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ABSTRACT: Major theoretical studies approached the crucial subject of *mimesis* focusing on the relationship between literature and reality, maintaining that novels imitate reality through language, translate facts and events into semiotic acts or they establish consistent fictional worlds intersecting the so called actual or 'real' one. The present account maintains a different point of view, introducing an ecological theory of narrative reference. According with Gibson's Theory of Affordances and recent findings in the field of neuroscience, namely mirror neurons, stories, and novels in particular, are addressed as being understood on the basis of individual action-related knowledge. Samples from the European tradition of medieval and early modern knightly novels are provided so as to show how novels do textually encode actions and how narrative events just referring to sensory experiences and interoceptive responses as emotions, feelings, thoughts, deductions or decisions are tightly connected, and to some extent dependent on action-related ones. Finally, a new assessment of novels as ecological niches will be taken into account, aside implications of an ecological theory of narrative reference for philological investigation of novels in the general framework of comparative literatures.

1. From Mimesis to Embodiment

Major critical studies regarding the novel approached its mimetic potential focusing on the relationship between literature and reality. Classical approaches focused on language and style of the novel, in its tight relationship with spoken vernacular languages (Auerbach 1946). Debate shifted to scientific categories, as novelistic representation of space and time, basically revolving around the concept of chronotope (Bachtin 1937-38 then 1975). Further discussions centered on structural semiotical status of the novel (Greimas 1970, 1983) or its internal logics (Bremond 1966, 1973). Later approaches reached the domain of epistemology, stressing the relationship between fictional and real world as the crucial issue (Pavel 1986).

Brief, throughout the critical history of the problem novels have been mostly considered as a mimetic reflex, a semiotic translation or a dialectic alter ego of a given reality. Basically, they have been supposed to imitate reality through language, to translate facts and events into semiotic acts or to establish consistent fictional worlds intersecting the so called actual or 'real' one. Major approaches stressing such peculiarities of the genre are certainly based on peculiarities that make each of them very different from each other, even radically in some cases. Still, a common *fil rouge* can be found in the fact that all of them basically presuppose sort of a previous, standard distinction between fictional and real.

An attempt to «discard the old opposition of fiction and reality» as «inadequate and misleading» has been proposed by Iser (1993). Complaining about the latter-day fate of epistemology, that «ended up having to recognize its own premises as fiction» while investigating the nature of fictionality, he tried to establish a literary anthropology by replacing «this duality with a triad: the real, the fictive, and what we shall henceforth call the imaginary». Assuming that «is out of this triad that the text arises», Iser offered that the text «functions to bring into view the interplay among the fictive, the real and the imaginary», leading «the real to the imaginary and the imaginary to the real».

Hence, the text «conditions the extent to which a given world is to be transcoded, a nongiven world is to be conceived, and the reshuffled worlds are to be made accessible to the reader's experience». Brief, the act of fictionalizing mediates between «external reality» and «diffuseness of imaginary» making it possible the «crossing of boundaries». That is, reshuffling of real and imaginary «takes place not by plain mimesis of existing structures but by a process of restructuring them».

A different approach has been lately suggested by some experimental studies on narrative text processing developed in the field of social and media psychology. Namely, some investigations aiming to explain why narrative persuasion and influence of beliefs differs from non-narrative or nonfiction

established the concept of «transportation» (Green -Brock 2000, 2002, Green -Brock -Kaufman 2004) as an «an integrative melding of attention, imagery, and feelings, focused on story events» (Green 2002).

Interestingly, theory of «transportation» focuses on sensory absorption of the «traveler», that is the reader or listener, engaging his cognitive resources, emotions and mental imagery. Still, no clues are offered about how «transportation» is supposed to happen, neither «where» it is supposed to physically lead the traveler. Hence, «transportation» basically counts as a new metaphor describing the interactive rendering of so called «fictional worlds». The opposite key-concept of 'embodiment', not to be intended as a metaphor at all, has to be intended as crucial to the different, very materialistic approach to narrative reference this contribution aims at introducing, arguing that all previous mentioned ones are basically faulty and misleading.

Embodiment of stories has been investigated so far especially in respect to psychotic stories. In particular, Els van Dongen devoted a book (2002) and a follow-up paper (2003) to the topic, maintaining that stories that are seen as irrelevant and incomprehensible get their non-psychiatric meaning and power by embodiment. According with van Dongen, psychotic people, namely patients diagnosed with schizophrenia, try to regain control over their lives and to influence the course of events by performing and carrying out actions that are based on a story, which has become sort of a text for living. Indeed, so as to gain power and control, schizophrenics need to do more than narrating in language: they have to make their story a narration of flesh and blood, they have to become part of the story itself by embodying it. Since the power of psychotic stories doesn't depend on telling but on acting out accordingly, the final meaning of the mad story is less situated in the performance, exerting narratives as social features, than in discursive practices.

