

Metaphor and Experimental Pragmatics: When Theory Meets Empirical Investigation

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ABSTRACT

In this contribution we focus on one phenomenon that has a special role in pragmatic theorizing, namely metaphor, and select two issues deriving from theoretical models and prone to be tested experimentally. The first issue concerns the comprehension procedure, that is whether access to metaphorical meaning goes through a mandatory literal stage and thus is indirect, as predicted by a Gricean inspired account, or rather is retrieved directly. The question will be discussed by referring to behavioral and neurophysiological studies, which advanced our understanding of the time course of metaphorical interpretation but proved not fully suitable to answer the question. The second issue revolves around the cognitive architecture of the pragmatic system as it operates in the case of metaphor comprehension. We will illustrate the contribution that functional neuroimaging, coupled with clinical investigations can provide to fine-tune the architecture of the system responsible for metaphor processing. Some outstanding questions are highlighted in the final part, aiming at sketching our interpretation of the experimental pragmatic enterprise.

Keywords: metaphor, experimental pragmatics, neuropragmatics, literal-first hypothesis, mind-reading

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Introduction

Research in pragmatics follows a thread that originated in philosophy, developed in linguistics and cognitive science, and more recently experienced an expansion indeed a real turn into experimental investigation. This introduction briefly traces this evolution, with the aim of presenting the background upon which metaphor studies have moved and are still moving.

The study of pragmatics finds its origin in the philosophical tradition, and mostly in the attempt of distinguishing formal language from actual linguistic usage. First references can be traced back to Charles Morris's semiotic theory (Morris, 1938), who defined pragmatics as the study of the relations between signs and their users, in opposition to syntax (the relation of signs to one another) and semantics (the relation of signs to what they denote). The field developed in the 1970s after the contribution of philosophers adhering to the so-called ordinary language philosophy, namely the late Wittgenstein, Austin (with his famous lecture "How to do things with words") and Strawson, highlighting the complexity of meanings and the variety of forms of verbal communication, and assuming an unbridgeable gap between the semantics of formal language and that of natural languages. In his William James Lectures at Harvard in 1967, Herbert Paul Grice claimed that the gap between formal and natural language could be reduced by way of distinguishing linguistic meaning from speaker's meaning (Grice, 1989). He showed that, when considered in specific contexts of use, linguistic meaning can convey richer and fuzzier speaker's meanings, made up not only of "what is said", but also of "what is implicated". In doing so, he introduced new conceptual tools, in particular the notion of "implicature" that became the foundation for modern pragmatic theories. One of the merits of Grice is to have shown that pragmatics identifies a form of behavior, and thus, ultimately, deals with mind faculties. His Cooperative principle ("Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged"; Grice, 1989) was intended as a general law of human rationality. In this frame, meaning became primarily a psychological phenomenon, and only derivatively a linguistic one. Although it is widely recognized that Grice intended to offer only a rational reconstruction rather than a real-time description of pragmatic processes (Bach, 2005), his work paved the way to a consideration of pragmatics at the interface between language and cognition.

A full account of pragmatics in psychologically plausible terms developed in the late 1980s, when pragmatic processes were considered in a mentalistic perspective, and the term “cognitive pragmatics” started to circulate. Major issues became the description of comprehension procedure and mechanisms, and the identification of the pragmatic system with respect to the general architecture of cognition (Kasher, 1984; Bara & Tirassa, 1999). Upon this background, Relevance Theory appears as the most full-fledged account of pragmatic processes, and specifically verbal communication.¹ By revisiting the Gricean maxims in terms of Relevance, i.e., as a function of processing efforts and contextual effects, and by promoting Relevance to the status of a key principle in human cognition, Relevance Theory aims at explaining every possible meaning phenomenon in communication (Sperber & Wilson, 1986/1995). In this framework, “pragmatics is a capacity of the mind, a kind of information-processing system, a system for interpreting a particular phenomenon in the word, namely human communicative behavior. It is a proper object of study itself, no longer to be seen as simply an adjunct to natural language semantics. The components of the theory are quite different from those of Gricean and other philosophical descriptions; they include on-line cognitive processes, input and output representation, processing effort and cognitive effects” (Carston, 2002).

