

The Role of the Image Schemas in the Analysis of the Semantic Variation of Action verbs. Data from IMAGACT.

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Abstract. Embodiment plays an essential role in both concrete and abstract semantic representations. Our perceptual and motor system does not only impact on the way we physically interact with the external world but also on the way we cognitively structure external inputs. Both our experiential and conceptual knowledge may be encoded, in natural language, by means of action verbs. The action verbs are primarily used to refer to concrete actions and physical events (e.g., "To push the button"). Nevertheless, they are also extensively used to express figurative meanings (e.g., "To push someone to change habits"). This study aims to show how the semantic core of action verbs does influence their metaphorical potential. In particular, the image-schematic structure of the semantics of these predicates provides us with precise details on the linguistic processing of highly abstract concepts. The study we present is carried out within the IMAGACT framework. The analysis focuses on the metaphorical variation of a set of 10 Italian action verbs, divided in 2 cohesive groups: one codifying a movement along the vertical axis (*alzare, abbassare, salire, scendere, sollevare*), and the other one codifying the application of force on tangible objects (*attrarre, premere, spingere, tirare, trascinare*). The results confirm that the metaphorical extensions of action verbs are not randomly created. Indeed, they are strictly constrained by the same image schemas that structure the core of the verb, when the verb is used to encode action concepts and events.

Keywords. image schema, action verbs, abstract concepts, metaphors, semantic variation

1. Introduction

Sensory-motor experience strongly influences our cognitive structure, shaping both our concrete and abstract semantic representations [2,3,14,6,29]. The linguistic encoding of bodily movements, action events, and objects manipulation is primarily expressed by means of action verbs [25]. Action verbs are not only used in the encoding of physical meanings, but they also play a pivotal role in the production and the linguistic representation of metaphorical uses. CHANGES, STATES, CAUSES, and many other highly abstract concepts are commonly understood via concrete domains, related to our bodily experience and interaction with tangible objects in the world.

Our findings show that the metaphorical extensions of action verbs are not randomly produced but are strictly constrained by the image-schematic structure of the verbs semantic core (see *Invariance Principle*, [12,13,34]). In particular, image schemas are essential to motivate metaphorical asymmetries of local equivalent verbs, that is, of those

verbs that can be used in the same pragmatic contexts to encode the same kind of action events (e.g., *premere* and *spingere*; *to press* and *to push*).

In this pilot study, we present the analysis of the marked variation of 4 Italian action verbs: *alzare* (*to raise*), *premere* (*to press*), *sollevare* (*to lift*), and *spingere* (*to push*). The analysis we present is part of a wider ongoing annotation project aimed at categorizing the figurative uses of high-frequency action verbs within the framework of the IMAGACT multilingual ontology of action. So far, the annotation process included 10 Italian action verbs, divided in 2 cohesive groups: one codifying the application of force on tangible objects (*attrarre*, *premere*, *spingere*, *tirare*, *trascinare*), and the other one codifying a movement along the vertical axis (*alzare*, *abbassare*, *salire*, *scendere*, *sollevare*).

Section (1) stands as an introductory section that has the only aim to shortly present the key elements by which the research has been carried out. Section (2) will briefly describe the ontology we used to extract data and carry out the annotation process. Sections (3-3.1.) will present the theoretical framework that we used to account for the cognitive models emerging from the corpus analysis [8,11]. Section (4) will briefly illustrate the data and the methodology used to carry out the analysis. Finally, in sections (5-6) we will discuss two case studies: 1) *spingere* and *premere*; 2) *alzare* and *sollevare*.

2. IMAGACT: the Multilingual Ontology of Actions

IMAGACT¹ is a multimodal and multilingual ontology that represents action concepts using prototypical 3D animations or brief videos [23]. The visual representation system that the ontology relies upon has been primarily conceived as a tool to avoid the vagueness of semantic definitions [4]. The use of scenes allows not only to distinguish the identification of the action types from their linguistic definition but also to ensure that the representation of the action concepts is retained independently of the specific language.

