RIFL (2012) 5: 84-98 (Azione, percezione e linguaggio)
DOI 10.4396/20120307

Where are abstract concepts from? Embodiment beyond the body

Carmen Granito
University of Bologna
carmen.granito@gmail.com

Abstract Grounded and embodied theories of cognition face the problem of a consistent account of abstract concepts: if cognition is grounded in the brain modal systems and consists in modal simulations, where are abstract concepts from? After discussing some fully modal embodied theories of abstract concepts and two pluralistic approaches involving modal and amodal representational systems, we will present a way to account for abstractness without involving amodal formats: the Words as Tools theory. Combining embodied and extended approaches, the WAT theory holds that embodied experience is not enclosed inside the boundaries of our body; words are modal entities (they are perceivable and activate multimodal situations related to their meaning) and they also are social instruments to perform actions of selection and grouping; abstract words are grouping tools whose related sensorimotor experiences are so variable and dissimilar among them that linguistic information provides us with a necessary support to bind them together in the same category. Social and linguistic (embodied) experience is crucial for building the meaning of words, particularly of abstract ones.

Keywords: abstract-concrete, grounded cognition, embodiment, representational pluralism, extended mind

0. Introduction: Embodiment, empiricism and the problem of abstract concepts

Grounded and embodied theories of cognition can be considered as a contemporary version of modern philosophical empiricism, with the difference that not only do they propose theoretical accounts of concepts, but also they inspire experimental research in cognitive science and neuroscience1 (see MACHERY 2007).

According to the traditional cognitivist theories representations of knowledge in cognition are structures of amodal data processed independently from modal systems in the brain; conversely, grounded and embodied (G and E) theories of cognition state that specific contexts, the body and simulations in the modal systems in the brain ground cognitive representations (for a review, see PECHER 2011 or BARSALOU 2008).

Although there are many differences between specific embodied theories, we can consider two main claims *usually* shared by them (see MACHERY 2007 for a complete review):

1 Importantly, Machery points out that "neo-empiricists" differ from traditional empiricists such as Berkeley, Hume, or Russell, in that they are not necessarily committed to anti-nativism.

1) The knowledge stored in a concept is encoded in several perceptual representational systems[2]. This claim is in contrast with amodal theories of concepts, that assume the existence, besides our perceptual representational systems, of a distinct representational system, usually thought of as being languagelike. For example, for amodal theorists, a concept like DOG encodes some perceptual as well as some non-perceptual information about dogs in a unique, distinct and linguistic representational system. Proponents of embodiment deny the existence of this distinct representational system. According to embodied theories of concepts, our concept of dog encodes some visual information in a vision-specific representational system, some auditory information in a different audition-specific representational system, and so forth. The perceptual information about dogs that is stored in our concept of dog is a subset of the perceptual information about dogs that is processed by our perceptual systems.
2) Conceptual processing (categorization, induction, deduction, analogy-making, planning, linguistic comprehension, etc.) involves essentially reenacting some perceptual states and manipulating them; the cognitive processes that underlie our higher cognition involve our senses, that is some of the processes involved in perceptual information processing.
One of the most influential grounded theories is Barsalou's Perceptual Symbol Systems theory (PSS). In his view, once a perceptual state arises, a subset of it is extracted via selective attention and stored permanently in long-term memory. On later retrievals, this perceptual memory can function symbolically, standing for referents in the world, and entering into symbol manipulation; thus, retrieving a concept from long-term memory consists in producing a perceptual state; when we reason, we manipulate this perceptual state. For example, when we reason about dogs, we simulate seeing, hearing, smelling a dog, and we manipulate these perceptual representations. The production of perceptual states is called *simulation* or *re-enactment*.
Therefore, in the G and E view there is circular relationship between perception, action and cognition; consistently word meanings are grounded in perceptual and motor systems.
These theories, though, share with philosophical empiricism a fundamental problem: the need of a consistent account of abstract concepts. As clearly pointed out in BARSALOU (2008), if cognition is grounded in the brain modal systems and consists in modal simulations, where are abstract concepts from?

1. Embodied theories of abstract concepts

Within the embodied framework, several explanations of abstract concepts have been proposed. These theories differ for the degree of importance they attribute to the role of sensorimotor representations; as noticed in PECHER (2011) they differently answer to the "necessity and sufficiency question" (see PECHER 2011: 224) about whether sensorimotor representations are necessary and/or sufficient for cognitive processing. In the following section we will first present some fully modal embodied theories of abstract concepts (§ 1.1 – 1.3); we will then discuss a more moderate pluralistic approach involving both modal and amodal representational systems (*see*

2 Admittedly, there are a few researchers in G and E cognition who do not emphasise perceptual aspects of representations or completely reject the notion of representation itself.

§ 1.4 – 1.5); finally we will present a way to reconcile modality and the pluralism of representations proposing a social extension for embodiment (*see* § 2).

