-teeth) than when they were frowning (pen-in-lips); unpleasant sentences were read 36msec slower when participants were smiling than when they were frowning" (p. 437). In another experiment (Havas et al., 2010), they used injections of Botox to paralyze temporarily the muscle used in frowning. Participants in this condition where significantly slower in understanding emotional sentences that involved the use of that muscle.

Niedenthal et al. (2009) conducted an experiment that confirms that emotion words can bring on a sensory-motor re-experience. Using EMG, they recorded facial electromyographic activity while participants were classifying emotion words and neutral words randomly displayed on a screen. Some participants just had to indicate whether the word on the screen was in capital letters or not. Others, in turn, had to indicate whether that word is associated with an emotion or not. As expected, "participants who made judgments in which the emotion component of the concept was relevant recruited somatic components of emotions, as reflected in the presence of EMG activity". Such responses were not observed "with the same-word stimuli when the task did not require consideration of the emotional content of the concept" (p. 1125).

Kever et al. (2015) found a correlation between levels of physiological arousal and the processing of emotion words. In their experiment – an attentional blink task –, participants had to detect and report target words right after a cycling session (increased arousal) as well as after a relaxation session (reduced arousal). The target words where either neutral (e.g. call, compass, echo etc.), low arousal (e.g. boredom, kindness, tender etc.) or high arousal (e.g. pain, guilt, orgasm etc.). Their data confirm that the increased arousal condition improves the detection and report of high arousal words, whereas reduced physiological arousal improves low arousal words. These findings "reveal that the arousal dimension of emotional concepts is grounded in our

bodily systems of arousal. [...] an increase or decrease in physiological activation facilitates the awareness of emotional words that are congruent in terms of their arousal value" (p. 586).

To sum up: according to the embodied view, be it radical or moderate, language production and comprehension is fundamentally linked to perception and action. Conceived as an online activity, language becomes sort of a "procedural knowledge – knowledge how, not knowledge that – that enables us to interact with others in a shared physical world" (ELK, SLORS, and BEKKERING, 2010, p. 01).

2. Disembodied language

Critics of the embodied view of language contend that *(2) Language has a disembodied nature, and hence enables us to enjoy symbolic distance from surrounding environment*. Instead of related to the here-and-now tasks via sensorimotor processing, language is understood as an offline activity that depends on a set of symbols whose manipulation is governed by a small set of rules. This view is in line with the so-called 'symbolic paradigm of cognition'.[2]

The disembodied approach to language comes in several varieties. One of the most well known can be traced back to the 1950s, when Chomsky (2002 [1957]) proposed a nativist theory nowadays known as 'Generative grammar'[3]. The key idea is the following: humans rely on an internal grammar – a set of innate and universal rules –, that supports and enhances the learning of natural languages, these understood as an infinite series of finite sentences build with a finite alphabet of symbols. Consisting of a set of syntactic rules (rules governing sentence structure)[4], this internal grammar supports the particular grammar of any natural language.

The strength of Chomsky's view becomes clear when we consider that (i) virtually all natural languages in the world share a set of basic syntactic rules (Generative grammarians usually call them 'principles'); and (ii) grammars of

[2] 'Symbolic cognition' labels the idea that human cognition is essentially a matter of symbol manipulation. This view requires a clear distinction between perception and cognition, and a process that transduces sensory and motor information (signals) into a different format (symbols) that is suitable for cognitive processes. On the one hand, a symbol is thought of as inherently non-perceptual or amodal, in the sense that it holds no structural correspondence to the perceptual state from which it originates. On the other hand, a symbol is arbitrarily linked to a perceptual state. For a precise and compact description of symbolic cognition see Harnad (1990, p. 336).

[3] Chomsky's theory has had many different names through its development: Transformational Grammar; Transformational Generative Grammar; Standard Theory; Extended Standard Theory; Government and Binding Theory; Principles and Parameters approach; Minimalism. The name Generative Grammar is, then, sort of a blanket name.