Opportunately, van Dongen never suggested that mad stories should be assessed as different from normal ones because the former have to be embodied and the latter have not. Rather, according with the embodied theory of narrative reference this paper is aiming at stressing, embodiment of stories is even implied to a different, or at least less evident extent, in the processing of narratives normal people go through while reading a novel or listening to a story.

Basically, a variable extent of embodiment has to be credited as crucial for narrative comprehension in general. That is any given narrator, listener or reader follows and understands a given story as far as he or she keep embodying narrative references they are provided with while talking, writing, listening or reading. Accordingly, distraction and misunderstanding happen as interruption of the process making it possible for people to embody a story, causing separateness between the story and who is supposed to process it.

Typically, inability to precess narrative references based on resonance of the very body effectors involved in described events may be associated with peculiar, very disruptive neural lesions. A classic case, the one of «The man who mistook his wife for an hat» has been described by Oliver Sacks (1985) in his famous collection of clinical stories. Indeed, investigating the difficulties with left lateralized tasks of his patient, Sacks observed that his visual field deficits affected both his visual perception and his visual memory and imagination.

Hence, «thinking of the almost allucinatory intensity with which Tolstoy visualises and animates his characters», he tested dr. P's «internal visualization» questioning him about Anna Karenina, a novel he craved. Interestingly, Sacks describes the reactions of his patient as follows:

«he could remember incidents without difficulty, had an undiminished grasp of the plot, but completely omitted visual characteristics, visual narratives and scenes. He remembered the words of the characters but not their faces; and though, when asked, he could quote, whit his remarkable and almost verbatim memory, the original visual descriptions, these were, it became apparent, quite empty for him and lacked sensorial, imaginal, or emotional reality».

Such clinical case describes how disembodied processing of a novel, and a story in general, should be working. Basically, descriptions do not relate to any sort of embodied response as sensory experiences, emotions or feelings, enacted actions. Besides, the mere words or sentences are stored, saved as 'empty' labels and strings, lacking peculiar 'meaning'. Conversely, common readers or listeners, that is the ones not suffering from any peculiar impairment caused by neural lesions, do not need to memorize words, clauses, sentences or phrases in order to understand a novel or a story in general. They hardly succeed in the task of retelling a single sentence of given narratives they read or listen to, even though they can retell what the story is about in different words, sentences, phrases.

Very likely, if asked to retell a single narrative event extracted from a story, both listeners or readers would completely replace most of the words and/or to reshuffle their order, as they would very likely adopt new verbal tenses and/or modes. So, where the novel is gone? Is it just disappeared as soon as the text has been forgotten? Is it just safely preserved in the more and more dusty book up on the shelf of the library either it keeps interacting in some way with the reader's personal experience of the environment that surrounds him?

An embodied theory of narrative reference basically maintains that described actions resonate in the motor system of the reader or the listener, who embodies and enacts the corresponding activity patterns. That's how selected narrative events manage to 'survive' as embodied references after the

textual features they are symbolically encoded into are gone and forgotten. Consequently, embodiment of stories has to be empirically considered as part of the every-day experience of so called 'normal' people. Accordingly, the present research aims to establish an ecological theory of narrative reference, based on the idea that the understanding of textual descriptions basically revolves around the embodiment of perceptual events, emotions, feeling, states of mind in general, and actions they convey.

Since its basic premises rely on the Theory of Affordances and recent discover of mirror neurons, its exposition will be introduced by an errand in the fields of ecological psychology and neurolinguistics. Following remarks will focus on how novels do textually encode actions, showing that even narrative events just referring to interoceptive responses as emotions, feelings, thoughts, deductions or decisions and sensory experiences are tightly connected and dependent on action-related knowledge.

2. Affordances and Mirror Neurons

Developing his ecological approach to visual perception, Gibson (1966, 1977, and 1979/1986), introduced the concept of affordance, implying the complementarity of the animal and the environment, that is an anatomically and physiologically implemented interaction between perceiving organism and perceived target. Basically, Gibson's Theory of Affordances maintains that objects are not perceived insofar their properties or qualities are discriminated, as traditional psychology assumed. Rather, organisms do perceive items in terms of opportunities for actions they gather, both detection and decoding of perceived environmental features depending on the action potential they trigger in the body of the perceiver.

Affordances have been further debated as a crucial question by ecological psychologists, aiming at clarify debatable points of a theory that evolved in time throughout Gibson's bibliography (Jones 2003). According with major recent contributions, the perceiving organism has to be considered as part of the environment in which the perceptual event is taking place. Accordingly, affordances have to be addressed as dynamic properties of an integrated system emerging from the fluid interactions of an animal and the environment in which his/her/its abilities are actually challenged (Chemero, 2003, Stoffregen 2003, Heft 2003).