1.1 The metaphor theory

Some of the first theories to champion grounded cognition in modern times arose in cognitive linguistics. Researchers (LAKOFF & JOHNSON 1980; LAKOFF 1987) proposed the idea that human thought is fundamentally metaphorical; according to this view, we can understand a conceptual domain metaphorically in terms of another, namely we map the structure of an origin domain A (*vehicle*, e.g. boiling pot) onto a target domain B (*topic*, e.g. anger) and thus obtain a re-organisation of the topic representation. The conceptual mapping is based on cross-categorial correspondences, which can be ontological (i.e. entities of B systematically correspond to entities of A) and epistemic (i.e. knowledge about A is projected on knowledge about B): for example, we can understand love in the terms of a journey of two travellers (the lovers) encountering obstacles (the difficulties in their relationship) on their way to reach common destinations (their shared existential goals).

It is important to note that proponents of the metaphor theory claim that people do not just speak metaphorically, but think metaphorically; more so, they speak metaphorically because they think metaphorically. Linguistic expressions of metaphors are only an epiphenomenon that occurs alongside the primary phenomenon of conceptualisation.

Conceptual metaphors are described by LAKOFF (1986) as being a) systematic: there is a fixed correspondence between entities and structures of the two domains involved; b) unconscious: the subject does not control them; c) generalisable: we can understand new extensions of a metaphor in terms of the same cross-conceptual correspondences; d) productive: we can create new linguistic metaphors on the basis of the already existing unique conceptual metaphor e.g., poetic metaphors; e) conventionalised in natural languages.

This theory accounts for abstract concepts referring to the same process just described: we use concrete concepts as vehicles to structure abstract topics through metaphorical mapping; the representation of the vehicle is necessary to fully understand the topic. Since the concrete vehicles refer to sensorimotor experiences, the sensorimotor system can be used to represent abstract concepts.

LAKOFF & JOHNSON (1980) proposed that humans have a set of basic concepts called *image schemas* that are central to their experience and provide a basic structure to both concrete and abstract concepts. Image schemas are analogue representations of sensorimotor experiences, consistently they are grounded. Nevertheless they are more *abstract* than proper modal sensorimotor representations because they lack the perceptual detail of sensorimotor representations. For example, the *up-down* image schema refers to spatial experiences of verticality, that are visual, tactile and/or motoric.

Such schemas are involved in the metaphorical mapping of the concrete vehicles onto the abstract topics, therefore abstract concepts are partially represented by image schemas; because image schemas in turn are grounded in sensorimotor experience, it follows that abstract concepts are ultimately grounded in sensorimotor experiences as well. It is important to note that this is a two-step grounding operation.

As pointed out in PECHER et al. (2011), a big challenge for the metaphor theory is clarifying the process of mapping image schemas onto abstract concepts. One of the main problems is that what is meant by the phrase "image schema" is not well specified and it has been used to mean different things. However, most researchers agree on considering image schemas as reflecting commonalities between distinct experiences in different domains. Notwithstanding, if the metaphor helps us in establishing similarities between two concepts, then image schemas are not sufficient in order to fully understand abstract concepts because they cannot capture differences: for example, if the *up-down* schema can be mapped on several concepts like *power*, *divinity* and *valence*, then we need further features to distinguish these concepts, features that might be provided by additional situational representations.
Evidence in favour of this view is confined to specific domains and it is difficult to imagine how far a mechanism based on metaphorical mapping can be extended and used in a predictive way.

1.2 The motor theory

This view is more radically action based. The core claim is that action schemas play an important role in representing concepts; indeed, since the main function of cognition is to support our interactions with the environment (GLENBERG 1997), action should be central to cognitive representations. Evidence in favour of this view is mainly based on the Action-sentence Compatibility Effect (ACE, see GLENBERG & KASCHAK, 2002): people react to a sentence faster when they perform a motor action that matches the action described by the sentence, e.g., participants are faster to verify sentences such as *You gave Andy the pizza* by making a hand movement away from themselves than by making a hand movement towards themselves; conversely, they are faster to verify sentences such as *Andy gave you the pizza* by making a hand movement towards than away from themselves. This supports the existence of a relation between representation and action.
According to this view, also during comprehension of abstract words the motor system is recruited. GLENBERG et al. (2008) showed that abstract transfer sentences activate motor information exactly as their concrete homologues, exhibiting similar ACEs. Sentences such as *Liz told you the story/You told Liz the story* facilitated responses towards or away from oneself respectively, even though the described situation does not involve any hand movements. These results indicate that both concrete and abstract transfer events are represented by simulating concrete transfer, and suggest that the ACE is elicited by a competition for resources by the motor planning associated with the action and the language processing associated with the sentence.
As noticed in DOVE (2011), the action schema theory faces some of the same challenges as the metaphor theory, for instance the problem of how differences between various concepts constructed on the same action schema are represented.