Despite Relevance Theory considers pragmatics as a process and not as a set of abstract and formal relationships (Wilson & Sperber, 2012) and is concerned with real time processes (Wilson & Sperber, 2004), for a long time it remained exclusively theoretical, and the same holds true for other pragmatic hypotheses and research traditions. Theories were tested by using as evidence a mixture of intuitions about interpretation and observations of behaviors. In this sense, an experimental approach can strongly help in disentangling alternative theoretical accounts and their implications regarding underlying cognitive mechanisms. Psycholinguistics has developed sophisticated experimental methods in the study of language processing. These were applied to pragmatic phenomena, but not systematically used to test pragmatic theories. In the last decade, the publication of the book “Experimental Pragmatics” (Noveck & Sperber, 2004) marked what became known as the “experimental turn” in pragmatics (Noveck & Reboul, 2008). Experimental

¹ Another model of pragmatic interpretation is Bara’s Cognitive Pragmatics, which accounts for communicative processes, both linguistic and extralinguistic (i.e., gestural), by positing special emphasis on the description of the communicative agents’ mental states (Bara, 2010).

pragmatics presents itself as a new field that “draws on pragmatics, psycholinguistics and also on the psychology of reasoning” (Noveck & Sperber, 2004) and opens new scenarios in the formulation of testable predictions derived by theory. More specifically, experimental pragmatics aims at furthering linguistic and pragmatic theoretical assumptions by better describing the cognitive factors and mechanisms playing a role in communicative exchanges and by testing the validity of pragmatic theoretical proposals for a number of specific phenomena (Noveck & Reboul, 2008). Developing the experimental side of pragmatics entails deriving testable pragmatic hypotheses from theoretical assumptions – based on intuitions and observations – and thus leading theory to refine itself in the light of experimental evidence.

The experimental side of pragmatics is explored also within the field of neuropragmatics (Bambini, 2010; Bambini & Bara, 2012), aimed at describing the neural underpinnings of pragmatic processes by applying, for example, functional neuroimage. Even though the identification of the aspects of the pragmatic theory to be addressed in brain’s terms is not definite yet (Bertuccelli, 2010), most neuropragmatic studies “go neuro” by using neuroscientific techniques to validate cognitive models and hypotheses. The importance of this research direction is undeniable, because models are able to support investigations that otherwise will be only be mere empiricism (Van Berkum, 2010). However, it should be noticed that the levels of analysis proposed in the linguistic field may be not always suitable to reflect brain functioning due to incommensurable units between the linguistic and the neural level (Poeppel & Embick, 2005; Grimaldi, 2012). Thus, for “going neuro” it would be desirable also starting from “neuro” hypotheses and reconsidering research issues with special attention to brain mechanisms and functioning Van Berkum (2010), which holds for pragmatics as well.

Overall, the experimental turn puts forward a two-way relation between theory and empirical confirmation. On the one hand, theoretical issues ask for more detailed experimental evidence and, on the other hand, experimental evidence puts pressure on theorizing, which in turn leads to refinements and expansions of theoretical models. As regards the objects under the lens of experimental pragmatics, several phenomena fit into the paradigm. Some of them, as for example scalar inference and reference resolution have received systematic attention (Noveck & Reboul, 2008), whereas for others, as for example metaphor, experimental evidence is still fragmentary and needs to be

gathered more systematically. In the present work, we will focus precisely on metaphor, assuming its definition as a “paradigmatically pragmatic phenomenon” “involving a gap between the conventional meaning of words and their occasion-specific use”, able to motivate the distinction between pragmatics and semantics (Camp, 2009), and to approach the psychological reality of pragmatics as well. We will discuss two research questions that concern fundamental unit of construction in a pragmatic model such as Relevance Theory. The first one concerns the comprehension process and, more precisely, whether there is a mandatory literary step while accessing metaphorical meanings. The second issue concerns the mental architecture and how of the pragmatic system operates in the case of metaphor comprehension cognitive components.

1. Issue 1: Metaphor comprehension: a direct or indirect process?

The assumption that metaphor is a deviation from literal meaning dates back to Aristotle’s *Poetics*, where metaphor was considered as a departure from the “literal norm”. This position has been widely developed within the so-called standard pragmatic model, associated primarily with philosophers Grice (1975, 1978) and Searle (1979). Grice assumed metaphor to violate one of the cooperative principles that govern communication, namely the first Maxim of Quality, i.e., “Do not say what you believe to be false”, and thus to be defective in communicative terms compared to literal language. In order to succeed in metaphor comprehension, the hearer relies on a set of inferential rules and pragmatically works out speaker’s meaning, which is separated from the linguistic meaning. Therefore, part of the conveyed meaning is explicitly communicated, while another part needs to be inferred (“implicature”). Moreover, whereas literal meaning is accessed directly, metaphor interpretation requires subsequent different stages: first, literal meaning is accessed; second, literal interpretation is detected as defective; and third, the search for another interpretation is pursued. Accessing literal meaning is thus a mandatory stage, and metaphor interpretation occurs indirectly. A similar position is held by Searle (1979), who argued that in understanding a metaphor the hearer first determines whether seeking for a metaphorical interpretation or not, then uses a particular set of strategies for computing the values of the intended metaphorical meaning and, finally, uses a particular strategy for restricting these values. Interestingly, also the psychologist George

Miller (1979) argued that metaphor generates a “recognition problem”, i.e., a discrepancy against the previous context, which is the first step, followed by reconstruction and interpretation towards metaphor comprehension. Note that the standard pragmatic model provides a rationalization of the processes used in deriving figurative meanings but it is in no ways a psychological or cognitive model. No speculation about the nature or the temporal development of cognitive processes behind metaphor is provided.