[4] For an example, see Jackendoff's (2002, p. 09-10) analysis of the syntactic structure of the sentence 'The little star's beside a big star'.

natural languages vary only in a restricted number of ways (often called 'parameters'). Chomsky himself insists on these points especially in publications of the 70s and 80s. In *Reflections on language* (1975), for example, he focuses on "the system of principles, conditions, and rules that are elements or properties of all human languages not merely by accident but by [biological] necessity" (p. 29). In *Rules and representations* (1980), he invites the reader to consider "the set of properties, conditions, or whatever that constitute the 'initial' state of the language learner, hence the basis on which knowledge of a language develops" (p. 69). Later in this book he talks about a "genetic program that permits the range of possible realizations that are the possible human languages" (p. 234). In the 90s, under the title *The minimalist program* (1995), he deepened studies around two principles: *Merge*, which is a set-forming operation that concatenates two elements (two syntactic objects) and projects the category label of one on the newly formed constituent. "The operation *Merge* (α, β) is asymmetric, projecting either α or β, the head of the object that projects becoming the label of the complex formed" (p. 225); and *The inclusiveness condition*, which states that no properties can be added to a syntactic representation. All properties must be grounded in the properties of the words that make up that representation. In his words, "any structure formed by the computation is constituted of elements already present in the lexical items selected for N; no new objects are added in the course of the computation apart from rearrangements of lexical properties" (p. 209).

Over the years, generative grammar has accumulated support of various types. I will not delve into empirical literature here, but we should note that children develop language remarkably rapidly without any formal instruction (For a review on this point, see Yang et al., 2017). Another well-known piece of evidence comes from pidgin language studies. In short, pidgin languages are rudimentary communication systems, with little or no grammar, invented by slaves whose native tongues were so different that they couldn't understand each other. Researchers like Bickerton (2016) discovered that the children of those slaves, once exposed to the pidgins, did not merely imitate them. Instead, they came up with certain syntactic rules, thus originating Creole languages. "In Hawaii", Bickerton claims, "we have empirical proof that the first creole generation produced rules for which there was no evidence in the previous generation's speech" (BICKERTON, 2016, p. 08).[5]

On the Chomskyan view, language can be thought of as offline (/disembodied) in the following sense: first, the language faculty in the narrow

[5] For neurological evidence related to generativity and Merge, see PALLIER, DEVAUCHELLE and DEHAENE (2011), and GOUVEA et al. (2010).

sense – that is, as a syntactic machinery (HAUSER, Chomsky and Fitch, 2002) –, does not share neural substrates with sensorimotor systems; second, the meaning of a word, conceived as a symbol, comes from relations to other words (i.e., a symbol does not ground it's meaning in body experience); third, symbols are amodal (i.e., they bear no structural correspondence to perceptions or to objects/events).

Deacon (1997) has put forward a different disembodied view that conceives language as "based upon symbolic reference [...] and involving combinatorial rules that comprise a system for representing logical relations among these symbols" (p. 41). Less known than the Chomskyan approach, this view is best understood in the light of Peirce, who distinguished three categories of referential associations: the iconic association, which is mediated by similarity between the sign and object; the indexical association, mediated by some physical or temporal connection; and the symbolic association, mediated by some formal or merely agreed-upon link. For Peirce, it is worth noting that, "all words, sentences, and other conventional signs are symbols" (PEIRCE, 1965, Vol. II, p. 165 [2.292]).

According to Deacon (1997, p. 73), Peirce's most fundamental and original insight is that "the difference between different modes of reference [iconic, indexical, symbolic] can be understood in terms of *levels* of interpretation". More specifically, the iconic interpretation is a prerequisite for indexical interpretation, which in turn is a prerequisite for symbolic interpretation. In a later publication, Deacon (2003, p. 121) clarifies this point by saying that "the differences in the interpretative competence to 'recognize' a sign as iconic, indexical, or symbolic turns out to be hierarchically organized and of increasing complexity from icon to index to symbol". In a nutshell, the increasing complexity is the following: "symbolic relationships are composed of the indexical relationships between sets of indices and indexical relationships are made up of the iconic relationships between sets of icons" (VILLIERS, 2007, p. 97).