1.3 The situated simulation theory

BARSALOU (2003) integrated PSS theory with situated cognition, proposing that simulations typically contextualise the categories that they represent in background situations, which include objects, agents, actions, events, and mental states.
In a series of studies, Schwanenflugel et al. demonstrated the role of situations in conceptual representation. The core claim of their context availability theory

(SCHWANENFLUGEL 1991)[3] is that in order to understand a word (or a sentence) we need to represent a context where those words have meaning; accordingly, meanings for both concrete and abstract words are accessed by associating the word with a network of relevant prior knowledge, the context. The main difference between the two types of words would be that it is more difficult to find an appropriate context for abstract than for concrete words; namely, abstract words would depend on a looser set of semantic associations compared to concrete words. The advantage in comprehension and recall shown by concrete over abstract words would depend on the easier access of related contextual information. Therefore, providing abstract and concrete words with an equally supportive context would result in equivalent comprehension and recall.

According to BARSALOU & WIEMER-HASTINGS (2005), who refer to "situations" rather than "contexts", the findings of Schwanenflugel et al. demonstrate two points about the processing of words. First, the meanings of words are not established in isolation, but words are typically understood and represented against background situations; when a situation is not available, a concept is difficult to process. For example, «Understanding what CHAIR means relies not only on the physical properties of the object, but also on the settings in which it is found (e.g., classrooms) and the activities performed in them (e.g., attending lectures). Knowledge of chairs is inadequate if one does not know how they are used in relevant situations» (BARSALOU & WIEMER-HASTINGS 2005: 131). Second, retrieving situations for abstract concepts seems to be more difficult than retrieving situations for concrete concepts.

They propose that both concrete and abstract concepts involve situated simulations, but where concrete and abstract concepts differ is in their focus within background situations: for concrete concepts attention focuses on the respective objects against their background situations, whereas abstract concepts focus on event and introspective properties.

Finally, because the content of abstract concepts is grounded in situations, this content can be simulated by sensorimotor systems.

However, the body of evidence cited in support of the situated simulation proposal is admittedly quite thin and, more importantly, it is hard to imagine how far the evidence can be extended beyond specific domains.

1.4 The Dual Core Theory

Paivio's dual code theory (DCT, e.g., PAIVIO 1991) assumes the existence of two different representational systems: a verbal system represents the structural and functional properties of language, a nonverbal system represents the nonlinguistic world. Their representational units are called *logogens* and *imagens*, respectively, and are said to be modality-specific[4] perceptual-motor analogues. More complex units are formed from smaller ones, hierarchically or linearly; it is a componential approach where components are concrete, modality-specific analogues rather than abstract amodal features[5].

3 Unlike the situated simulation theory, the context availability theory proposes the existence of a single amodal semantic system encoding the meaning of both abstract and concrete words.

4 Representational units are modality-specific in that different representations correspond to the different modalities (visual, auditory, hactic etc) of the events experienced by the subject.

5 At the time of Paivio's first proposal of DCT, the dominant position was that the language of thought is unimodal and abstract, classically viewed as internalized words and sentences, and as

In this view, although the two systems are functionally independent (each one can be active without the other or both can be active in parallel), units are interconnected so to allow the spread of activity from one unit to others within or between systems; the so called *referential interconnections* link imagens and logogens (one to many in both directions) so that nonverbal information can be named or, vice versa, names can evoke nonverbal experiences.
According to the DCT, «word concreteness reflects the directness of connections from a logogen to a related imagen» (PAIVIO 1986: 46), in other words while logogens of concrete words activate directly the imagens of the referent objects, logogens of abstract words firstly activate the logogens of other words they are associated with and eventually evoke images, but illustrative images rather than the image of the referent object, e.g. «*religion* might activate *church* first as a verbal associate and then as an image of a church» (*ibid*). All words engage associated verbal codes, but concrete words activate image-based code to a greater degree than abstract words do, resulting in a concrete word processing advantage.
The representational difference of concrete and abstract words follows from a different acquisition process: «whereas object names are learned in relation to the objects themselves, the learning of abstract words depends on prior learning of concrete words and thus on intraverbal associative contexts» (*ibid*).
As already mentioned, DCT explains why performance in memory tasks is better for concrete than for abstract words (*concreteness effect*): concrete words activate both verbal and nonverbal representations, whereas abstract words activate only (or mainly) verbal representations. Therefore, more retrieval cues can be used for concrete than abstract words.
DCT has been recently resumed in several studies. BINDER et al. (2005), for example, put to test the prediction that different, although overlapping, neural mechanisms underlie the processing of concrete and abstract concepts. They examined the effects of word imageability and concreteness using event-related functional magnetic resonance imaging, while participants identified concrete and abstract words. The results showed a bilateral network of association and posterior multimodal cortices activated during processing of concrete concepts, and a strongly left-lateralized network activated during processing of abstract nouns. These results provide evidence for a DCT model of concrete and abstract concepts.