Moreover, common coding of perception and action, the crucial concept underlying Gibson's Theory of Affordances, has been lately supported by large body of evidence collected in the field of neuroscience. Various fMRI and PET experiments demonstrated that understanding of actions performed by others in observation conditions depends on the same neural circuits recruited during the execution of the very same actions, both in human and non-human primates (Rizzolatti 1996a, Gallese 1996, Fadiga and colleagues 1995, Rizzolatti and colleagues 1996b, Rizzolatti, Fogassi and Gallese 2001).

So called 'mirror neurons', found in the premotor cortex of the human brain as in the one of monkeys, are responsible for somatotopic responses to the observation of an action, since they constantly associate visual decoding of action-related behaviors with motor facilitation. Basically, different sectors of premotor cortex and Broca's Area are activated depending on the effector responsible for the observed action. That is, observation of actions performed with hand, mouth and foot cause congruent motor facilitation and idiomotricity to be triggered in the brain and the body of the observer Buccino and colleagues 2001, Umiltà and colleagues 2001).

Interestingly, motor facilitation is not only triggered by visual observation of actions. Indeed, the neurons controlling execution and observation of purposeful actions even respond to auditory and multi-modal informations related to the very same actions. Auditory modulation of mirror matching systems has been originally discovered in monkeys (Kohler and colleagues 2002, Keysers and colleagues 2003). Further experiments demonstrated that even human subjects process action-related sounds or noises by recruiting the neural circuits overlapping the ones responsible for the understanding of corresponding actions in observation conditions (Aziz-Zadeh and colleagues 2004).

Since human perception of action-related sounds and noises actually depends on left-lateralized neural systems, as the processing of language typically is, such findings have been intended as bridge between auditory action-recognition based on sounds and the processing of action-related knowledge encoded through words. Actually, it has been proved that auditory processing modulates the excitability of tongue muscles, when perceived sounds are meaningful words (Fadiga and colleagues 2002). This crucial finding suggested that motor system may be recruited in mapping acoustic inputs to a phonetic code during speech processing. If so, action-related knowledge may be retrieved not only by visual observation or auditory perception, but even by language.

The hypothesis has been confirmed by evidence demonstrating pre-excitation of primary hand motor cortex through speech (flöel and colleagues 2003). Other studies even found left-lateralized neural responses in subjects both listening to verbal sounds and viewing speech-related lip movements (Watkins, Strafella and Paus 2003). Indeed, Broca's area 'primes' the motor system in response to speech even when no speech output is required (Watkins and Paus 2004). Further experiments showed that listening to speech activates bilaterally a superior portion of ventral premotor cortex that largely overlaps a motor area associated to speech production (Wilson and colleagues 2004). Such array of evidence strongly support the idea that both auditory and visual speech perception facilitate the

excitability of the motor system involved in speech production.

Specific responses to action-related words had already been found by specific researches about the processing of nouns and verbs in the intact brain (1999, 2002: ch. 4, 50-65; Pulvermüller and colleagues 1999, 2000). In particular 'Function words' have been found as evoking strongly left-lateralized activity restricted to perisylvian areas, whereas 'content words' elicited less lateralized activity in cortical areas. Data have been interpreted as supporting the idea that distinct cortical topographies represent biological counterparts of words and their inherently referential features.

Basically, processing of nouns and verbs may ignite neural networks connecting cells located in perisylvian region with additional ones located in various other cortical areas depending on the content of the word. Direct evidence supporting the idea that language and motor system interact on a somatotopic basis has been provided by further experiments, showing that activation in motor and premotor areas can influence processing of words specifically related to actions involving effectors as arms, legs and mouth (Shtyrov, Hauk & Pulvermüller 2004, Hauk and Pulvermüller 2004, Hauk, Johnsrude, & Pulvermüller 2004, Pulvermüller and colleagues 2005).

Such findings support the thesis of embodied semantics, maintaining that conceptual representations accessed during linguistic processing are partially equivalent to the sensory-motor representations required for the enactment of the described events. For instance, they provide strong validation of a Neural Theory of Language (Feldman and Narayanan 2004) based on the idea that listeners or readers enact to some variable extent corresponding embodied experience while hearing or reading about a given perceptual experience or action, even when metaphorically projected to analogue domains. Accordingly, synergy supporting gestures and more complex activity patterns required by ecological interactions between individuals and the environment define the core semantics of words referring to them. To some extent, such theory may be integrally reframed into an ecological framework by defining the meaning of words as the array of affordances they refer to.