In more recent times, Relevance Theory (Sperber & Wilson, 1986/1995), within a broad framework for explaining human cognition and communication, challenged the standard pragmatic model arguing that the same inferential processes determining implicatures may contribute also to the explicit level of communication. Metaphorical meaning is claimed to belong to this explicit level, namely to “what is said”, rather than to “what is implicated” as postulated by Grice. What guides inferential comprehension is the expectation of relevance raised by an utterance against the provided context (Sperber & Wilson, 2008). Inferential processes allow us to automatically “adjust” lexical concepts and construct *ad hoc* concepts during online interpretation without any conscious effort. The concept inferentially derived may have a “broader” or “narrower” denotation compared to lexically encoded concept. Contrary to the standard pragmatic model, the relevance-theoretic approach does not recognize a mandatory literal step in metaphor interpretation. The lexical encoded meaning is a mere point of access to an array of encyclopedic information from which the hearer selects in order to achieve a satisfactory interpretation. Interpretative hypotheses are tested in order of accessibility and are driven by the achievement of optimal relevance (Wilson & Sperber, 2004).

Turning into the experimental field, these different accounts of the comprehension process allow for a wide margin for empirical translation of theoretical hypotheses into time-sensitive predictions. Predictions have been derived mainly from the standard pragmatic model and were based on the assumption that literal meanings have absolute priority, and that literal intended meanings should be easier and faster to understand than figurative meanings (the so-called “literal first hypothesis”). Longer reaction times for metaphors were assumed as an indirect support for this hypothesis, assuming that the process of accessing literal meaning, rejecting it, and searching for a figurative interpretation requires longer times than directly accessing literal meaning. In a few words: more stages require more time. This assumption seemed to be confirmed by behavioral measurements showing that reading

metaphors is more time consuming than reading literal utterances (Janus & Bever, 1985). Similar findings, however, were soon challenged by evidence showing that, when contextually supported, metaphors are comprehended as quickly as literal counterparts (Gibbs & Gerrig, 1989; Inhoff, Lima, & Carroll, 1984), opening the way to the formulation of an alternative model, known as “direct access view”.

The dichotomy indirect *versus* direct access to metaphorical meaning is mitigated by the Graded Salience Hypothesis (Giora, 2003), a general view of language comprehension that postulates the activation of salient meaning (i.e., the most prominent and faster retrievable from the mental lexicon) in the first stage of language processing without additional pragmatic interferences and regardless of context. When literal and non-literal utterances converge in the degree of salience, the initial process is the same and a direct access occurs. On the contrary, in the case of novel – non salient – metaphors, the access to metaphorical meaning is not direct. Gibbs (2001) defined the Graded Salience Hypothesis as a “hybrid theory of figurative language” because it combines both a direct access view (for salient meanings) and an indirect access view (for non salient meanings). The Graded Salience Hypothesis seems to be confirmed by reading times that showed equal reading times for both salient literal and metaphorical meanings (Giora, 2003).

Equal reading times, however, are not sufficient *per se* neither to support nor to discredit the standard pragmatic model, because several elements may induce an “incorrect illusion” of equivalence (Gibbs & Gerrig, 1989). Importantly, McElree and Nordlie (1999) showed that even if the process of understanding literal and figurative language might be equal in time, differences in accessibility might be significant. A number of techniques are able to offer online, more fine-grained data on metaphor understanding process than those provided by reading times. Among these, the recording of brain activity through Event-Related Potential (ERP) technique seems especially promising in disentangling the direct *versus* indirect dichotomy as it is able to give millisecond precise temporal pattern of comprehension process time-locked to the word of interest.