The information implemented in IMAGACT is relevant for both the action concepts understanding and for the investigation of the relation between language and action. In this regard, a campaign of enrichment of IMAGACT has been launched through the comparison and mutual exchange with other resources [25,30]. In particular, IMAGACT has been linked with BabelNet [24] and Praxicon [28]².

IMAGACT contains 1010 distinct action concepts [23], which have been primarily derived from the set of physical actions categorized starting from the annotation of spoken language corpora in English and Italian (about 500 verbs for English and Italian)³. The action concepts collection is presented in the form of prototypical scenes linked to the verb lexicon of the included languages. Within IMAGACT, each action verb is usually connected to more than one scene, and each scene prototypically represents a single action concept (or action type). On the other hand, each scene can be encoded by more than one verb. The action verbs that share a common referent within the ontology create a sort of semantic network and are called local equivalent verbs.

¹www.imagact.it.

²In particular, from the comparison with BabelNet, IMAGACT may gain important translation information for languages still not implemented in the Visual Ontology, while the comparison between IMAGACT and motor knowledge on actions (Praxicon) proves to be essential for theoretical analysis and robotic applications.

³The ontology is in continuous development and currently contains 9 languages and 13 more that are under development, with an average of 730 action verbs per language.

The ontology sharply separates the occurrences referring to physical actions from those that refer to metaphorical or idiomatic uses. The first phase of the corpus annotation process consisted in the selection of those occurrences in which verbs refer, in their basic meaning, to concrete actions. The annotator elicited the judgment on the basis of his or her semantic competence. In general, the verb occurrences are judged primary if it is possible to say to someone who does not know the meaning of a given verb that the referred action and similar events are what we intend with V; otherwise, the occurrences are tagged as marked (operational test à la Wittgenstein). By *primary variation*, we refer to the set of different action types to which the verb can refer in its proper and concrete sense. By *marked variation*, we refer to the set of non-primary occurrences of action verbs, in which semantic processes operate so to create new abstract extensions (e.g., metaphors, metonymies, and idioms) [3]. For instance, the occurrences standardized as "Maria spinge il pulsante" ("Mary pushes the button") or "Maria spinge il carrello" ("Mary pushes the cart down the hall") are assigned to the PRIMARY variation, since both can be pointed to explain what *spingere* means. Conversely, the instances standardized as "Il dirigente spinge Maria a lasciare il lavoro" ("The boss pushes Mary to quit the job") or "Le circostanze spingono Maria a lasciare la città" ("Circumstances push Mary to leave the city") are not what one uses to instantiate the meaning of *spingere*, and therefore they are considered MARKED.

It is worth noting that IMAGACT only specifies the semantic interpretations of verbs with respect to their physical actions: other kinds of interpretations are ignored and are not visually represented within the ontology. Nevertheless, an ad-hoc infrastructure has been designed to organize the marked uses found in the variation of the action verbs [3]. The infrastructure allows the annotator to analyze each action verb following a sequence of steps [35]: a) evaluation of the marked occurrences; b) reading of the specific context of use of the occurrences; c) association of each occurrence with its marked type (metaphor, metonymy, and idiom); d) gathering of similar occurrences in a single class, and association of each class with a specific conceptual metaphor or metonymy [14,17]; e) assignment of local equivalent verbs; and f) association of each class with a prototypical scene, derived from the primary variation of the verb.

3. Images Schemas Theory

The early notion of image schema dates to the empirical studies on spatial relation terms by Talmy [33] and Langacker [18,19], but it received a deeper investigation only starting from the foundational works by Johnson [8] and Lakoff [11]. Over the years, image schemas have proved to play a key role in many research fields, such as psycholinguistics [7], first acquisition studies [20,21], poetics [16], gesture studies [5], and mathematics [15]. Image schemas have been introduced in the field of Cognitive Linguistics to show the strong relationship that exists between embodied experience, thought, and language. The central idea, in fact, is that our ability to conceptualize, reason, and infer about experience depends on our bodily nature [8,11]. Image schemas are conceived as kinesthetic structures emerging from our sensory-motor programs, by means of which we make sense of our everyday experiences [8,11]. These conceptual building blocks seem to be normally operative in our perceptual interactions, bodily movements, and physical manipulation of objects since early infancy [20]. Standard examples of image

schemas are given by schemas such as CONTAINER, OBJECT, PATH, PART-WHOLE, AND UP-DOWN [8,11].