Further confirmation of an embodied theory of language processing has been provided by studies showing that listening to action-related sentences activate the same left-lateralized fronto-parieto-temporal system actually activated by the execution and observation of the corresponding action (Tettamanti and colleagues 2005). Body part-specific responses to action-related sentences support the idea that somatotopically organized motor representations of the described actions partially coincide with the ones activated by the observation of the corresponding action.

Moreover, Aziz-Zadeh and colleagues (2006) found clear congruence in premotor cortex leftlateralized activation patterns while testing subjects in respect of visually presented and verbally described effector-specific actions involving foot, hand and mouth. Crucially, selected subjects showed stronger activation while reading sentences literally describing actions specific to the effector they resulted more responsive to in visual observation conditions. Congruence between the cortical sectors activated by observing actions and by the reading of corresponding verbal descriptions proves a direct involvement of premotor areas with mirror-neuron properties in re-enactment of sensory motor representation during processing of linguistic sentences describing actions.

Furthermore, Meister and Iacoboni (2007) compared neural activity during perception of static pictures portraying items, observation of tasks involving manipulation of the very same items and invariant linguistic verbalization of the very same tasks. According with previous results supporting mirror neuron theory, they found robust neural bilateral activity of fronto-parietal areas during action observation compared to no activation during perception of static pictures portraying items invariably manipulated during action observation.

Processing of language describing actions activated a left-lateralized subset of neural networks subserving action visual recognition via mirror matching. Not a single cortical area demonstrated exclusive or even simply higher activation for invariant verbalization in respect of observation of corresponding actions. Hence, resulting activity patterns support the idea that mirror matching of actions relies both on visual recognition and verbal description.

A major argument against the assumption that cortical motor regions are involved in the processing of action-related words and sentences is that language-induced motor activity might depend on mental imagery, that is voluntary or involuntary mental representation of the movements depicted by the words (as described by Jeannerod 1994). If so, neural motor regions would not be vital for the effective processing of action words, since related cortical motor activity should rather be considered a by-product of language processing with no specific functional relevance. Still, such assumption has been ruled out by the finding that specific motricity is modulated by action-related language processing despite the fact that words were not consciously perceived.

Indeed, a recent study investigated cross-talk between language and motor processes using visual words that are masked by other visual symbols, and presented too fast to be consciously perceived (Boulenger and colleagues 2008). The experiment showed that subliminal displays of action verbs during movement preparation affected the subsequent arm-specific reaching movement. Since words that are not consciously perceived cannot trigger mental motor imagery, such finding suggests that cortical structures serving preparation and execution of motor actions are indeed part of the neural network

processing action-related language.

In sum, this vast and quickly growing body of evidence (Galantucci and colleagues 2006, Iacoboni 2008) basically supports the motor theory of speech perception, originally developed by Liberman and colleagues (1985, 2000), maintaining that the ultimate constituents of speech might be articulatory gestures subserving the production of phonemes. At the same time, such findings are providing with crucial support the idea that language evolved from gestures and its functioning it's tightly linked to activation of motor system. Indeed, Recognition of intentional gestures in humans and non human primates can be credited as the archetypal mirror matching mechanism responsible for bridging action and communication (Rizzolatti and Arbib 1998, Corbalis 2002, Arbib 2005, Arbib 2008).

Furthermore, neurolinguistic evidence is definitely confuting modular theories of language (as in Pylyshyn 1984 and Fodor 2001), since processing of linguistic references doesn't seem to be only depending on abstract and amodal units, as claimed by modular theories. Besides, perception and action are proved to be commonly coded by the very same neural substrates as ecological theory of perception predicted. That is, modalities of action and perception are integrated at the level of the sensory-motor system itself and not via higher association systems (Gallese-Lakoff 2005). Hence, as proved by plenty of recent neuroscientific evidence (Aziz-Zadeh and Damasio 2008), utterance, listening and reading of action-related words and sentences recruit motor representations involved in the execution of the corresponding actions, as hypothesized by theories of embodied semantics (Lakoff and Johnson 1999, Gallese and Lakoff 2005, Arbib 2008). Accordingly, evidence of effectorspecific motor responses to speech and activation of mirror matching circuits during the processing of action-related words and sentences while speaking, listening and reading throws open the door to an ecological theory of narrative reference based on embodied semantics.

3. Described actions and action-related knowledge

Defining «idiomotricity» as spontaneous motor reactions induced and modulated by other people's actions (1987 in part., and cfr. even 1990, 1997), Wolfgang Prinz pointed out that:

«while watching, in a slapstick movie, an actor who walks along the edge of a plunging precipice, people are often unable to sit still and watch quietly. They will move their legs and their arms or displace their body weight to one side or another» (Prinz 2005: 148).