1.5 Embodied and dis-embodied theory

DOVE (2011) proposes a hybrid theory of concept representations which can be seen as an attempt to interpret Paivio's DCT within an embodied perspective (see also DOVE 2009). On the one hand, Dove partially agrees with the embodied accounts of cognition as based on our bodily interactions with the world and embraces the perceptual symbol system of conceptual representation; on the other hand, he argues that sensorimotor simulations are not sufficient in order to thoroughly explain our acquisition of abstract concepts, and thus a plural (at least dual) code is required involving some kind of "ungrounded" representation.
There is general agreement about the existence of an asymmetry between representation of concrete and abstract concepts: while concrete concepts generally depend on both linguistic and non-linguistic perceptual symbols, abstract concepts

amodal propositional structures and rule-governed (computational) processes. His insistence in favour of modality makes Paivio a predecessor of contemporary embodied theories.

tend to rely primarily on linguistic perceptual symbols. In Dove's view, concepts are encoded in at least two types of representations: embodied sensorimotor representations of our interactions with the world, i.e. perceptual symbols, and dis-embodied sensorimotor representations. According to Dove, «A mental symbol is dis-embodied if 1) it is embodied but 2) this embodiment is arbitrarily related to its semantic content» (DOVE 2011: 2); that is to say: dis-embodied representations are dynamic and multimodal and rely on sensorimotor simulations just as embodied ones do, but in contrast they do not inherit semantic content from this embodiment. The symbolic structure of natural languages seems to be well suited as a form of dis-embodied cognition: whereas embodied perceptual symbols are causally connected with the objects and events they represent, Dove argues that there is no extralinguistic reason to connect a certain word to a certain object or category. The semantic content of dis-embodied linguistic symbols would then derive from their relations with other linguistic representations. In this view, «language is an amodal symbol system built on an embodied substrate» (DOVE 2011: 8), namely the sensorimotor simulation of language processing[6]. In keeping with CLARK (2008), the dis-embodied theory claims that, thanks to linguistic arbitrariness, natural language provides us with a system of representation that enhances our cognitive abilities, in particular it allows us to generalise beyond the information coming in specific modalities and thus plays the integrative role traditionally associated with amodal symbols in order to explain abstraction. Without a dis-embodied system of representation, i.e. language, we couldn't build abstract concepts.

A first objection to the dis-embodied theory concerns the necessity to turn to an amodal (even though partially grounded) symbol system in order to account for the computational property of language; as argued in BARSALOU (1999), PS can implement all the computational functions that amodal symbols were traditionally assumed to have: «through the construct of simulators PSS implements the standard symbolic functions of type-token binding, inference, productivity, recursion, and propositions. This approach retains the symbolic functionality of traditional theories but implements it differently, using simulation and dynamic systems» (BARSALOU 2008: 622).

Furthermore, in Dove's account the difference between the two types of coding lies in the link between representations and their semantic content (in the most likely interpretation, the experience they represent). Non-linguistic sensorimotor representations are linked to the experiences they represent by a causal relation (see DOVE 2011: 2): experiences previously caused those representations, so that we can later use the same representations to refer to experiences. Conversely, linguistic sensorimotor representations are said to lack a causal connection with the experiences they represent and thus to be arbitrary with respect to these experiences, because the experiences which previously caused those linguistic representations are experiences of words, not of situations. In this second case, the assumed missing causal link to the represented experience is replaced by a linguistic mediation: the semantic content is provided to the linguistic representation by the linguistic association network to which it belongs.

6 It is essential to note that Dove's account differs from Paivio's DCT first because Dove considers perceptual symbols and not images to be the basic units; second, according to DCT the basic elements of linguistic representations (logogens) differs in nature from the basic elements of nonlinguistic representations, whereas Dove claims that all conceptual representations consist of perceptual symbols; linguistic representations are distinguished from nonlinguistic ones because they are an internalisation of en external symbol system.

However, this account presents two problems. Firstly, it does not explain how linguistic representations ultimately gain their semantic content; assuming a chain or a network of linguistic connections only moves the problem one step further, resulting in an infinite regress unless at some stage linguistic representations are anchored to some kind of situation. Secondly, there is a possibility to find a causal relation between a linguistic sensorimotor representation and the world experience it refers to: a person can learn a word because someone says it to her in the presence of the referred object or situation, so that she will store the sensorimotor representation of the word together with the other sensorimotor aspects of the situation; therefore, she will have a sensorimotor representation, which includes linguistic information, that has been caused by the referred experience. We find that Dove is missing the fact that words are part of our experience of situations, and not just signs belonging to the abstract system of the *langue*. Also, Dove might be confusing two levels of analysis: the relation word-meaning and the relation between our mental linguistic representations and the represented experiences. If the first is certainly arbitrary (unmotivated), the second is hardly so. Therefore, the difference between pre-linguistic mental representational systems and linguistic ones does not lie in the fact that the second is arbitrary whereas the first is causal, because they are both causal; the relevant distinction here is between natural languages, where the link word-object is arbitrary, and pre-linguistic communication systems, where the link sign-object is somehow motivated (on the symbol grounding problem see HARNAD 1990). As MACHERY (2007) points out, it is «inadequate to contrast amodal and perceptual representations by means of the contrast between linguistic and analogical representations» (MACHERY 2007: 23).