Image schemas are not only used to structure bodily aspects of experience but also to metaphorically project perceptual and motor knowledge into highly abstract domains [8,11]. In particular, they have been extensively used in the field of metaphor studies [14,31]. Image schemas constrain the metaphorical mapping in order to guarantee that the topology of the source domain is coherent with the internal structure of the target domain (*Invariance principle*: [12,13,34]). It follows that metaphors preserve the inferential structure and that abstract inferences are metaphorical versions of spatial inferences that are inherent to the topological structure of image schemas [12,13]. From this point of view, the invariance principle stands out as a control tool on the flow of information, hence on the possible correspondences, that can be transferred during the metaphorical mapping from domain to domain.

In our research, we approach the study of image schemas from a purely semantic perspective. The concept of image schema has proven to play a crucial role in the analysis of the semantic variation and, specifically, of the non-literal uses of action verbs. Image schemas constrain the metaphorical potential of action verbs, and allow to explain the metaphorical gap existing between the semantic variations of local equivalent verbs. In other words, image schemas can partially explain the reason why verbs that share a co-extensive primary variation do not have a co-extensive marked variation.

3.1. An Example of Image Schema: the Force Schema

The FORCE schema is a very standard example of image schema. It plays a pervasive role not only in the myriad of activities that we perform every day with our body but also in the way we construct highly abstract concepts and develop equally abstract meanings [1,8,9,10,32]. COMPULSION, BLOCKAGE, COUNTERFORCE, DIVERSION, REMOVAL OF RESTRAINT, ENABLEMENT, and ATTRACTION constitute the most common FORCE schemas operating in our experience [5]. These schemas must be conceived as a cluster of gestalt (have parts and relations) structures, which share a common set of characteristics. As Johnson points out [8]:

- Forces are always experienced through interaction (e.g., with object in the surrounding space);
- Forces usually involve the movement of some object through space in some direction (force has a vector quality, a directionality);
- Forces have typically a single path of motion (a leaf falling to the ground);
- Forces have degrees of power or intensity;
- Since we experience force via interaction, a structure or sequence of causality is implied.

The FORCE schema is one of the most basic image-schematic structures of our conceptual system and hence constitutes one of the most common source domains for many metaphors (e.g., EMOTIONS ARE FORCES, CAUSES ARE FORCES). As we will see in the following sections, it forms the basis of many of the abstract concepts and meanings found within the marked variation of action verbs. The FORCE schema does not only occur in isolation but also with a set of related schemas. It can be co-experienced with other image-schematic structures, such as the VERTICAL AXIS and the MOTION

schemas. These interactions represent the basic components of a wide array of action concepts and action schemas and seem to be also responsible for the enrichment of the mapping process of many metaphors.

4. Data and Analysis

As we anticipated in section (1), this pilot study has been carried out within the IMAGACT framework and included a set of 10 Italian action verbs (about 500 occurrences), divided in two internally cohesive groups: one related to the verticality domain (e.g., verbs *abbassare, alzare, salire, scendere, sollevare*) and one related to the force-dynamics domain (e.g., verbs *attrarre, premere, spingere, tirare, and trascinare*). In the two following sub-sections, we will shortly discuss two case studies (i.e., *spingere* and *premere*; *alzare* and *sollevare*), extracted from the IMAGACT dataset. The action verbs in analysis encode the FORCE schema in their semantic core. The FORCE schema will be used to motivate the types of metaphors that the 2 groups of verbs produce (e.g., PROBLEMS ARE WORRIES, PSYCHOLOGICAL FORCES ARE PHYSICAL FORCES). The case studies will be also used to present the interesting interactions existing between the FORCE schema and other kinds of image-schematic structures, respectively, with the MOTION and the VERTICAL AXIS schemas. In particular, the interactions between different image schemas will be used to show why some verbs activate a range of abstract concepts wider than that of some other verbs.

