NOTICE: This is the author's version of a work that was
accepted for publication in <Reti, Saperi, Linguaggi. Italian Journal of Cognitive Science>.
Changes resulting from the publishing process, such as peer review,
editing, corrections, structural formatting, and other quality control
mechanisms, may not be reflected in this document. Changes
may have been made to this work since it was submitted for
publication. A definitive version is to be published in
RETI, SAPERI, LINGUAGGI. ITALIAN JOURNAL OF COGNITIVE SCIENCE

Language and action: a common intentional, generative, and inferential process

Abstract: The thesis that language is a special case of action is analysed in terms of the following three claims. First, language is presumably just as intentional as action is, in the precise sense that both involve largely automatic processing of goal-directed representations, with conscious attention essentially granting stability to the process. Second, this largely automatic processing of both language and action seems to be based on a shared generative mechanism. Third, this common process can be described as a bidirectional inferential device, which at the same time allows the prediction of goals from means and the retrodiction of means from goals. These considerations converge towards the idea that language processing is based on domain-general processes which are shared with non-linguistic action.

Keywords: intention; action; language; generative process; inference

1. Introduction

Is language processed by domain-specific or domain-general processes? I have recently pursued some lines of research based on the common assumption that linguistic processes are not specific for language since, in an important sense, language is just a special case of action. My purpose here is to sum up in a coherent picture three specific themes that have been central in my

recent work: the nature of intentions in general and of communicative intentions in particular; the way (either domain-specific or domain-general) in which linguistic processes can be said to be generative; the way (again, either domain-specific or domain-general) in which pragmatic processes can be said to be inferential. The first two points raise issues that directly impact the Chomskyan paradigm, the third addresses the modular view of pragmatic processing that is argued for by Relevance Theory.

Based on these lines of reasoning, the general conclusion that language is a special case of action is specified in terms of the following three claims. First, language is presumably just as intentional as action is, in the precise sense that both involve largely automatic processing of goal-directed representations, with conscious attention essentially granting stability to the process. Second, this largely automatic processing of both language and action seems to be based on a shared generative mechanism, with common neural bases and a quite similar structure of representation. Third, this common process can be described as a bidirectional inferential device, which at the same time allows the prediction of goals from means and the retrodiction of means from goals.

In the next sections I will address in turn the intentional, generative and inferential nature of language and action.

2. Communicative intentions

According to some scholars, intentional processes, including communicative ones, are quite different from linguistic processes in the narrow sense. A paradigmatic example of this perspective is Levelt (1989), according to which the route leading from intention to articulation of linguistic utterances is at the same time a route leading from controlled and conscious planning to automatic execution. In his account, the cognitive component which performs the intentional planning of utterances is called Conceptualizer. Levelt provides the following argument for why this component should involve controlled processing:

> Clearly, the Conceptualizer involves highly controlled processing. Speakers do not have a small, fixed set of intentions that they have learned to realize in speech. Communicative intentions can vary in infinite ways, and for each of these ways the speaker will have to find new means of expression. This requires much attention. (Levelt 1989, 21)

Levelt's argument here seems to be an application of Chomsky's thesis about the productive nature of language: just as there is an infinite variability of sentences that can be realized in speech, so there must be an infinite variability of utterances in context and therefore of communicative intentions behind them. Generally speaking, Levelt adopts a view of language that is compatible with Chomsky's program insofar as he approves the idea that syntactic processing is an automatic and possibly modular process. In this quotation, though, he employs the argument from productivity in order to draw a conclusion that is opposite to the one drawn by Chomsky for syntax: Levelt's conclusion is that the process by which communicative intentions are formed *cannot* be automatic and modular.