An interesting proposal that might avoid some objections moved to Dove's dis-embodied theory comes from the Words as Tools theory (WAT, Borghi & Cimatti, 2009). WAT's proponents agree with Dove that speaking a natural language makes a difference in cognition, and also that a pluralism of representations is needed if we want to reach a thorough account of human cognition; however, they believe that it is not necessary to resort to amodal symbols in order to explain our ability of constructing abstract concepts. Like Dove, WAT theory proposes that conceptual processing uses multiple representations (sensorimotor and linguistic), but differently from Dove, it considers representations to be all modal. This step is allowed if we think of words as part of our experience, more so as experiences themselves.

2. WAT: extending embodiment beyond the boundaries of the body

BORGHI & CIMATTI (2009) propose a social extension of the embodied cognition to solve the problem of abstract words acquisition and representation; they argue that «the social and linguistic experience is crucial for building the meaning of words, particularly of abstract ones» (BORGHI & CIMATTI 2009: 3).

The proponents of WAT believe that the discovery of mirror neurons has greatly contributed in highlighting the social aspects of linguistic experience. Neurophysiological and brain imaging studies suggest the existence of a link between the canonical and mirror neuron system along with language processing: canonical neurons, which are active during the observation of objects and are the neural basis of the possible actions that can be performed with that object (*affordances*), would take part in noun processing; mirror neurons, which are active during the observation of other individuals interacting with objects, would be

involved in verb processing. The two neural systems would be triggered not only during action and object observations, but also during language comprehension.
However, understanding a word also requires a social experience and even though motor resonance may be part of the neural substrate for language comprehension, the mirror neuron theory should be complemented with deeper investigation of the influence that conventional aspects of language may have on cognition.
Since the proponents of WAT theory believe that concepts are always influenced to some extent by language, they do not talk of abstract and concrete concepts, but of meanings of abstract words (MAWs) and concrete words (MCWs), where meanings are defined as mental representations mediated by language.
From an embodied point of view, words are modal entities because they are perceivable and activate a variety of multimodal situations related to their meaning. In addition, WAT considers words to be embodied also because they are tools that allow us to modify the state of the world: naming an object entails selecting and emphasising certain features; labels help us change the focus of attention (on this topic, see also CLARK 2008). Considering words as instruments to perform actions of selection and grouping allows WAT proponents to reformulate the difference between abstract and concrete words: sensorimotor experiences related to abstract words are so variable and divergent that the linguistic label provides us with a necessary support to bind them together; conversely, sensorimotor experiences related to concrete words do not necessarily need the linguistic support because they are sufficiently perceptually similar to "stay together". The ability of pre-linguistic children to form pre-linguistic categories only on the basis of perceptual similarity provides an evidence for this account.

2.1 Consequences

Two consequences follow from this view:

a. A different way of acquisition for MAWs and MCWs:

Acquiring a word is learning the association between different kinds of experiences; when we learn concrete words, we associate a new label to a category which was previously formed on the basis of sensorimotor experience; this new association changes the category because the label is connected to a network of other labels and its meaning is part of a network of differences where the value of each term depends on the value of the other terms in the whole system. Accordingly, the concept of a non-linguistic animal is different from the meaning of a linguistic organism. In the case of MCWs, acquisition starts with non-linguistic sensorimotor experiences.
The opposite mechanism underlies abstract words acquisition: (embodied) linguistic experience helps us to collect a variety of bodily states which are categorised only once they are named.
Summarising, both MAWs and MCWs are grounded in sensorimotor experiences, both are tools to perform actions and modify the states of the world; however, embodied linguistic information is more crucial to acquire MAWs than MCWs. The role that social context plays in acquisition is different: we rely more on language to understand MAWs, whereas we rely more on individual sensorimotor experience to understand MCWs.

b. An asymmetry in cross-linguistic variability:

Word use varies depending on language and culture, because each language has got its own semantic network; different semantic systems can overlap, but they also have

idiosyncratic aspects. Language influences our way of forming categories (and therefore meanings), but since for MAWs linguistic information is determinant for the formation of the category, MAWs will be more variable cross-linguistically; instead, as for MCWs world structures provide more constraints to how categories are formed, the impact of linguistic differences will be less strong than in abstract domains[7].

2.2 Possible objections and further considerations

An objection that can be moved to the WAT theory is that words commonly considered as concrete can be learned by linguistic explanation without having any experience of sensorimotor situations to which the word applies, e.g. "elm". A reply to this objection could be that if the description used contains words that are concrete (in the WAT's meaning of concrete), then they will activate more sensorimotor information and therefore the word will be represented as more concrete; if the description is more abstract (e.g., functional, relational, etc.) the new word will be represented as more abstract because the component words will activate more linguistic information. A question arises, though, about whether it is possible to give an "abstract" description of an object to someone who has never experienced it and then to expect them to recognise an exemplar of that object when they meet one. If someone does not have any sensorimotor information, how can they possibly recognise an object from its appearance?