4.1. The case of *Premere* and *Spingere*

The verbs *premere* (to press) and *spingere* (to push) can refer to a common subset of action concepts and prototypical scenes. When used to express physical meanings, they both name events where a) we exert physical force on an object ("Spingere/premere il pulsante"; "To push/To press the button"); or b) we set relations between objects ("Spingere/premere il coperchio sulla scatola"; "To push/To press the lid on the box"). Since the two verbs can be applied in the same linguistic contexts as synonyms, within the IMAGACT ontology they were tagged as local equivalent verbs. Nevertheless, this does not mean that *premere* and *spingere* encode the same focal action properties. As a matter of fact, while the verb *spingere* always implies both the FORCE and the MOTION schemas, the verb *premere* has a more simplified image-schematic structure: the application of force (or pressure) does not entail any kind of motion in the physical space.

Although primary variation of *premere* and *spingere* can be considered as partially co-extensive, their marked variation does not coincide. This means that their metaphorical potential does not encompass the same kind of abstract concepts. Let us consider three examples derived from the marked variation of *spingere* (IMAGACT database): (1) "Le circostanze spingono Fabio ad agire"; "The circumstances push Fabio to act"; (2) "L'amministratore spinge avanti l'azienda"; "The manager pushes the company forward"; (3) "La situazione si spinge verso l'anno successivo"; "The situation presses on into the next year".

In example (1), the change of action is caused by an external force, conceived as an animate entity, and it is understood in terms of caused motion. The expression can be intended as the linguistic reflection of the conceptual metaphor CAUSED CHANGE OF

ACTION IS CONTROL OVER AN ENTITY RELATIVE TO A LOCATION. Example (2) involves a human entity that metaphorically performs a directed motion relative to an action-region/path. Since the motion is caused, it follows that the motion along the region/path is forced. The expression can be connected to the conceptual metaphor CONTROL OVER ACTION IS CONTROL OVER MOTION. Finally, example (3) describes an event in which an inanimate entity is conceptualized as an animate and forceful entity, whose action can be read in terms of directed self-propelled motion. In this last case, the conceptual metaphor of reference is THE PROGRESS OF EXTERNAL EVENT IS A FORWARD MOTION. As examples (1-3) show, the verb *spingere* makes use of both the FORCE and the MOTION image schemas to encode abstract meanings. In the marked variation of the verb, in fact, the two image schemas interact in the source domain of the relative metaphors, and give birth to metaphorical mappings in which the concept of force and the concept of motion are strongly tied up together. This also explains why the verb *spingere* can be normally used to express highly abstract concepts which involve both the FORCE and the MOTION schemas as, for example, causation and changes.

Let us now turn our attention from the marked variation of the verb *spingere* to the marked variation of the verb *premere*, and let us consider three of the most representative metaphorical expressions found in the IMAGACT dataset: (4) "L'oratore preme sul tema", "The speaker presses the issue"; (5) "L'associazione preme presso le amministrazioni pubbliche", "The association presses the public administration"; (6) "La domanda preme a Marco", "The question presses Marco". Examples (4-6) have all been associated with the conceptual metaphor PSYCHOLOGICAL FORCES ARE PHYSICAL FORCES. Nevertheless, they are not of the same type: each of them takes a specific kind of conceptual load and expresses a different kind of figurative meaning. In the first case (4), the result of the action is to draw the attention of the addressee to the content, in order to influence his actions. In the second case (5), the final goal is that of persuading the addressee. Finally, in the last example (6), there is not a proper agent, but rather a causer which influences in some way the cognizer. We can shortly say that the focus of the metaphor constantly changes, being on the content in (4), on the addressee in (5) and on the causer in (6).