How do we achieve the interpretative competence to recognize symbols? Deacon's (2003, p. 122) explanation involves two interdependent levels of correlational relationships: "we individually and collectively elaborate this system by learning how each symbol token both points to objects of reference and (often implicitly) points to other symbol tokens (and *their* pointings)". As such, symbolic reference seems to be a uniquely human capacity: regardless "of all the enormously powerful computing devices that we find in the heads of birds and mammals, only one uses symbolic mode of reference" (DEACON, 1997, p. 50-51). Consequently, human language turns out to be "a mental tool for gaining a kind of subjective distance [...] from our

own subjective experiences" (p. 450), since "symbolic reference strips away any necessary link to the personal experiences" (p. 451). Ultimately, this confers freedom to thought processes – a major evolutionary achievement that

> [...] has provided human selves with an unprecedented sort of autonomy and freedom to wander from the constrains of concrete reference, and a unique power for self-determination that derives from this increasingly indirect linkage between symbolic mental representation and its grounds of reference. [...] we should not underestimate the miraculous power of symbols to break down even vast barriers of space, time, and idiosyncratic experience that would otherwise separate us impenetrably (DEACON, 1997, p. 454).

Deacon's point – that symbolic reference enables us to shift away from here-and-now tasks – converts language processing into a less costly activity and this, in turn, seems key for other achievements such as greater expressive capacity due to cognitive flexibility, and better control of our own thoughts.

Jacques and Zelazo (2005, p. 54-55) define cognitive flexibility as "the ability to consider simultaneously multiple conflicting representations of a single object or event". This ability, they claim, "is a hallmark of human cognitive function": a cognitively flexible subject can act differently on the basis of each of the conflicting representations. More importantly, Jacques and Zelazo point out that "language development makes possible the development of cognitive flexibility" (2005, p. 75). In a previous work, Jacques (2001) has argued that the use of symbols generates a distance between the subject and the external stimuli the symbols represent. This distance, in turn, allows for more flexible thoughts. In her words, "the emergence of flexible thought may be a corollary of the development in humans of a higher form of abstraction in which objects and their attributes are represented within a broader system of concepts with the use of arbitrary linguistic symbols" (JACQUES, 2001, p. 155). This line of reasoning leads us to hypothesize that cognitive flexibility, as an output of symbolic reference, crucially depends on amodal and arbitrary symbols (For a review of empirical literature that supports the amodal nature of symbols, see Machery, 2016).

Cognitive flexibility also plays an important role in reading comprehension. Based on empirical literature, Cartwright (2009) points out that skilled reading comprehension is a complex accomplishment that requires the simultaneous and flexible consideration of at least three elements: "coordinating semantic propositions within texts to detect inconsistencies; linking semantic propositions within texts, across texts, and with prior knowledge to make inferences; and managing text content alongside metacognitive and strategic processes" (p. 124). The conclusion here is that

skilled reading comprehension demands decoupling attention from current sensorimotor information.

To sum up: language production and comprehension can be thought of as disembodied, that is, as largely independent from perception and action. On this view, language is fundamentally a matter of manipulation of symbols – an offline activity –, which arguably grants us first-rate cognitive advantages.

3. Embodied, disembodied, or both

The impasse between (1) and (2) has generated three lines of research: (a) embodied theorists typically focus on explaining the so-called 'scaling phenomenon'; (b) disembodied theorists are concerned with finding a solution to the 'grounding problem'; (c) "ecumenical" theorists have been seeking to reconcile (1) and (2) by suggesting that language may be both an online and an offline activity. In what follows, I offer a critical description of these efforts so as to highlight some major shortcomings.

3.1 Embodied theorists and the scaling phenomenon

Since almost all evidence in favor of the embodied approach has been gathered regarding linguistic items that are connected to perception, action, and emotion (items such as action-verbs, nouns of graspable objects, adjectives...), one may wonder how do we master items that lack this connection? Or: if language is essentially an online activity, how are we able to take it offline? These intuitive questions point to a major challenge known as 'the scaling phenomenon'.