Importantly, according to the WAT theory there is no definite boundary between purely concrete words and purely abstract ones; the dimension of concreteness and abstractness has to be seen as a continuum: at an end we find words that group together extremely perceptually similar (experiences that we might classify together even without the guide of language), at the other end there are words that group experiences so perceptually diverse that it is difficult (or impossible) to associate without language. In the middle, there are intermediate cases where perceptual similarity among experiences decreases as linguistic explanation becomes more determinant.

Now, which sensorimotor experiences are as similar as possible? Repeated sensorimotor experiences of the same single object (e.g. the same table or the same person), being extremely similar and minimally variable from a sensorimotor point of view, form the most concrete categories (i.e. sensorimotor information is of the utmost importance). Linguistic expressions linked to that object (e.g. "John Smith"

7 A theory very close to WAT is Barsalou's Language and Situated Simulation theory (LASS, see BARSALOU 2008). Like WAT, the Lass theory states that multiple systems represent knowledge: linguistic forms and situated simulations both play a role in conceptual processing; in this view, when a word is processed in a conceptual task, it first activates other linguistic forms, such as word associates, because representations of linguistic forms are more similar to presented words than are simulations of their referents. More slowly, the word activates a situated simulation to represent its meaning in neural systems for perception, action, and mental states.
The difference between WAT and the Lass theory is that proponents of the latter state that simulations represent deep conceptual information, whereas linguistic representations are more superficial; although language plays a role in conceptualisation, experience is more central and meaning is primarily represented in simulations. Conversely, in WAT's view sensorimotor linguistic and non-linguistic experiences do not have a different status and do not differ in depth; during language comprehension a combination of both experiences is activated and their weight might vary depending on the task and on the kind of word (i.e. linguistic information is more important for MAWs than for MCWs, because it is more crucial for their acquisition).

or “this table”) would then be the expressions that are represented in the most concrete way. Those expressions are singular terms, namely expressions that distinguish a single individual from others rather than “putting together” different exemplars as common nouns do (even though on the cognitive level they both keep together several sensorimotor experiences).
This is not an attempt to completely overlap two oppositions, the abstract-concrete and the generic-specific, on the basis of the extension of a linguistic term[8]; however, generally speaking, there is a connection between abstract and generic on one side and concrete and specific on the other: specific terms (e.g., “dog”) are likely to be represented as more concrete than generic terms (e.g., “animal”) because referents of the former allow more similar sensorimotor experiences than referents of the latter[9].
However, it is not the minimal extension in itself to determine the concreteness of a category, but the similarity between the subject’s sensorimotor experiences allowed by an object. There could exist a term referring to only two objects (and then rather specific), but nonetheless these objects could be very different on the sensorimotor side and, therefore, could not allow the formation of a sensorimotor category.
It follows that in order to distinguish between concrete and abstract categories, it does not matter what the “folk grammar” means by the traditional distinction between abstract and concrete words, nor does it matter a term’s extension in itself; what matters is the way a subject experiences individuals or object exemplars, which is in turn constrained by the experiences allowed by the referent of that term and its properties (a table allows sufficiently similar sensorimotor experiences, whereas situations of freedom allow more idiosyncratic aspects to enter in the representation of the MAW FREEDOM).

2.3 Evidence

The study of BORGHI et al. (2011) tested some aspects of the WAT theory. In order to simulate concrete and abstract words acquisition, participants were asked to manipulate images of novel objects or observe a group of objects interacting according to novel invented relations; participants were then given labels and some received a short description for each type of new entity; during the following test phases, some participants could respond to the task request pushing a button, some others using a microphone. Results showed a significant advantage of the microphone on the keyboard for abstract words, particularly in participants who had been given both the label and the description. In keeping with the WAT theory, because of the different acquisition modality, concrete words activated manual motor information, while abstract words activated phono-articulatory information. Labels improved the performances with abstract categories, and generally made it easier to handle concrete categories.

8 By extension of a term we mean the number of individuals falling under that label.

9 Some traditional semanticists (see ULLMANN 1970) consider the distinction between abstract and concrete words as nearly totally independent from the distinction between generic and specific words, because in their view a generic word like “animal”, although more generic than “dachshund”, is equally concrete in that it can be used to refer to a perceivable object. For Ullmann, the generic-specific opposition relies on a classification of terms in a hierarchical tree-like structure depending on semantic features distribution: the more dense of features intensions are, the less populated extensions will be. Terms with wide extensions are also the most generic. The distinction abstract-concrete, instead, is based on the perceivability of the referent of a term. Given the different assumptions of WAT proponents, in their view the two typologies discussed above are not so dramatically separated.