Beyond the specific semantic information taken by these metaphors, it is interesting to notice that three of them are the result of a conceptual mapping in which the FORCE schema appears to play a central role in the source domain, and to give the image-schematic knowledge in order to start the abstraction process. As a matter of fact, examples (4-6) conceptualize external and psychological conditionings in terms of physical forces directed to a specific target. It is also interesting to note that none of the examples discussed above allows us to infer the final state of the party affected by the force. This may depend on the fact that the semantic core of the verb *premere* does not presuppose the interaction between the FORCE and the MOTION schema. The verb *premere*, when used in its concrete sense, encodes action events that only focus on the application of physical force on tangible objects. When considering the non-physical uses of the verb, the force remains the central schema, and it is, in fact, responsible for the specific metaphorical potential of the verb. To sum up, from the comparison between the metaphorical variation of *premere* and *spingere*, it clearly emerges that the two verbs have asymmetrical metaphorical productions. Unlike the verb *spingere*, *premere* does not enable metaphors that codify causation or changes of states (e.g., CAUSED CHANGE

OF ACTION IS CONTROL OVER AN ENTITY RELATIVE TO A LOCATION; CONTROL OVER ACTION IS CONTROL OVER MOTION; THE PROGRESS OF EXTERNAL EVENT IS A FORWARD MOTION). We suppose that the reason behind this gap has to be searched in the type of image schemas involved in the semantic core of the verbs. The image-schematic structure of *premere* does not imply, for instance, the MOTION (self-propelled or caused) schema, which appears to be necessary to map the CAUSATION and the CHANGE domains (1-3). As the analysis of its marked variation shows, *premere* is only used to express abstract concepts that involve the FORCE as source image-schematic domain (4-6).

4.2. The Case of *Alzare* and *Sollevare*

If we look at the possible actions described by the primary variations of the verbs *alzare* and *sollevare*, we notice that both the verbs can be used to refer to action events in which the theme has weight, and its dislocation in the physical space is the result of upwards motion. Let us consider the sentence "Alzare/ sollevare una scatola" ("To raise/To lift a box"). The expression describes an event in which two image-schematic structures seem to be central, that is, the VERTICAL AXIS and the FORCE (REMOVAL OF RESTRAINT) schema. The local equivalence relation shared by the verbs *alzare* and *sollevare* could lead us to think that the two verbs have the same kind of image-schematic semantic core and that the VERTICAL AXIS and the FORCE (REMOVAL OF RESTRAINT) schema play the same role within their semantics. Well, that is not the case. *Sollevare*, for instance, can be applied in the sentence discussed above, but not to describe action events in which there is no weight that restricts upward movement (e.g., *Alzare lasta del microfono*; eng. To raise the microphone; **Sollevare*).

Complications arise when we consider the marked variations of the verbs. As in the examples discussed before (e.g., *spingere* and *premere*), there exists a deep gap between the marked variations of *alzare* and *sollevare*. As a consequence, these verbs are not used to encode the same kinds of abstract concepts and to produce the same kinds of figurative meanings. From the analysis of the data extracted by the IMAGACT database, the verb *alzare* seems to be extensively used to linguistically express orientational metaphors [10,14]. Orientational metaphors enable the representation of a concept (or of an entire system of concepts) by means of spatial vectors (e.g., in/out, front/back, up/down). Below we report a short list of orientational metaphors found within the marked variation of *alzare*: (8) "Marco alza il volume del televisore", "Marco turns up the volume of the television"; (9) "L'insegnante alza il voto allo studente", "The teacher raises the students grade"; (10) "La temperatura si alza"; "the temperature rises". Examples (8-10) are based on the conceptual mapping between the verticality and the quantity domain. This group of metaphorical expressions points to the existence of the same conceptual metaphor MORE IS UP/LESS IS DOWN, in which the increase or decrease of a quantitatively measurable value is involved. The metaphorical transfer is possible since the action verb *alzare* has: (i) the VERTICAL AXIS schema as the focal domain of its primary and physical meaning; (ii) the PATH/SCALE schema as the semantic core in its secondary and abstract sense. It is interesting to note that the orientational metaphor MORE IS UP/LESS IS DOWN is very pervasive in the marked variation of other 3 verbs related to the verticality domain, that is, *abbassare* (to lower), *salire* (to rise), and *scendere* (to descend). We could say that there is consistency in the metaphorical reference of these

verbs. *Alzare*, *abbassare*, *salire* and *scendere* create a very cohesive group, in which the VERTICAL AXIS schema constrains the type of metaphorical production.