> Consider 'A thief having to pay for stolen goods'. This rests on notions of ownership of property, of theft, of social compulsion ("have to") and of payment (through imprisonment or a fine, involving concepts of freedom and money, respectively). These are very abstract notions based on an understanding of a range of legal concepts in a given society, rather than *action-perception manifestations*. The issue then is: what must a brain possess to be capable of acquiring such concepts? This remains an open and challenging question (ARBIB, GASSER, and BARRÈS, 2014, p. 65).

In recent years, this challenge has given rise to a number of proposals with no agreement on (a) what abstract language is (words on the top of the abstraction hierarchy such as 'animal'; or words whose referents are non-material such as 'justice'; or words associated with mental states such as 'fear'; or words with a greater emotional valence and arousal etc.); (b) the degree of embodiment of abstract language (radical, moderate...); (c) the similarities and differences between concrete and abstract language; (d) what counts as evidence for the embodiment of abstract language (behavioral, neuropsychological...).

Those who conceive language as *radically* embodied assume that abstract language is also a matter of "full-simulation". This idea has been elaborated in two ways: the *Motor Theory* (GLENBERG et al., 2008a; GLENBERG et al., 2008b) and the *Conceptual Metaphor Theory* (LAKOFF and JOHNSON, 1999; LAKOFF and NÚÑEZ, 2000). The former builds on the similarities between concrete and abstract language, and gathers evidence with techniques such as the action-compatibility effect (GLENBERG and KASCHAK, 2002), the approach-avoidance effect (CHEN and BARGH, 1999), and force dynamics (TALMY, 1988). The latter highlights differences between concrete and abstract language and brings together behavioral and neural evidence to support the claim that "metaphors use embodiment to catapult our thinking into abstraction" (JAMROZIK et al., 2016, p. 1081).

Those who conceive language as *moderately* embodied have put forward a number of different accounts of the scaling phenomenon. One such proposal, the *Words as Social Tools Theory*, "extends embodied views assuming two simultaneous cognitive sources for word meanings: an individual one, the embodied individual experience, and a socially embodied one" (BORGHI and CIMATTI, 2009, p. 2304). On this approach, abstract words are for the most part socially embodied, while concrete words are individually embodied (BORGHI, 2014; BORGHI and BINKOFSKI, 2014). On another moderate theory, the *Affective Embodiment Account*, both concrete and abstract words "bind different types of information: experiential information (sensory, motor, and affective) and also linguistic information" (KOUSTA et al., 2011, p. 14). Abstract words differ by putting greater weight on affective information: "whereas sensory-motor information is statistically more important for the representation of concrete words, emotional content contributes to word representation and processing particularly for abstract concepts" (*op. cit.*, p. 14). Viglioco et al. (2014) report an fMRI experiment that shows a correlation between abstract words and the rostral anterior cingulate cortex – rACC, an emotion processing region (PHAN et al., 2002). These results, Viglioco and colleagues claim (2014, p. 1767), "support embodiment views of semantic representation, according to which, whereas concrete concepts are grounded in our sensorimotor experience, affective experience is crucial in the grounding of abstract concepts".

The growing variety of such proposals indicates that the scaling phenomenon remains a challenge of great magnitude for embodied theorists of language (BORGHI et al., 2017). On the one hand, a unitary theory of the embodiment of abstract language seems out of reach. On the other, it is odd to admit a collection of theories, each of which accounts in its own way for one conception of abstract language.

3.2 Disembodied theorists and the grounding problem

The disembodied approach to language also faces questions: How do words, conceived as arbitrary amodal symbols, attune with perception, action, and emotion? In other words: assuming that language is fundamentally an offline activity, how do we achieve the ability to bring it online? Echoing Searle's (1980) 'Chinese room argument', Harnad (1990, p. 339-340) labeled this situation 'the grounding problem':

> Suppose you had to learn Chinese as a *first* language and the only source of information you had was a Chinese/Chinese dictionary! [...] How can you ever get off the symbol/symbol merry-go-round? How is symbol meaning to be grounded in something other than just more meaningless symbols? This is the symbol grounding problem.[6]