Up to now, about fifteen ERP studies on metaphor have been published and among them a great variability of metaphorical structures, languages, experimental protocols, and observed ERP components is visible (among others, Arzouan, Goldstein, & Faust, 2007; De Grauwe, Swain, Holcomb, Ditman & Kuperberg, 2010; Lai, Curran, & Menn, 2009; Pynte, Besson,

Robichon, & Poli, 1996; Tartter, Gomes, & Dubrovsky, 2002). It is beyond the purpose of the present paper to review all available ERP contributions on metaphor. What falls within our aims is to overview how the literal-first question has been addressed in this domain. The dichotomy direct *versus* indirect access models seems indeed to be a compulsory step for introducing ERP studies on figurative language but, actually, only in a few cases precise experimental predictions are provided and discussed. Among the available amount of ERP studies on metaphor, we selected two studies that clearly transposed the theoretical assumptions of the standard pragmatic model into ERP predictions, in terms of modulation of components: Pynte et al. (1996) and De Grauwe et al. (2010).

The first one (Pynte et al., 1996) investigated the difference between familiar and unfamiliar metaphorical sentences both with and without contextual support. The second one (De Grauwe et al., 2010) investigated the difference between conventional metaphorical sentences and literal or anomalous sentences. Both studies predicted a modulation of two components as neural evidence for the literal first hypothesis. Namely, the N400 – a negative-going component that peaks at approximately 400 ms after the onset of the target stimulus – taken as an index of the difficulty in semantic processing, and the Late Positive Component (LPC) – a positive going potential following the N400 – taken as a marker of additional processing or meaning reanalysis. However, due to the variability in adopted protocols, conclusions proved highly different.

More specifically, Pynte et al. (1996) ran four ERP experiments comparing familiar metaphors (“Those fighters are lions”), unfamiliar metaphors (“Those apprentices are lions”) and literal sentences (“Those animals are lions”). The authors predicted that if the literal-first hypothesis holds, metaphors should elicit an N400 effect (i.e., a different amplitude compared to literal controls) indexing the access to literal meaning, followed by an LPC effect indexing the access to the metaphorical meaning. Otherwise, if the parallel hypothesis (or direct access) holds, the access to literal and metaphorical meaning should occur in the same latency band and the N400 should be modulated by factors that usually influence metaphor comprehension, such as familiarity. Finally, they introduced a third hypothesis, namely the context dependent-hypothesis arguing that metaphorical meaning is accessed directly when relevant to the preceding context. If this last hypothesis is valid, the N400 to metaphor should be reduced in presence of a supportive context. Results showed that, when

compared to literal sentences, familiar metaphor elicited a more enhanced N400, consistently with the literal-first hypothesis (experiment 1). But when familiar metaphors were compared to unfamiliar metaphor, no N400 was visible (experiment 2). In this case, N400 proved not sensitive to familiarity modulation thus disconfirming, according to the predictions, a parallel hypothesis. When context was added and again familiar and unfamiliar metaphors were compared, results run as follows. When context was supportive in the case of familiar metaphors (“They are not talkative: these counselors are carps”) and unsupportive in the case of unfamiliar metaphors (“They are not obedient: these engineers are carps”), unfamiliar metaphors elicited both N400 and LPC effects (experiment 3). The authors claimed that this result could be explained both in terms of the literal-first hypothesis because of the biphasic pattern N400-LPC reflecting different stages, and in terms of the context-dependent hypothesis, because context increased the difference between familiar and unfamiliar metaphors, not visible in the out of context condition. But, when context was unsupportive for familiar metaphors (“They are not naive: Those fighters are lions”) and supportive for unfamiliar metaphors (“They are not cowardly: this apprentices are lions”), surprisingly an N400 effect was elicited by familiar metaphors, while an LPC effect was observed for unfamiliar metaphors. The authors concluded that the crucial effect of context visible in N400 modulation definitely supports the context-dependent hypothesis.

De Grauwe et al. (2010) compared conventional nominal metaphors (“Unemployment is a plague”), literal (“Cholera is a plague”) and semantically anomalous sentences (“Metal is a plague”). Like in Pynte et al. (1996), here the authors suggested that if the literal-first hypothesis is valid, an N400 effect to metaphors should be elicited – indexing a preliminary difficulty in semantic mapping – followed by an LPC effect reflecting an additional effort in accessing metaphorical meaning or integrating it in context. Moreover, they took into account the Graded Salience Hypothesis (Giora, 2003) and predicted that if it holds no difference in the N400 amplitude should be recorded between conventional metaphors and literal sentences, as in both cases the critical word is salient in the context and should be activated immediately. The authors claimed that an LPC effect might be consistent with the Graded Salience Hypothesis, as well, because also in familiar metaphors the literal meaning could be accessed in addition to the metaphorical meaning until considered in conflict with a plausible interpretation thus eliciting a reanalysis indexed by the

LPC. Results showed that semantically anomalous phrases elicited a greater N400 effect than the other two experimental conditions, while the difference between metaphors and literal counterparts was only transient. The N400, indexing the access to literal meaning, was followed by an LPC effect triggered by the conflict between the correct metaphorical meaning and the still retained literal meaning, in other words by a kind of alignment process. To confirm these results, the authors designed a second experiment where the critical word was in mid-sentence position and thus wrap-up effects due to final-sentence positions were avoided. Importantly, also when presented in mid-sentence position, metaphorical critical words elicited an N400 (even if localized) followed by an LPC effect. Overall, the authors found thus support for the literal-first hypothesis, while the Graded Salience Hypothesis seemed to be not supported.