It is interesting to note that the same argument is employed by Sperber and Wilson (2002) with an opposite purpose, that is, with the purpose of arguing that pragmatic processes need to be automatic and modular:

> In the repertoire of human actions, utterances are much more differentiated than other types of actions: many utterances are wholly new, whereas it is relatively rare to come across actions that are not reiterations of previous actions. [...] Leaving stereotypical utterances aside, the prior probability of most utterances ever occurring is close to zero, as Chomsky pointed out long ago. (Sperber & Wilson 2002, 11)

As is clear, here the infinite variability and unpredictability of linguistic intentions is invoked in order to mark the difference with non-communicative intentions. Because of such unpredictability,

linguistic intentions would be characterized by greater cognitive difficulty than non-communicative ones. From this, Sperber and Wilson conclude that the understanding of linguistic intentions would require a specific module distinct from that responsible for mind-reading in general.

In sum, both Levelt (1989) and Sperber and Wilson (2002) make an appeal to the argument from productivity but with opposite goals. The former uses it in order to argue that linguistic intentions have to be managed by controlled processes, while the latter conclude by the same argument that the understanding of linguistic intentions requires an automatic module. Sperber and Wilson's modularist conclusion is in fact more coherent with the spirit of the Chomskyan argument, were it not for the fact that Chomsky did not mean the argument to apply to pragmatic processes. All in all, the argument seems not stringent enough to draw any clear conclusion.

Let us then put the productivity argument aside and focus rather on Levelt's thesis that utterances are intentionally planned in a controlled manner. This thesis, independently from the specific argument used by Levelt, seems to have some intuitive plausibility. Intentions are generally defined as goals adopted in a conscious and controlled manner, and language intuitively appears as the intentional activity par excellence. On the basis of such assumptions one might trace a distinction in line with that proposed by Fodor between central and modular processes: in linguistic production, intention formation would be under the control of central processes, while its syntactic and phonological implementation would be modular.

However, there are many reasons to think that this demarcation, as well as others on which the Chomskyan thesis of the autonomy of syntax is based, does not hold at a closer inspection. I am going to report some evidence to that effect and then propose a view which is more coherent with that evidence. More precisely, I will call into question the idea that intentional processes are clearly delimited a) temporally, in that they would be located at the beginning of actions, and b) as to the kind of representation they apply to.

Let us start from the temporality issue. A reference point for the current debate is to be found in the well-known studies of Benjamin Libet about the timing of consciousness (e.g., Libet 1992).

As claimed by Jeannerod (2006, 28), Libet's work has shown that “consciousness of the goal of an action is not immediate, it takes time to appear”. According to Jeannerod, since consciousness is a slow process while in motor action there are temporal constraints which do not leave enough time for consciousness to appear, “it follows that fast and accurate movement can only be executed automatically” (Jeannerod 2006, 28).

It should be noted that Jeannerod is making here implicit reference to the idea, which is independent from Libet's controversial results, that automatic processes can guide goal-directed behaviours. In other words, the idea is that consciousness is not necessary in order to initiate and drive goal-directed behaviour insofar as automatic processes may suffice to that effect. In fact, starting from the work of Bargh (e.g., Bargh 1989; 1990), decades of research in social psychology have shown that goal-directed behaviour can be automatic and unconscious (e.g., Bargh et al. 2001; Dijksterhuis, Chartrand, Aarts, 2007; Ferguson, Hassin, Bargh, 2007), even when routines have to be flexibly accommodated to the context (Hassin et al. 2009). In Hassin et al.'s (2009, 550) words, on the basis of previous experience we form habits conceived as “associative networks that include contexts, goals that are regularly pursued in these contexts, and means that one usually uses to attain these goals”. Thanks to these networks, goal-directed behaviours can be driven by simple spreading activation processes. In line with these considerations, Huang and Bargh (in press) have recently insisted on the existence of deep similarities between conscious and unconscious processing of goal-directed behaviour. In the control of action, then, it is possible that conscious and unconscious processes do not operate in radically different manners, were it not for the respective dynamics of activation: conscious processes would grant greater stability insofar as they keep the relevant information active until the current goal is attained.