Harnad's point is clear: successful syntactic manipulation of arbitrary amodal symbols provides no clue to the meaning of these symbols (HARNAD, 1990; 2006). Since the 90s, different strategies have been proposed to tackle this problem. One is the construction of lexical co-occurrence models aimed at capturing the meaning of a word by computationally studying its occurrence in large bodies of text. Lund and Burgess (1996), for instance, put forward the *Hyperspace Analogue to Language* model, "a methodology capable of capturing information about word meanings through the unsupervised analysis of text" (p. 206). In this model, words are seen as vectors in a semantic space. "A semantic space is a space, often with a large number of dimensions, in which words or concepts are represented by points; the position of each such point along each axis is somehow related to the meaning of the word" (p. 203). In such a space, the relations between words can be examined and quantified "by applying distance metrics to the points within the space" (p. 203). The crucial idea with respect to distance metrics is: points with smaller distance between them are considered more similar in meaning than comparatively farther away points. (For other lexical co-occurrence models see LANDAUER and DUMAIS, 1997; JONES and MEWHORT, 2007; BLEI, NG and JORDAN, 2003; GRIFFITHS, STEYVERS and TENENBAUM, 2007; SHAOUL and

[6] Kaschak et al. (2014, p. 118-119) have suggested a more detailed situation: "Imagine that you have just disembarked from a plane in China. You do not understand Chinese, but have a Chinese dictionary. You decide to find the baggage claim, and look at the sign hanging from the ceiling for directions. The sign is written in Chinese, so you open the dictionary to find the first word on the sign. You find the word, and find that its definition is written in Chinese. No problem, you think, you'll just look up the first word of the definition in the dictionary. You do so, and find that the word is defined in Chinese as well. It is clear that no matter how much time you spend with the sign and the dictionary, you will never figure out what the words on the sign mean".

WESTBURY, 2006. For reviews see CONG and LIU, 2014; MEHLER et al., 2016). Nonetheless, lexical co-occurrence models do not solve the grounding problem: rather than explaining how arbitrary amodal symbols acquire meaning, they just analyze relative frequency of symbols that are already meaningful.

Taddeo and Floridi (2005) reviewed eight solutions to the grounding problem (other than lexical co-occurrence models) that were proposed between 1990 and 2005. "The strategies differ in the methods used to elaborate the data obtained from the sensorimotor experiences and in the role (if any) assigned to the elaboration of the data representations in the process of generating the semantics for the symbols" (p. 420). Their conclusion is that all these attempts are semantically committed – i.e., they beg the question by supposing pre-existing semantic resources – and hence "none provides a valid solution of the symbol grounding problem" (p. 443).

Since 2005, several other explanations have been proposed. Mahon and Caramazza's (2008) *Grounding by Interaction* draws on a distinction between concepts – conceived as abstract and symbolic entities – and the instantiation of concepts. "[T]he specific sensory and motor information that goes along with the instantiation of a concept is not constitutive of that concept". However, "such sensory and motor information may constitute, in part, that instantiation" (p. 68). On their view, there is sort of "a structure that relates abstract conceptual content to sensory and motor processes". That structure "provides the conduit for both freeing cognition from the specifics of the body, as well as allowing cognition to interface with the world through the body" (p. 69). A problem with this approach is that acknowledging that sensorimotor information goes along with some linguistic items provides very little in terms of grounding. Secondly, the vast majority of our concepts/words don't have consistent sensory and motor information (if any) corresponding to them.