In sum, both reviewed ERP studies confirmed that metaphor evoked a biphasic pattern (N400-LPC), like other pragmatic phenomena (e.g. metonymy, Schumacher, 2011) but they differed in interpreting the results with respect to the direct *versus* indirect dichotomy: while Pynte et al. (1996) interpreted their results in terms of a context-dependent, i.e., direct hypothesis, De Grauwe et al. (2010) claimed to offer support in favor of serial, i.e., indirect access. Again, the literal-first hypothesis is neither confirmed nor disconfirmed definitely, as it is not possible to determine whether there is a mandatory initial stage.

Therefore, the question is whether available predictions and adopted experimental paradigms are actually suited to ascertain the presence of a literal step with sufficient accuracy. While an initial step with a fully accessed literal meaning seems implausible, it is possible that core aspects of the literal meaning are automatically activated even in metaphorical-biased contexts. Remarkable evidence in this direction comes from a cross modal priming study (Rubio Fernandez, 2007). This study showed that core features of word meaning (i.e., literal meaning) are always activated even in context biased towards metaphorical interpretation and remain activated beyond the recovering of the metaphorical meaning. On the contrary, irrelevant features were deactivated between 400 and 1000 ms through a suppression process that involves high-level cognitive processes similar to those involved in ambiguity resolutions. In its turn, also theory is moving towards a convergence with experimental data by incorporating the idea of a “lingering” of literal meaning throughout the metaphor comprehension process (Carston, 2010) in

perfect accordance with experimental pragmatics' aims. In this scenario, the question about whether the access to metaphor passes through a mandatory literal step seems to be rather interpreted as "what is the role of literal meaning". Some promising suggestions rely on new paradigms – as for example the combination of masked priming and ERP recording (Schumacher, Bambini, Weiland *in press*) – that are able to tap the very early phases of processing and could be profitable used for investigating also the construction of metaphorical meanings.

2. Issue 2: Cognitive components in metaphor comprehension

The second issue we would like to consider is related to the cognitive architecture of the metaphor comprehension process, i.e., the description of the cognitive systems that participate in metaphor understanding and of their neural underpinning. Here the experimental pragmatics perspective blends with clinical pragmatics and neuropsychology, as it enters matters and adopts methodologies belonging to neuropsychology and cognitive neuroscience. To our view, here too it is possible yet profitable to stick with the guideline of a strict dialogue between theoretical hypotheses and empirical data.

Going back to Grice, he was certainly far away from approaching the neurocognitive description of metaphor. However, the assimilation of metaphor to implicature and the description of how implicatures are derived, namely through the recognition of intentions, makes it plausible to assume that, in a Gricean inspired cognitive model, metaphor comprehension – as all cases of implicated meaning – would require mind-reading operations, i.e., what has become known as Theory of Mind, defined as the ability of attributing mental states to others. The Gricean view is that pragmatic interpretation is ultimately an exercise in metapsychology, in which the hearer infers the speaker's intended meaning from evidence she has provided for this purpose (Sperber & Wilson, 2002).

In maintaining the inferential nature of pragmatic processes at the implicit level and extending it to the explicit level of communication, Relevance Theory too assumes the involvement of mind-reading mechanisms. More specifically, Relevance Theory considers mind-reading as a dedicated inferential module, and pragmatics as a sub-module of the mind-reading module, with its own special-purpose principles and mechanisms, especially dedicated to verbal communication (Wilson, 2005). The relevance-theoretic comprehension

procedure automatically constructs hypotheses about the speaker's meaning on the basis of a description of the utterance plus available contextual information. In the case of metaphor, the hypotheses about the speaker's meaning cannot be based on the default rules of literalness, being metaphorical expressions alternative routes to reach optimal relevance, determining additional efforts in terms of intention recognition (Happé, 1993).