According with theories of embodied semantics, supported by the neuroscientific evidence which has been discussed in the previous chapter, action recognition based on mirror matching is even enabled by listening or reading verbal descriptions. Hence, the processing of stories should involve sensory-motor responses, eventually modulating a certain degree of idiomotricity as well.

According to the Neural Theory of Language introduced by Feldman and Narayanan (2004), words, sentences, linguistics constructions in general attain meaning through the embodiment of intended references, as far as speakers, listeners or readers are able to tag properties they are aware of. Indeed, narrative descriptions of actions are processed and filtered by readers or listeners in respect to their individual action-related knowledge, based on previous experience, peculiar interests and personal goals. Hence, listeners and readers should be enacting to some variable extent the corresponding embodied experience, when hearing or reading about a given perceptual experience or action, even when metaphorically projected to analogue domains.

Feldman and Narayanan openly state that both the utterance and the understanding of narrative description of actions should rely on the enacting appropriate embodied experiences the described events refer to. According with discussed neuroscientific evidence, they actually maintain that the ability to utter and process linguistic references seems to be related to the ability to perform corresponding actions in natural environments and recognize them by visual observation. Therefore, action-related knowledge encoded into narratives should be processed on the basis of individual sensory-motor representations required for the enactment of corresponding actions.

Narratives encode action through textual references suitable to be processed by linguistically competent readers and listeners in terms of enacting similar experiences they actually went through. Understanding of narrative description of actions the common reader or listener may find quite unusual in respect to his own previous environmental experience requires the recruitment of congruently corresponding sensory-motor entries to be matched with the ones the story refers to. In such terms embodiment and enaction of described events have to be credited as the crucial factors supporting the universal strategy adopted by readers or listeners for action recognition through textually encoded narrative descriptions from basically every novel, tale, story, despite geography and history, language and culture.

Data collected so far through experiments supporting embodied semantics only allow to draw conclusions about the processing of words and sentences describing actions that actually belong to the human motor repertoire, namely actions that humans can themselves execute. Consequently, as some of the neuroscientists openly stated (Tettamanti and colleagues 2005) the extent of the account is currently unknown. Accordingly, on the basis of evidence collected so far, understanding of sentences involving verbs such as 'fly' may be addressed as being based on analogically congruent motor responses just on an hypothetical basis.

More in general, approaches based on embodied semantics even differ in respect of the way they explain the understanding of descriptions that are not directly referring to actions, either because they address actions that are not part of the human sensory-motor vocabulary or they do not literally refer to them. Such debate even concerns how sensory-motor responses based on embodied experience are involved in the understanding of negative descriptions, defining the interaction between the character and the environment by invalidating the described facts, so as to indirectly affirm opposite ones. Likewise, it touches on the role of sensory-motor resonance in the processing of hypothetical sentences, defining the extent of actual events taking place on the basis of given premises and potential expected outcomes.

'Milder' theoretical approaches actually maintain that integrated systems aimed at processing language are deeply rooted in specific sensory-motor experience, but have developed both historically and ontogenetically through layer upon layer of abstraction so as to handle concepts which are not embodied save through their history (Arbib 2008). Since words referring to so called abstract concepts may be used for years before learning their usually embodied etymology, patterns of increasing abstractions shouldn't be considered as exclusively based on metaphors. According with such view, language provides a symbolic overlay both for embodied experiences and generalizations, semi-factual and counterfactual events falling in the latter category.

However, a more radical stance maintains that semantics and conceptual knowledge have to be considered much more integrated and rooted into action-related knowledge (Lakoff and Johnson 1999, Gallese and Lakoff 2005). Accordingly, even narrative events described as happening in the past, in the future, in dreams, while daydreaming, or openly defined as desires, wishes or thoughts should resonate in the sensory-motor system of the reader or the listener by means of mirror matching as the ones assumed as actual events taking place in the narrative 'here and now' do. Likewise, the prediction of possible outcomes descending from described premises as the understanding of given circumstances on the basis of lacking factors both have to be assumed as recruiting embodied action-related knowledge exactly as the processing of events described as actual, that is 'factual' do.

Recent experiments actually support the latter view, at least when it comes to the understanding of counterfactual descriptions (Tettamanti and colleagues 2008), still addressed by traditional cognitive approaches as more or less rational or irrational attempts to create alternatives to reality (Byrne 2007 and following Open Peer Commentary). Indeed, reduced activity within the actionrepresentation neural system has been found for negative action-related sentences in respect to corresponding affirmative ones. Such results very likely indicate that sentential negation transiently reduces the access to cortical areas carrying mental representations of the negated information.

As it happens with negative function words in counterfactual descriptions, hypothetical ones might even determine a reduced access to the specific semantic information contained in the predicate of the hypothetical propositions. That is, they might modulate the activation of the sensory-motor system responsible for the understanding of corresponding affirmative descriptions. In such terms, semifactual description might be processed as counterfactual ones are, by temporarily reducing the access to corresponding affirmative references.