Further evidence supporting the WAT theory is expected from a study by GRANITO et al. (in preparation). Families of novel objects and novel relations, respectively standing for concrete and abstract words' referents, were created using Lego bricks; participants had to manipulate exemplars of objects and relations, then they were given labels and descriptions for each family. Differently from the study mentioned above, objects and relations were real world 3D materials (not images on the screen) and the acquisition procedure was the same for abstract and concrete categories (it included manipulation and linguistic training for both). Nevertheless, in line with some of the consequences of the WAT theory, an advantage of the button on the microphone is expected to emerge for concrete labels from the test phase, because an object family is made of exemplars which are very perceptually similar among them and therefore they allow the representation of the category on the basis of sensorimotor non-linguistic information; vice versa, an advantage of the microphone on the button is expected for abstract words, given the high perceptual variability among exemplars of a relation and the consequent determinant role played by linguistic information in the subject representation of the category.

Conclusions

The social extension defended by WAT proponents seems necessary to many researchers in order to reintroduce the social and cultural level which had been deliberately and programmatically kept out of the scientific enterprise by pioneer cognitive scientists for methodological reasons (see GARDNER 1987 for a reconstruction). As pointed out in FUSAROLI & PAOLUCCI (in press), the founders of cognitive science shared the idea that mental representations had to be analysed separately from the biological/neural level on one side, and the sociological and cultural level on the other; nevertheless, they did not claim that cognition is entirely independent from biological/neural and social/cultural processes and their choice to de-emphasise those elements was a mere methodological limitation. With the "embodiment revolution" the theory of mind has been embodied in a body-brain system, reintroducing biological-neural variables into cognitive science investigation; one further step is now required if we want to reach an exhaustive account of cognition: we need to re-integrate the intersubjective and cultural dimension as constitutive of cognition, in line with the recent extended/distributed approaches of mind (for a review, see KIVERSTEIN & CLARK 2009). According to CIMATTI (2002), those who claim to naturalise human mind without considering the socio-cultural horizon have in fact an anti-naturalistic approach, because they are missing the very biological specificity of *Homo Sapiens*: «If I want to *naturalistically* understand human mind, I must delve into its environment, that is the environment of language and of all those practices inseparable from language, that is cultural practices» (CIMATTI 2002: 18, translation mine).

In keeping with these views, the WAT theory considers social experience as foundational of cognition and stresses the impact of language on our cognitive abilities; it shares with extended theories of cognition the idea of words as an «external artefact whose current adaptive value is partially constituted by its role in re-shaping the kinds of computational space that our biological brains must negotiate in order to solve certain types of problems» (CLARK 1998: 2). In order to mitigate the uneasiness of embodied theories in explaining abstract concepts' acquisition and representation, WAT proponents consider it necessary to extend the notion of

embodiment combining embodied and extended approaches, holding that embodied experience is not enclosed inside the boundaries of our body.

Bibliography

BARSALOU, L. W. (1999), «Perceptual Symbol Systems» in *Behavioral and Brain Sciences*, n. 22, pp. 577 – 609.

BARSALOU, L. W. (2003), «Abstraction in Perceptual Symbol Systems» in *Philosophical Transactions of Royal Society*, B, 358, pp. 1177 – 1187.

BARSALOU, L. W. (2008), «Grounded Cognition» in *Annual Review of Psychology*, n. 59, pp. 617 – 645.

BARSALOU, L. W. & WIEMER-HASTINGS, K. (2005), «Situating abstract concepts» in PECHER, D. & ZWAAN, R. A. (2005), (eds.), *Grounding cognition. The role of perception and action in memory, language and thinking*, Cambridge, Cambridge University Press.

BINDER, J. R., WESTBURY, C. F., McKIERNAN, K. A., POSSING, E. T. & MEDLER, D. A. (2005), «Distinct Brain Systems for Processing Concrete and Abstract Concepts» in *Journal of Cognitive Neuroscience*, n. 17 (6), pp. 1-13.

BORGHI, A. M. & CIMATTI, F. (2009), «Words as tools and the problem of abstract word meanings» in TAATGEN, N., VAN RIJN, H., (eds.), *Proceedings of the 31st Annual Conference of the Cognitive Science Society*, Amsterdam, Cognitive Science Society, pp. 2304 – 2309.

BORGHI, A. M., FLUMINI, A., CIMATTI, F., MAROCCO, D. & SCOROLLI, C. (2011), «Manipulating objects and telling words: A study on concrete and abstract words acquisition» in *Frontiers in Cognition*, 2 (15), doi: 10.3389/fpsyg.2011.00015, special issue on Embodied and Grounded Cognition (editors: A.M. Borghi, D. Pecher).

BORGHI, A. M. & PECHER, D. (2011), «Introduction to the special topic Embodied and Grounded Cognition» in *Frontiers in Psychology*, n. 2, doi: 10.3389/fpsyg.2011.00187.