This aspect of the relevance-theoretic perspective found an empirical test bed in the autistic condition: autistic patients lacking mind-reading abilities should be impaired in deriving metaphorical meanings as compared to literal interpretation. The data collected by Happé (1993) supported this view, by showing that autistic children who do not pass the first-order theory of mind test are impaired in metaphor comprehension but not in simile comprehension, as the latter condition can be interpreted literally. Several studies confirmed this piece of evidence, although it has been showed that Theory of Mind is necessary but not sufficient to understand metaphor (Norbury, 2005), the specificity of pragmatic disorders in autism is a matter of current debate (Giora, 2012). Recently, Wearing (2010) highlighted the apparent conflict between the idea of metaphor as loose use, based on *ad hoc* concepts and not involving special mechanisms, and the special mind-reading effort assumed to be necessary for metaphor interpretation. The conflict is solved by clarifying that the mind-reading effort in metaphor processing lies in the type of source the hearer must rely upon to derive the *ad hoc* concept and solve the interpretive process successfully: not only the world at large, as typically in the literal case, but the beliefs that the speaker is likely to hold and not to hold. The relevance of a metaphor is guaranteed by the speaker's mental states, rather than by the world, which is what autistic individuals are unable to process.

Importantly, as evident from the description of the relevance-theoretic comprehension procedure, mind-reading mechanisms operate against a wider cognitive background which includes other systems. As already mentioned, the comprehension procedure follows a path of least effort in formulating hypotheses about the speaker's meaning, aiming at the maximization of relevance and "using whatever contextual information is most highly activated by the automatic workings of the cognitive system at the time" (Wilson, 2005). The maximization of relevance is guaranteed by three notably characteristics of the human cognition: the constant monitoring of the environmental features, the permanent availability of a huge amount of memorized data, and the

attentional resources, which are able to handle only a limited amount of information at any given time. The efficiency of the process is a matter of being able to select, from the environment and from memory, the most relevant information for attentional processing (Sperber & Wilson, 2002).

On this basis, if we could take a global picture of the cognitive systems at work in pragmatic interpretation, one should expect not only mind-reading mechanisms, but also the attentional system to be involved, possibly with a higher effort for metaphor as compared to literal interpretation, related to higher costs in selecting the relevant information from context and possibly also the appropriate meaning among competing ones. Moreover, the construction of the *ad hoc* concepts – accessing concepts and modulating their denotations through broadening and narrowing – implies operations that should be reflected in the conceptual system.

In a similar scenario, functional neuroimaging techniques appear as the methodology of choice for exploring the cognitive architecture of metaphor comprehension, being able to provide information concerning “where” the processes take place, and allowing for anatomo-functional correlations between brain structures and cognitive systems. The neuroimaging of metaphor comprehension is relatively vast, including around twenty studies published in the last decade. Metaphor nicely suits into the requirements of standard neuroimaging paradigms, i.e., subtractive: while for structural aspects of language we need to devise sound experimental designs, for instance introducing anomalies (Moro, 2008), metaphor can be easily compared to its literal equivalent, offering a window on what systems are recruited to adjust meaning pragmatically. However, most of the existing literature has not paid attention on describing the architecture of the process, being interested instead in assessing hemispheric involvement, following the classic hypothesis that pragmatic aspects of language are processed in the right hemisphere (Joanette, Goulet, & Hannequin, 1990; Tompkins, 1995). In contrast with the classic view, most studies on metaphor interpretation report bilateral patterns of activations, where frontal and temporal areas stand out in particular, as shown in recent comparative analyses (Bohrn, Altmann, & Jakobs, 2012; Rapp, Mutschler, & Erb, 2012). The involvement of the right hemisphere seems to be especially modulated by the conventionality vs. novelty of the metaphorical expressions, with greater right activations involvement for novel and unfamiliar expressions (Schmidt et al., 2010). This is in line with the theoretical tenets of Graded Salience Hypothesis, which specifically aims at

accounting for the difference between familiar and unfamiliar expressions, assuming two different processing styles (Bohrn et al., 2012). The cognitive architecture of the comprehension process, however, is not the main topic in the neuroimaging of metaphor.

In a recent fMRI study, we tried to overcome the right versus left debate to focus on the neurofunctional description of metaphor comprehension, based on the cognitive architecture put forward in the cognitive pragmatics literature (Bambini et al., 2011). The building blocks of the metaphor comprehension process assumed were the following:

a) To start with, we hypothesized the crucial involvement of *the conceptual component*, reflecting conceptual access and the construction of *ad hoc* concepts through context-based inferences.

b) Second, we hypothesized the involvement of *the attentional component*, in charge of selecting the information worth bring together, filtering contextual features and competing meanings.

c) Finally, the *mind-reading component* is assumed to participate in supporting the recognition of the speaker's communicative intentions, and specifically, along Wearing (2010), the recognition of the speaker's belief on which *ad hoc* concepts are based.