Moreover, according to radical theories of embodied semantics, even metaphorical descriptions of actions are processed and understood by enacting to some variable extent some corresponding embodied experience. It has to be reported that recent experiments didn't find evidence for congruent somatotopic responses to processing of metaphorical sentences (Aziz Zadeh 2006). Still, studies that found different activation patterns for the processing of literal and metaphorical references to hand, foot and mouth related actions actually tested responses to over-used, that is lexicalized metaphors, as in sentences like 'grasp the meaning'.

Other investigations found different neural circuits to be activated by lexicalized metaphors and novel, unusual ones, the right hemisphere being more involved during the processing of the latter cases (Bottini and colleagues 1994, Mashal and colleagues 2007, Smith and colleagues 2007). Such results, showing that highly familiar meanings already represented in the mental lexicon are accessed more readily, have been correlated with Graded Salience Hypothesis, predicting that salient meanings are accessed more quickly than less salient meanings (Giora 1997, Giora -Fein 1997). They are even congruent with the idea that embodied literal representations are crucial in the understanding of novel, unusual metaphors, whereas lexicalized, that is conventional overlearned ones are processed by quicker circuits recognizing the more salient intended meaning.

Nonetheless, other experiments found that patients with right hemisphere damage are able to explain the meaning of non-conventionalized, newly created metaphoric sentences (Rapp and colleagues 2004). The same studies found that even in normal subjects metaphors elicited increased activity clearly lateralized to the left hemisphere with a maximum in the inferior frontal and middle temporal gyri. Such findings support the idea that even metaphoric sentence processing may be just left lateralized, the involvement of the right cerebral hemisphere being neither essential nor specific for the understanding of their meaning.

Since right cerebral hemisphere activation may not be essential for understanding phrasal metaphors, other factors than metaphoricity *per se* should explain its involvement in language processing on a sentence level. Namely, Inferencing of word meanings to integrate the metaphoric expressions into

context may underlie this brain activation. Accordingly, dysfunction of these brain regions may explain both the deficit in metaphor comprehension and more general impaired understanding of non-literal, semantically complex language structures in some clinical populations (Kircher and colleagues 2007).

Basically, semantic complexity, rather than novelty, may trigger right hemisphere recruitment eventually required in metaphor comprehension. Namely, right hemispherical activity may depend on the processing of new connections between domains that are normally not related to each other, aimed at defining a new overall meaning. Since this inference process is by nature more difficult in non-salient metaphors, activation might reflect a higher processing demand for the metaphoric sentences during the process of inferencing word meanings.

Such approach, even more than the one referring to Graded Salience Hypothesis, supports the idea that sensory-motor systems are to some variable extent recruited when it comes to the understanding of metaphorical and, more in general, non-literal, semantically indirect meanings of sentences requiring additional right-hemispheric activation. That is, the understanding of literal, semi-factual, counterfactual, metaphorical, generally non-literal descriptions of actions sets in the present, past, future, even in characters' dreams, desires or thoughts relies on action-related knowledge, that is on the enaction of corresponding embodied experience. Accordingly, as assumed on premises, an ecological theory of the novel may even be addressed as a theory of literary reference based on embodied semantics, maintaining that the processing of textually described actions depends on somato-topically congruent sensory-motor responses.

4. Narrative Perception and Interoception

Of course, novels, stories, any narratives do not just describe actions. Certainly they even feature plenty of narrative events typically referring to so called 'abstract' generalizations. Such empirical evidence may actually circumscribe the effectiveness of an ecological theory of narrative reference based on embodied semantics to some of the events described into narratives, that is the ones referring to proper actions.

Indeed, so called 'abstract' sentences referring to generalizations, as in 'now I appreciate loyalty', have not been found to activate the left-hemispheric action-representation neural system as action-related sentences such as 'I bite an apple', 'I grasp a knife', 'I kick the ball' or 'now I push the button' actually do (Tettamanti and colleagues 2005, 2008). However, other experiments offered evidence for modulation of motor system activity during the comprehension of language referring to both concrete and abstract events, by investigating linguistic processing during the performance of a repetitive hand-specific action aimed at transferring beans from a wide mouthed container to a target (Glenberg and colleagues 2008). Indeed, greater modulation of activity has been found in the hand muscles when subjects were reading sentences referring to 'transfer' of both concrete objects and abstract information in comparison with responses to sentences not describing transfer.