By contrast, the MORE IS UP/LESS IS DOWN metaphor does not appear to be productive in the marked variation of the verb *sollevare*, although this verb is largely equivalent to *alzare* as for its primary variation. The marked variation of *sollevare*, as has been suggested on the basis of the IMAGACT corpus, shows two main metaphorical types: (11) "Il cinema solleva dai problemi", "Cinema is a source of relief"; (12) "Marco era molto sollevato", "Marco was very relieved". Example (11) describes a situation in which something or someone makes someone else feel less sad or burdened. Here, the cinema affects a generic (implicit) patient, relieving him from his initial state. This scene could be conceived of as a situation in which something (such as a heavy object) affects another participant in the event (i.e., the patient), constraining his/her physical and (on a more abstract level) emotional state. This metaphorical mapping specifically allows the activation of the REMOVAL OF RESTRAINT image schema, and, consequently, proves the applicability of the verb *sollevare* [27]. Example (12) is similar to the previous one (someone starts to feel better): in both cases, relieving problems or worries is equated to the removal of a condition that anchors the subject to something heavy. The main difference is that the latter example does not express the entity that causes the change of state. In a CMT scenario [14], we associated examples (11-12) with the conceptual metaphors PROBLEMS/WORRIES ARE HEAVY OBJECTS, which is connected to the most general ones HAPPY IS UP/SAD IS DOWN and HELPING IS RAISING/HARMING IS LOWERING.

To sum up, from the comparison between the marked variations of *alzare* and *sollevare*, it emerges that the two verbs have asymmetrical metaphorical productions. On one hand, *alzare* is never used to express the kind of abstract meanings found within the marked variation of *sollevare*; on the other hand, *sollevare* does not codify the kind of abstract concepts found in the marked variation of *alzare*. What keeps *sollevare* from linguistically codifying the conceptual metaphor MORE IS UP (and its variants) is that, unlike *alzare*, its semantic core does not properly focus on the VERTICAL AXIS schema, but rather on the FORCE (REMOVAL OF RESTRAINT) schema [27]. Within the semantic variation of *sollevare*, the VERTICAL AXIS and the FORCE schema do not have the same load. If we consider once again the possible actions described by the primary variation of *sollevare*, we notice that they always refer to events that contain the image schema RESTRAINT REMOVAL (part of the FORCE schema), and that they use the VERTICAL AXIS schema as a secondary (and peripheral) component. The RESTRAINT REMOVAL schema is triggered by the fact that the theme of *sollevare* must necessarily have weight, that is, a gravitational restraint [22]. *Sollevare* cannot be applied to events in which gravity does not constitute a focal semantic property. We could argue that, unlike the verb *alzare*, in the case of *sollevare*, vertical movement is just a contextual property, since upwards motion is always required to overcome gravity and to remove the stationary configuration of an object. However, upwards motion is not a sufficient condition for the use of *sollevare* [27]. To conclude, we claim that this is why, for example, *sollevare* does not linguistically codify common orientational metaphors, like those discussed above (e.g., MORE IS UP).

5. Conclusions

The research shows that abstract concepts represented within the marked variation of action verbs are not randomly produced, but are the result of metaphorical processes in which embodied knowledge is transferred from one domain to another. The inherent structure of highly abstract concepts mirrors specific properties of the predicate semantic core and is constrained by the diverse types of image schemas active in the primary variation of the verb (see *Invariance Principle*). It is true that differential semantic properties (and image-schematic structures) characterizing the action verbs strictly reflect on their metaphorical potential, influencing the kind of metaphorical expressions that may be produced. From this perspective, action verbs constitute linguistic anchors between the sensory-motor experience and conceptual knowledge. Hence, the analysis of the image-schematic components operating within the marked variation of action verbs contributes to the understanding of the way in which we use bodily information to structure language and all its semantic dimensions.

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