We constructed an experimental paradigm where participants were presented with paired passages including literal and metaphorical expressions (e.g., “Do you know what that insect is? A dragonfly” vs. “Do you know what that dancer is? A dragonfly”), intermixed with fillers, in order to reduce the proportion of figurative language. Participants were instructed to read the passages, and then perform an adjective matching task, making metaphor comprehension an implicit task. The analysis showed that metaphor as compared to literal comprehension produced greater activations in a number of regions, distributed bilaterally and involving especially the frontal and temporal lobes: the bilateral inferior frontal gyrus (extending over left and right BA 45 and left BA 47) and other prefrontal regions (right BA 9 and left BA 8), the left angular gyrus (BA 39), the cingulated cortex bilaterally (BA 24 and BA 32) and the right posterior superior temporal gyrus (BA 22).

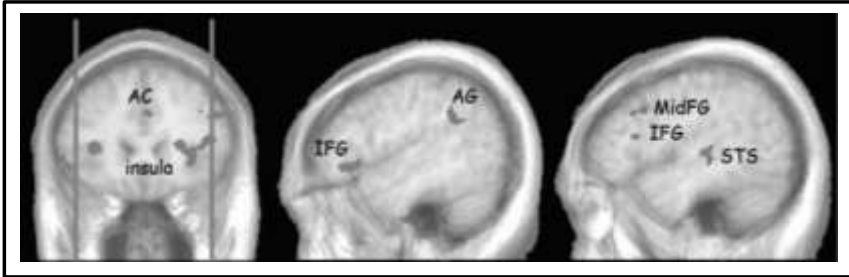


Figure 1. Brain areas activated for metaphor comprehension as compared to literal sentences. Coronal (on the left) and sagittal view of the left hemisphere (center) and of the right hemisphere (right); the lines in the coronal image correspond to the location of the sagittal slices. AC: anterior cingulate; IFG: inferior frontal gyrus; MidFG: middle frontal gyrus; STS: superior temporal sulcus; AG: angular gyrus. Adapted from Bambini et al. (2011).

The anatomo-functional correlations seemed to confirm our predictions:

a) Activity at the level of the inferior frontal gyrus bilaterally is likely to reflect the activation of the *conceptual system*. The activation of bi-frontal areas is probably the most robust results across the literature on metaphor, and in discourse processing as well, i.e., when word meaning needs to be integrated with world knowledge and the wider context. The same function seems to be supported by the angular gyrus (BA 39), which too is greater activated in metaphor as compared to literal process, and which is considered as an area supporting high-level conceptual processing.

b) The activity observed in the cingulate cortex, as well as activity in prefrontal areas, is likely to reflect *attentional mechanisms*. These regions are implicated in cognitively demanding tasks involving stimulus-response selection in the face of competing streams of information, including Color Stroop and Stroop-like tasks and many working memory tasks.

c) Finally, the posterior part of the right superior temporal gyrus might reflect *mind-reading mechanisms*, as this area has been implicated in monitoring the protagonists' perspective and attributing intentions to agents. Interestingly, in our study the regions along the superior temporal sulcus show greater activity in response to unfamiliar than familiar metaphor, extending to the left hemisphere for unfamiliar items, pointing to a strong relation between novelty and mind-reading efforts.

Two important considerations should be added here. First, this decomposition is highly compatible with the clinical literature on metaphor deficit, which is not limited to the autistic population. Deficit in metaphor

comprehension are indeed vulnerable to several neurological and psychiatric conditions (Thoma & Daum, 2006; Rapp & Wild, 2011), which suggests that a complex cognitive architecture is involved: the underlying cause of deficits in pragmatic interpretation, far from being unitary, might find different explanations in different populations (Stemmer, 2008). For instance, difficulties in demented patients might be related to attentional deficits in the case of demented population (Amanzio et al., 2008). Second, this decomposition shares similarities with the findings reported for other cases of figurative language interpretation, for instance idiom processing (Papagno & Romero Lauro, 2010) which suggests common mechanisms and is in line with the Relevance Theory's idea that metaphor doesn't require specific operations to be processed.