Based on considerations of this sort, Mazzone and Campisi (2013) have proposed that, in order for actions to be intentional (in accordance with the definition of intentions as conscious goal representations), it is necessary that goal-related structures of representation are activated and that consciousness play some role in their processing, but it is not necessary that goals are consciously

activated from the beginning. As a matter of fact, intentional actions seem to be subserved by an automatic flow of goal-related information processing, in the course of which consciousness may focus on different components as a function of the circumstances. Thus, consciousness is normally distributed in two senses. It is distributed in time, that is, it is present for large portions of the action processing but hardly at its initiation. And it is distributed through the entire representation structure, in that not only (and not necessarily) high-level goals are conscious: other components of the involved representation structures can be conscious as well.

Assuming this is the general picture in the case of intentional action, there seem to be no reasons why language should behave differently, at least in face to face communication. In dialogue you cannot plan your contribution in advance because you don't know what the other will do. Therefore, the temporal constraints that prevent conscious planning of non-communicative actions appear to apply to language production as well (Campisi and Mazzone submitted; more on how the argument applies to language processing in Mazzone 2013).

To sum up, contrary to what Levelt contends for language, there are reasons to think that in action processing consciousness is not precisely delimited either in the sense of being temporally located at the initiation of actions or in the sense that it exclusively concerns high-level goals (for instance, communicative intentions) that need to be subsequently implemented by purely automatic processes (e.g., by syntactic and phonological processing). In a word, it is not the case that language qua intentional action is managed by controlled processing while its low-level implementation is devolved to automatic processing. Here an important assumption is that the same information can be processed by both automatic and controlled processes as a function of the circumstances, since the two processes are largely similar except for the greater stability of the latter.

3. Generative processes

In cognitive explanations there is notoriously a balance between processes and representations, in the sense that the more complex the representations, the less complex the

processes need to be. One very clear example of this strategy is Jackendoff's (2007a) proposal according to which it is possible to reinterpret Chomskyan phrase structure rules (such as F → NP – VP) as hierarchical representations instead of as procedures or processes. In other words, phrase structure rules would be pieces of structure stored in long term memory just as words or idioms: "words, regular affixes, idioms, constructions, and ordinary phrase structure rules […] can all be expressed in a common formalism, namely as pieces of structure stored in long term memory" (Jackendoff 2007a, 11).

This does not imply that, according to Jackendoff, the generative character of Generative Grammar is to be abandoned. However, in his view the generation of an infinite number of utterances is not granted by specifically linguistic processes but instead by an operation called "unification" which is explicitly conceived as domain-general and consists in "clipping together pieces of stored structure" (Jackendoff 2007a, 11). In practice, unification does nothing else but assemble representations according to what they themselves prescribe, on the basis of their hierarchical structure. That is, any higher-level item (for instance, F → NP – VP) prescribes how lower-level items (for instance, NP → Det – N; VP → V – NP) must be combined together, and so on and so forth.

That a generative mechanism of this sort is at work not only in language but also in (non-linguistic) action has been recently proposed by Glenberg and Gallese (2012), Pastra and Aloimonos (2012), Jackendoff (2007b), and Mazzone (2014a). These authors essentially provide two sorts of arguments in favour of that hypothesis. First, they claim that a hierarchical structure of representation is required by non-linguistic (as well as linguistic) actions. And second, they make an appeal to the evidence that non-linguistic actions share a common neurological basis with language. Let us start form the former line of argument.

From a theoretical perspective, starting at least from the classic analysis of Schank and Abelson (1977) it is a common assumption that actions are not only analysable but in fact analysed and generated by agents on the basis of hierarchical representations. With the words of Baldwin and

Baird (2001, 172), agents

> appear to process continuous action streams in terms of hierarchical relations that link smaller-level intentions (e.g. in a kitchen cleaning-up scenario: intending to grasp a dish, turn on the water, pass the dish under the water) with intentions at higher levels (intending to wash a dish or clean a kitchen).

As a matter of fact, despite the argument of Sperber and Wilson (2002) we mentioned above, it is far from obvious that non-linguistic actions are less complex or fewer in number than linguistic ones (as argued in Mazzone 2014a). Therefore, even for non-linguistic action we seem to need a hierarchical structure capable of generating infinite outputs.