According with the Somatic Marker Hypothesis some of these generalizations, namely the ones entailing emotions such as happiness or sadness, embarrassment or pride, can not be defined as abstract at all (Damasio 1994, 1996). Rather, they have to be considered inherently connected with action-related knowledge based on embodied experiences. Indeed, emotions are just the most evident part of a system of biological regulation that includes for example homeostatic reactions maintaining metabolism, pain, hunger and thirst signaling.

Patterned chemical and neural responses to emotionally competent stimuli, such as processed objects, items, events or situations even target the brain, for example monoaminergic nuclei in the brainstem tegmentum, but their main target is the body indeed, namely the internal milieu, the viscera and the musculoskeletal system. The result of the brain-targeting responses is an alteration in the mode of brain operation during the emotional body adjustments, the consequence of which is, for example, a change in the attention accorded to stimuli. The result of the body-targeting responses is the creation of an emotional state involving adjustments in homeostatic balance, as well as the enactment of specific behaviors and the production of particular facial expressions.

Emotions immediately respond to challenges and opportunities, allowing organisms to cope successfully with objects and situations that are potentially dangerous or advantageous. The feeling of those emotions amplify the impact of a given situation, enhances learning, and increases the probability that comparable situations can be anticipated. Hence, according with the Somatic Marker Hypothesis, feelings are the mental representation of emotionally-dependent physiological changes.

According with the assumptions summarized above, the Somatic Marker Hypothesis maintains that emotions are biologically indispensable to decisions. Emotionally Competent Stimuli depend on the actual presence or the mental recall of an object or an event and they are processed by a system relying on somatosensory perception, that is on an interoceptive sense (Craig 2002). Responses provided by the system aim at placing the organism «in circumstances conducive to survival and well-being», hence, perception, emotion and action are tightly linked, since «emotions provide a natural means for the brain to evaluate the environment within and around the organism, and respond accordingly and adaptively» (Damasio 2003: 53).

Researches on patients affected by frontal lobe damage indicate that internal states associated with

emotional contents support response options and advantageous choice. According to Damasio (1999: 53-54), emotions provide a couple of connected biological functions: the production of specific reactions to the inducing situations and regulation of the internal state of the organism in order to prepare specific reactions. Moreover, since the process of deciding advantageously starts even before knowing the advantageous strategy (Bechara and colleagues 1994, 1997, 2000), emotions should play a major role when it comes to action planning.

So, emotionally-related interoceptive responses have to be assumed as ecologically dependent on perceptual events depending on specific sensory appraisal of environmental circumstances. At the same time, an action might be hardly defined as 'planned', as it might be hardly considered as meaningful at all, if lacking some sort of emotional trigger or, more in general, an interoceptive background. Accordingly, novels and stories in general typically provide readers or listeners with descriptions of actions intended as meaningful in terms of being tightly connected with characterspecific interoceptive assessments of given environmental circumstances.

So, descriptions of character-specific emotions entailing so-called 'abstract' references are hardly independent on action-related knowledge based on embodied experience. Rather, they are deeply immersed and strictly connected with the described environmental settings characters are experiencing them into. Moreover, descriptions referring to how emotions are felt amplify the impact of described situations and crucially support both action-planning and decision-making, eventually leading to actual or hindered action-related events.

Some narrative descriptions might eventually seem peculiarly consistent with a view supporting tight connections between described emotions and action-related knowledge based on embodied experience. Still, even more typical cases would hardly be describing character-specific emotions as completely unrelated with environmentally situated decisions and actions. Since novels and stories in general are hardly conceivable once they are deprived of actions, it is not big surprise that they typically avoid similar descriptions, eventually consisting in a hard-to-process, easily distracting and disturbing list of states of mind leading to nothing, not even inaction.

So, according with an ecological view based on the somatic marker hypothesis, descriptions of the way emotions are experienced and felt may hardly consist in isolated narrative events taking place somewhere in the secluded 'interiority' of a specific character. Rather emotions are typically described into novels and stories in general as modulations arising in response to environmentally situated events, such as character-specific sensory experiences supporting descriptions of landscapes. Congruently, even the third major narrative semantic domain, the one consisting in environmental descriptions, may be hardly considered as independent on individually embodied action-related knowledge.

Actually, an ecological theory of narrative reference based on the Theory of Affordance necessarily predicts that environmental descriptions do not simply define the stage set in which action would eventually take place. Rather, they draw a variable amount of suspensive potential, either exerted by the development of the story or not. Indeed, the comprehension of an environmental description presumably depends on sensory-motor resonance triggered by the recognition of opportunities for action emerging from potential interaction with featured objects, people and other described items.