Overall, the main achievement of our study is the neutrally-plausible decomposition of the metaphor comprehension process in a network of functional components, which are candidate to represent basic blocks in a full-fledged neurocognitive model of metaphor processing. Cognitive pragmatics provided the foundation for the study, by helping formulating predictions and interpreting results. To this respect, Relevance Theory seems to offer a comprehensive framework for understanding figurative language comprehension, by sketching a model which is grounded in general cognition and takes into account different aspects of the process. Besides, Relevance Theory might hopefully bear on neuroimaging evidence to further detail the architecture of the system. Similar considerations, however, are not limited to the Relevance Theory framework, but extend to other cognitive models of metaphor comprehension: we will go back to this point in the final remarks. One can expect that major future achievement could come from the attempt to go beyond the decomposition toward a proper neurocognitive model: much promises lie in the study of connectivity between brain areas, in order to explore the delicate interplay of the components, the order of activation, and their specific roles.

Conclusion

In this contribution, we attempted to show how theoretical assumptions in pragmatics can be translated into experimental paradigms, and indeed can profitably guide empirical investigations in formulating predictions and interpreting results. As emerged in the discussion, the process is far from

being complete. Rather, the experimental turn in metaphor research is in the phase of sharpening research questions and experimental paradigms for closer addressing key theoretical points.

One of these central questions regards the description of the time course of metaphor interpretation, bearing in mind the standard pragmatic view and the hypothesis of a mandatory initial literal step. Through the consideration of behavioral data and ERP results collected over the last three decades, we argued that available experimental data are still not able to give a decisive answer to this question. Promising hints seem to come from a refinement of the theory, incorporating the notion of lingering of the literal meaning, and from the employment of new paradigms able to tap the very early stages of processing (e.g., masked priming combined with ERP).

Another case is represented by the cognitive architecture of the metaphor comprehension process. The involvement of mind-reading mechanisms, since long assumed in the pragmatic tradition, is confirmed by clinical evidence on autistic patients. Moreover, functional neuroimaging helped decomposing the process of metaphor interpretation in a number of cognitive components which include also the conceptual and the attentional system. Guided by theoretical modeling, we are stepping forward in describing the neurofunctional architecture of metaphor interpretation.

A framework such as Relevance Theory – explicitly modeled on online processes of utterance interpretation and the nature of the systems behind (Wilson & Sperber, 2004) – offers many more aspects to be addressed experimentally. We would like to mention just two of them, which are of special interest to our view and on which our group is working within an experimental (neuro)pragmatics perspective.

First, recent developments in the relevance-theoretic account of metaphor suggest that the comprehension of creative and extended metaphors might imply a meta-representative process of extracting the intended meaning from both literal meaning and the evoked imagery rather than a process of *ad hoc* concept construction (Carston & Wearing, 2011). To now, very little experimental evidence has been collected on literary metaphor, which might represent a case very high processing costs are compensated by high cognitive benefits, possibly in terms of aesthetic appreciation. Early results showed that literary metaphor is a complex, multidimensional phenomenon whose comprehension is influenced and mediated by a number of psycholinguistic variables (Resta, Bambini, & Grimaldi, *submitted*). This domain appears to us

as a good candidate for a rich dialogue between experimental evidence and theory, pragmatics and possibly also cognitive poetics.

Second, figurative language has been used in pragmatics as a label for several different phenomena, and only recently theory is starting to clarify the differences across phenomena, by developing a finely-grained lexical pragmatics account. Although we assume that all figurative instances require pragmatic inferences, there might be different underlying processes linked to different operations at conceptual level. For example, there is early evidence supporting a distinction between metaphor, metonymy, and approximation – which are claimed to vary in the degree of underlying adjustment – in terms of the interpretation availability and costs (Bambini, Ghio, & Schumacher, *submitted*). We believe that along this line a psychologically grounded taxonomy of figurative language might be reached, which might account for the alternative routes speakers might choose to communicate meaning.

Besides Relevance Theory, interesting suggestions might come from other theoretical proposals which move in different fields than pragmatics. Above all, Cognitive Linguistics – grown out from the work of Lakoff and colleagues – suggested that metaphor is not a specific linguistic device, but a conceptual phenomenon deriving from bodily grounded mapping operations (Lakoff & Johnson, 1980). Interesting experimental predictions about the involvement of the sensory motor system in the processing of metaphor meaning might be derived in this scenario, which are being elaborated but still require further exploration. Furthermore, the mechanisms of mapping might play a role in understanding some types of metaphor, although the theory is still underdetermined in terms of comprehension procedure. Importantly, Cognitive Linguistics appears to be not incompatible with Relevance Theory's main claims and the possibility of a combination of the two to contribute to a comprehensive theory of metaphor has been already explored, as they might target different aspects and thus be complementary (Tendahl & Gibbs, 2008; Wilson, 2011). In this light, experimental pragmatics might be at the forefront in solving theoretical disputes within the wider perspective of sharpening theory to account for experimental evidence and allowing experimental evidence to sharpen theory in its turn.

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