From an empirical perspective, evidence of a hierarchical organization comes from both psychological and neurophysiological research. In the psychological domain, Baldwin and Baird (2001, 172) point to the fact that even infants as young as 10-11 months are able to detect hierarchical structure and in fact they parse continuous action along intention boundaries. Moreover, Pastra and Aloimonos (2012, 103) recall that two-year old children can not only parse hierarchically organized actions (Bauer 1995), but they also can copy and reproduce them (Whiten et al. 2006). In neurophysiology, we should consider studies (such as Fuster 2001; Koechlin, Jubault 2006; Grafton, Hamilton 2007; Botvinick 2008) that show a topographic organization of the frontal cortex in correspondence with different hierarchical levels of action representation. An example is Botvinick (2008), where a model is proposed according to which action is represented at progressively more abstract levels as we proceed from premotor cortex towards more anterior areas of the brain.

As to the second line of argument, in neurophysiological research there is a growing body of research suggesting that Broca's area is not a specifically linguistic area, it is instead a crucial component of the circuit which processes hierarchical representations in general, in language as well as in music and tool use (Tettamanti, Weniger 2006; Koechlin, Jubault 2006; Higuchi et al.

2007; Clerget et al. 2009; Fadiga et al. 2009; Fazio et al. 2009; Roby-Brami et al. 2012).

From what we have said so far, it seems to follow that there is a strict relationship between language and action. Specifically, we have argued that representations in the two domains seem to have a quite similar hierarchical structure, and a common neural basis. A reasonable hypothesis is that the same domain-general generative process is at play in both domains. If Jackendoff is right, this might be a very simple process of unification, insofar as the main weight is put instead on representations: it is their hierarchical structure which is supposed to drive the generative combination of items. On the basis of our considerations in section 2, this process might be intentional in the sense previously specified: a largely automatic process, some portions of which partially receives stability thanks to the interaction with conscious attention.

4. Inferential processes

Let me now address the issue of pragmatic processes. For these, too, a modularist view has been argued for, especially by Relevance Theory (Sperber, Wilson 1986/1995; Wilson, Sperber 2004). A possible alternative is to extend to pragmatics the approach proposed by Jackendoff (2007a), that is, the hypothesis of a domain-general unification process operating at different levels of linguistic representation. Jackendoff takes into consideration a phonological, a syntactic, and a semantic-conceptual level. Pragmatics might be a further level of this general constraint-based process, where representations at different levels act as constraints on the result. I do not presume to settle here the issue of modularism in pragmatics. My more modest aim is to focus on one hypothesis made by Relevance Theory on pragmatic processing and show, once again, its strict analogy with non-linguistics processes, specifically, with the ones guiding action.

After Grice, the understanding of utterances in their actual situation of use has been seen as an inferential process: utterances do not merely encode the speaker's communicative intentions, they are instead evidence on whose basis, together with other contextual assumptions, the addressee may inferentially recover those intentions. As relevance theorists would put it, the addressee makes

an inference having as its premises the explicit content of the utterance and some contextual assumptions, and as its conclusion the implicit content (possibly, together with other contextual conclusions).

An interesting claim of Relevance Theory is that this inferential activity is not to be conceived as a derivation proceeding linearly from premises to conclusions. On the contrary, the assumption is that there is a parallel mutual adjustment between premises and conclusions, based on both forward and backward inferences. In practice, not only are conclusions inferred forwards starting from premises, but premises may also be adjusted backwards as a result of contextual expectations about the conclusions to be inferred.

This idea that intentions can be at the same time the result of forward inferences and the starting point of backward inferences is also found in the literature on intentional action in general. For instance, the Event Coding Theory of Bernhard Hommel (2003; Hommel et al. 2001) claims that action goals are represented as perceptual effects associated to the motor act representations which have proved apt to pursue those effects in the past. Thanks to the association between motor acts and perceptual effects, it is possible both for the observer to make a forward inference from the observed movement to the intended effect, and for the agent to make a backward inference from the intended effect to the required movement. To be more precise, such a distinction between forward inferences in action observation and backward inferences in action execution is a rough simplification. It is easy to see that both inferential directions can be found both in execution and observation.