CACCIARI, C. (1991), (ed.), *Teorie della metafora*, Milano, Raffaello Cortina Editore.

CACCIARI, C. (2006), *Psicologia del linguaggio*, Bologna, Il Mulino.

CIMATTI, F. (2002), «Filosofia e scienza cognitive», in GAMBARARA, D. (ed.), *Filosofia e linguaggio in Italia: nuove ricerche in corso. Incontro dei Dottorati di*

Ricerca. Atti dell'VIII Convegno della Società Italiana di Filosofia del Linguaggio, Rende (CS), pp. 13 – 21.

CLARK, A. (1998), «Magic words: How language augments human computation» in CARRUTHERS, P. & BOUCHER, J. (eds.), *Language and thought: Interdisciplinary themes*, Cambridge, Cambridge University Press, pp. 162 – 183.

CLARK, A. (2008), *Supersizing the mind. Embodiment, action, and cognitive extension*, Oxford, Oxford University Press.

DOVE, G. (2009), «Beyond perceptual symbols: A call for representational pluralism» in *Cognition*, n. 110, pp. 412-431.

DOVE, G. (2011), «On the need for embodied cognition and dis-embodied cognition» in *Frontiers in Psychology*, n. 1, pp. 402-414.

GARDNER, H. (1987), *The Mind's New Science: A History of the Cognitive Revolution*, New York, Basic Books.

GLENBERG, A. M. (1997), «What memory is for» in *Behavioral and Brain Sciences*, n. 20, pp. 1 – 55.

GLENBERG, A. M. & KASCHAK, M. P. (2002), «Grounding language in action» in *Psychonomic Bulletin and Review*, n. 9, pp. 558 – 565.

GLENBERG, A. M., SATO, M. & CATTANEO, L. (2008), «Use-induced motor plasticity affects the processing of abstract and concrete language» in *Current Biology*, n. 18, 7, R1 – R2.

GLENBERG, A. M., SATO, M., CATTANEO, L., RIGGIO, L., PALUMBO, D. & BUCCINO, G. (2008), «Processing Abstract Language Modulates Motor System Activity» in *The Quarterly Journal of Experimental Psychology*, n. 61, pp. 905 – 919.

GRANITO, C., SCOROLLI, C. & BORGHI, A. M. (in preparation), «Alice in Legoland: how we acquire and represent concrete objects and abstract relations».

HARNAD, S. (1990), «The Symbol Grounding Problem» in *Physica D*, n. 42, pp. 335 – 346.

JIRAK, D., MENZ, M.M., BUCCINO, G., BORGHI, A. M. & BINKOFSKY, F. (2010), «Grasping language – A short story on embodiment» in *Consciousness and Cognition*, n.19 (3), pp. 711 – 720.

KIVERSTEIN, J. & CLARK, A. (2009), «Introduction: Mind Embodied, Embedded, Enacted: One Church or Many?» in *Topoi*, n. 28, pp. 1 – 7.

LAKOFF, G. (1986), «Frame semantic control of the coordinate structure constraint» in *CLS-22, Part 2: Papers from the Parasession on Pragmatics and Grammatical*

Theory at the Twenty-Second Annual Regional Meeting, pp. 152 – 167, Chicago, Chicago Linguistic Society.

LAKOFF, G. (1987), *Women, fire, and dangerous things*, Chicago, Chicago University Press.

LAKOFF, G. & JOHNSON, M. (1980), *Metaphors we live by*, Chicago, Chicago University Press.

LAKOFF, G. & JOHNSON, M. (1999), *Philosophy in the flesh: The embodied mind and its challenge to western thought*, New York, Basic Books.

MACHERY, E. (2007), «Concept empiricism: A methodological critique» in *Cognition*, n. 104, pp. 19 – 46.

PAIVIO, A. (1986), *Mental representations: A dual coding approach*, New York, Oxford University Press.

PAIVIO, A. (1991), «Dual coding theory: Retrospect and current status» in *Canadian Journal of Psychology*, n. 45 (3), pp. 255-287.

PAOLUCCI, C. & FUSAROLI, R. (in press), «The external mind: an introduction» in *Versus – Quaderni di studi semiotici*, n. 112 – 113, pp. 3 – 31.

PECHER, D., BOOT, I. & VAN DANTZIG, S. (2011), «Abstract Concepts: Sensory-Motor Grounding, Metaphors, and Beyond» in *Psychology of Learning and Motivation*, n. 54, pp. 217 – 248.

PECHER, D. & ZWAAN, R. A. (2005), (eds.), *Grounding cognition. The role of perception and action in memory, language and thinking*, Cambridge, Cambridge University Press.

SCHWANENFLUGEL, P. J. (1992), «Context availability and the recall of abstract and concrete words» in *Memory & Cognition*, n. 20 (1), pp. 96-104.

ULLMANN, S. (1970), *La semantica. Introduzione alla scienza del significato*, Bologna, Il Mulino.