Zwaan (2014) highlights that language processing happens at five levels of environmental embeddedness, these "characterized in terms of the overlap between the communicative situation and the referential situation" (p. 231): (i) a *demonstration* is the most completely embedded level of language use, where agents, objects and actions are all present in the communicative situation; (ii) an *instruction* describes "a desired or required state of the world that (slightly) differs from the present one"; (iii) a *projection* maps "a past or future state of the environment on the current one". The less embedded levels are (iv) a *displacement*, that is, a description of "an environment that is unrelated to the current environment, as is the case in narratives", and (v) an *abstraction*, i.e., a communicative situation exempt of spatiotemporal framework and not

referring to any environment in particular. It is debatable whether these levels of embeddedness count as an answer to the grounding problem. Consider, for instance, a case in which language is almost completely embedded: In virtue of what does a given linguistic item refer to a particular object or action? In this case, do all linguistic items count as referring expressions? If so, is the meaning of a given word to be identified with its reference? These questions have no uncontroversial answers. So, it is fair to say that the grounding problem remains a challenging situation for disembodied theorists of language (LEIBOVICH and ANSARI, 2016).

3.3 Ecumenical theorists and the hybrid view

The difficulties in solving the grounding problem, on the one hand, and the scaling phenomenon, on the other hand, have encouraged efforts in a third direction: the idea that (1) and (2) can be reconciled by suggesting that language may be both an online and an offline activity. The key idea is the following: a subset of our language is modal/online while another subset is amodal/offline. As Dove (2009, p. 413) put it: "there are diverse semantic codes, some of which are indigenous to perceptual systems and some of which are not. [...] our concepts contain both modal and amodal representations".

Prima facie, the hybrid view accounts quite nicely for both the relationship between sensorimotor and language processing and the capacity of symbolic distance from surrounding environment. So, one may ask: how are these different codes defined? Günther, Dudschig and Kaup (2017, p. 35) summarize hybrid theorists' answer:

> In hybrid models, the representation format of a word can be assumed to depend on the experience available with that word: if direct experience with the reference is available, the representation format is modal, and if the word has been learned only from linguistic context, the representation format is amodal instead.

If direct experience with the reference plays a key role in determining whether a concept/word is modal or not, then words such as 'pisco' (a well known Chilean drink) and 'aojiru' (a well known Japanese drink) are both amodal for me (the author of this paper) but not for an average Chilean or Japanese person, respectively. I regard this proposal as problematic for a number of reasons. First, it is incompatible with the view on which language is radically embodied. By definition, an amodal concept does not relate to sensorimotor processing in an isomorphic manner. Stating that someone can learn words from linguistic context alone – for example, that 'aojiru' means a Japanese drink developed during the Second World War and nowadays widely seen as a dietary supplement associated with longevity, but without any clue as

to its taste, texture, smell and drinkability – implies that "full simulation" is not required in language processing.

Second, on the ecumenical proposal, empirical evidence for the moderate embodiment of language needs to be considered again. Consider the motor evoked potentials related to an adjective such 'thorny': instead of evidence for the embodied status of this linguistic item, as in Gough, Campione and Buccino (2013), they now count as evidence of direct experience with thorny objects. In other words, the motor activity is no longer a constituent aspect of linguistic processing, but a contingent fact.

Third, it is not clear what counts as direct experience with the reference of action-verbs and emotion words. Do words such as 'closing' and 'pleasant' have clear referents?

Fourth, the idea that some semantic codes are indigenous to perceptual systems while others are not raises questions both about the ontology of concepts and about the architecture of human cognition. Can language still be thought of as a module – an innate and universal capacity "that determines what counts as linguistic experience and what knowledge of language arises on the basis of this experience" (CHOMSKY, 2006, p. 24) – or is it more like a pervasive component of the mind? In sum, there are more questions than answers surrounding the hybrid view of language.

Concluding remarks

All theorists agree that language is a central component of human existence. However, there is no consistent agreement when it comes to explain what language is, as well as its place and role in cognition. This paper has shown that both the embodied and the disembodied view of language face challenging questions. Indeed, those who claim that *(1) Language has an embodied nature, and hence is meaningful only for embodied subjects* have to explain how we achieve the ability to master abstract language – the scaling phenomenon. In turn, those who hold that *(2) Language has a disembodied nature, and hence enables us to enjoy symbolic distance from surrounding environment* need to explain how symbols acquire meaning – the grounding problem. Finally, those who propose that a subset of our language is modal while another subset is amodal – and thereby suggest that (1) and (2) can be reconciled –, shall come up with a convincing explanation of how these subsets get defined.

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