I will limit the discussion to the observer's side. It is well known that Rizzolatti's group, and especially Vittorio Gallese, has explained intention reading in terms of a form of anticipation. At least in the simplest cases, the goal of an action would be the motor act in which the action culminates. In practice, on the basis of statistical chaining of motor acts we can make a forward inference to the likely intended goal of a given motor act, and thus to the underlying intention:

> Determining why a given act (e.g. grasping a cup) was executed can be equivalent to detecting the goal of the still not executed and impending subsequent act (e.g. bringing the cup to the mouth). (Gallese 2007, 662)

However, other studies conducted by this group seem to show that forward inferences are not the only means for perceptual recognition of intentions. In a well-known experimental study, for instance, Iacoboni et al. (2005) tested observers with actions (such as grasping a cup) both out of context and in contexts suggesting different intentions (drinking tea, cleaning up). In the latter condition (presence of context) there was increased activation of premotor mirror neuron area, a result strongly suggesting – in the author's words – that "this mirror neuron area actively participates in understanding the intentions behind the observed actions" (Iacoboni et al. 2005, 532). Since in those experiments the manipulated factor was the presence/absence of a context, it follows that, in order to recognize the underlying intention of an observed motor act, mirror areas may be sensitive not only to previous motor acts but also to statistically relevant contexts (Mazzone 2011a, 771-72; for a further discussion of the associative components of mind-reading, see also Mazzone 2014b). In other words, context is a relevant factor in intention understanding: it suggests the underlying intention (in the example, respectively the intention either to drink tea or to clean up) independently from the observed action. We should note the similarity between this conclusion and the view of Relevance Theory according to which communicative intentions can be suggested directly from the context, independently from the possibility to infer this intention forwards starting from explicit content.

In sum, goals can not only be inferred from actions used to pursue them (i.e., from means), but also from contexts. But then, it is at least a reasonable speculation that goal recognition can retroact on the understanding of the involved means. As we said, according to relevance theorists contextual expectations on communicative intentions may cause backward adjustments in the comprehension of the explicit content of utterances. It is not difficult to imagine analogue situations in non-verbal action. For instance, in Iacoboni et al.'s setting the context "after tea" could suggest

the goal “clean up” and a backward inference from this goal could modify the interpretation of the action acting as a means, in case this had been erroneously interpreted as a “drinking” grip.

To sum up, a similar dynamic, based on a double inferential movement going both forwards and backwards, might be involved in the comprehension of both utterances and non-verbal actions. Obviously, this is far from showing that pragmatic processes have a non-modular nature. Elsewhere I have analysed in more detail the nature of pragmatic inferences, arguing that they have in fact a non-modular nature (Mazzone 2011b; 2014a; in preparation). My more modest purpose in this paper was to focus on the bidirectional dynamic of the inferences that seem to be involved both in action and language processing.

4. Conclusions

In this paper, I explored the hypothesis of a unique domain-general process underlying both language and action, a process which can be described as i) intentional, in the sense of being implemented by an automatic flow of processing which is partially and dynamically granted stability thanks to the interaction with conscious attention; ii) generative, due to the hierarchical structure of the involved representations; iii) characterized by bidirectional inferences, in that the connection between represented means and goals can be used both to predict goals from means and to retrodict means from goals.

To be sure, each of these aspects would have required wider justifications than I have provided in this paper and some of them can be found in my previous papers I have made reference to. However, the main purpose of the present paper was not to argue in detail for any specific thesis. It was instead to show the coherence between seemingly disparate lines of research, that is, the interesting convergence of different arguments and sources of evidence towards the idea that language is just a specific kind of action.

References

Baldwin D. A., Baird J. A. (2001), *Discerning intentions in dynamic human action*, in «Trends in Cognitive Sciences», 5, 171-178.

Bargh J. A. (1989), *Conditional automaticity: Varieties of automatic influence on social perception and cognition*, in J. Uleman, J. Bargh (eds.), *Unintended thought*, New York, Guilford Press 1989, 3-51.