Congruent results have been found in respect to the activity of canonical neurons found in premotor areas of both human and non-human primates. Unlike mirror neurons canonical neurons do not respond to observed actions, rather they fire both when a grasping action is carried out and when the animal merely observes the object to be grasped, in absence of any detectable action aimed to it (Rizzolatti, Fogassi and Gallese 2000; Rizzolatti & Luppino, 2001). Interestingly, the activity of canonical neurons demonstrates that the presence of a graspable object in the visual space activates the appropriate motor program of the intended type of hand-object interaction.

Experiments more directly concerning sensory experience and language found that perception of words or objects that index tactile, gustatory, auditory, and visual knowledge activate brain regions associated with encoding these sensory experiences (for instance, Goldberg and colleagues 2006, Gomez and colleagues 2006 and see also Martin 2007). Other studies showed that both silent naming, and visual presentation of words and pictures referring to the use of man-made objects lead to the activation of the ventral premotor cortex (Perani et al. 1995; Grafton et al. 1997; Chao and Martin 2000; Martin and Chao 2001), a brain cortical region typically associated with the control of action and not in the conceptual representation of objects. Such findings have been interpreted in terms that perceived objects directly trigger pre-motor regions of the brain that control interactive responses based on their affordances.

So, pragmatic properties of objects emerging from potential interaction, handling, manipulation or use in general, apparently make a substantial contribution their conceptual representation, clearly reflecting into linguistic processing of words referring to them. Accordingly, environmental description of natural, urban or whatever landscapes may hardly keep being considered as *ancilla narrationis*, that is to be intended as a static, marginal, «decorative», accumulative form of digression, definitely subsidiary to narrative action (1969: 56-61). Indeed, far from being just a preliminary step aimed at setting up the landscape actions will be performed 'into', environmental descriptions have to be addressed as a narrative strategy establishing *suspence*, especially when they are based on a character-specific sensory

experiences.

In such terms, traditional accounts of narrative description have to be discarded as incorrect and misleading (Hamon 1972, 1981, 1991, Adam, J. M. -Petitjean, A. 1989, Adam 1993). Even a more balanced approach addressing description as the vital nucleus from which fictional words are actually generated seem to miss the point (Bal 2006), that is the crucial role of description when it comes to action planning. Indeed, From the medieval origins of the genre, through early modern experiences, till contemporary developments, environmental descriptions listeners or readers are typically exposed to while processing narrative references encoded into novels actually anticipates potential outcomes of the story.

Character-specific sensory events bearing visually or acoustically perceived affordances, entail prospective opportunities for action that are exerted in further development of the story. Descriptions directly referring to perceptual experiences are often integrated with other ones generically depicting the landscape from an aspecific point of view carried by the narrating voice. Both are equally processed on the basis of sensory-motor resonance according with pragmatistical properties of described items.

Even environmental descriptions that are completely independent on actions taking place in the development of the story afford opportunities for action. Likewise, references that are simply alluded or implicitly conveyed, trigger prospective events even if they are not directly encoded into corresponding textual features as words and sentences. For instance, affordances suggested by the description of a crime scene in a detective novel define the potential extent of the crime the novel is about and make readers wonder about *whodunit*?

Brief, an ecological theory of narrative reference assumes that even the recognition and the understanding of environmental descriptions depend on embodied experiences recruited by means of sensory-motor resonance. Both the ones introduced by the storyteller's aspecific point of view and the others featuring character-specific perceptual events are actually processed according with variable anticipation and expectancies triggered by the emerging action potential. Moreover, intentionality and purposefulness of described actions is recognized by readers or listeners on the basis of characterspecific states of mind, emotions and feelings emerging in response to perceptual events depending on environmental descriptions they are situated and immersed into.

Traditional approaches to the novel and other forms of storytelling give for granted such integration and mutual dependence of perception, interoception and action, since they consider it as a consequence of the fact that stories imitate reality through language or they build up a fictional world somewhat intersecting the real one. That is, since the novel depends on reality it 'works' as reality does, borrowing from real world its own ontological system. Rather, an ecological approach maintains that both the novel and so-called reality depend on the very same strategy integrating perception, interoception and action so as to regulate the interaction between the individual and the environment.

As stated by Hommel and colleagues (2001: 878) «action planning has been the problem, common coding has been the solution, and reality has come as a by-product of the solution». Assuming such an ecological perspective, the novel might hardly be addressed as imitating 'reality' through language, as claimed by mimetic approaches based on aristotelian stances. Likewise, theories based on modern epistemology claiming that the novel establishes a more or less consistent fictional world intersecting an actual one have to be discarded as misleading.

Indeed, both 'reality' and the novel are different outcomes of the same process, aimed at finding an effective-enough solution to the crucial problem of developing representational schemes for the planning of purposeful, intentional, goal-oriented actions. As previously stated, such solution entails processing strategies integrating perception, interoception and action in the very same framework, so as to answer questions like when, why, what 'to do', while implicitly providing given definitions of 'doing'.

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