Bargh J. A. (1990), *Auto-motives: Preconscious determinants of social interaction,* in E. T. Higgins, R. M. Sorrentino (eds.), *Handbook of motivation and cognition Vol. 2*, New York, Guilford Press 1990, 93-130.

Bargh J. A., Gollwitzer P. M., Lee-Chai A., Barndollar K., Troetschel R. (2001), *The automated will: Nonconscious activation and pursuit of behavioral goals*, in «Journal of Personality and Social Psychology», 81, 1014-1027.

Bauer P. (1995), *Recalling past events: from infancy to early childhood*, in «Annals of Child Development», 11, 25-71.

Botvinick M. (2008), *Hierarchical models of behavior and prefrontal function*, in «Trends in Cognitive Sciences», 12, 201-208.

Campisi E., Mazzone M. (submitted), *Do people intend to gesture? A review of the role of intentionality in gesture production and comprehension*.

Clerget E., Winderickx A., Fadiga L. et al. (2009), *Role of Broca's area in encoding sequential human actions: a virtual lesion study*, in «NeuroReport», 20, 1496-1499.

Dijksterhuis A., Chartrand T. L., Aarts H. (2007), *Effects of priming and perception on social behavior and goal pursuit*, in J. A. Bargh (ed.), *Social psychology and the unconscious: The automaticity of higher mental processes*, Philadelphia, Psychology Press 2007, 51-132.

Fadiga L., Craighero L., D'Ausilio A. (2009), *Broca's area in language, action, and music*, in «Annals of the New York Academy of Sciences», 1169, 448-458.

Fazio P., Cantagallo A., Craighero L. et al. (2009), *Encoding of human action in Broca's area*, in «Brain», 132, 1980-1988.

Ferguson M. J., Hassin R. R., Bargh J. A. (2007), *Implicit motivation*, in J. Shah, W. Wood (eds.), *Handbook of motivation*, New York, Guilford Press 2007, 150-168.

Fuster J. (2001), *The prefrontal cortex-An update: time is of the essence*, in «Neuron», 2, 319-333.

Gallese V. (2007), *Before and below 'theory of mind': Embodied simulation and the neural correlates of social cognition*, in «Philosophical Transactions of the Royal Society B: Biological Sciences», 362, 659-669.

Glenberg A. M., Gallese V. (2012), *Action-based language: A theory of language acquisition, comprehension, and production*, in «Cortex», 48, 905-922.

Grafton S., Hamilton A. (2007), *Evidence for a distributed hierarchy of action representation in the brain*, in «Human Movement Science», 26, 590-616.

Hassin R. R., Aarts H., Eitam B., Custers R., Kleiman T. (2009), *Non-conscious goal pursuit and the effortful control of behavior*, in E. Morsella, J. A. Bargh, P. Gollwitzer (eds.), *Oxford handbook of human action*, New York, Oxford University Press 2009, 549-566.

Higuchi S., Chaminade T., Imamizu H. et al. (2007), *Shared neural correlates for language and tool use in Broca's area*, in «NeuroReport», 20, 1376-1381.

Hommel B. (2003), *Planning and representing intentional action*, in «The Scientific World», 3, 593–608.

Hommel B., Müsseler J., Aschersleben G., Prinz W. (2001), *The theory of event coding (TEC): A framework for perception and action planning*, in «Behavioral and Brain Sciences», 24, 849-878.

Huang J. Y., Bargh J. A. (in press), *The Selfish Goal: Autonomously operating motivational structures as the proximate cause of human judgment and behavior*, in «Behavioral and Brain Sciences».

Iacoboni M., Molnar-Szakacs I., Gallese V., Buccino G., Mazziotta J. C., Rizzolatti G. (2005), *Grasping the Intentions of Others with One's Own Mirror Neuron System*, in «PLoS

Biology», 3 (3), 529–535.

Jackendoff R. (2007a), *A parallel architecture perspective on language processing*, in «Brain Research», 1146, 2-22.

Jackendoff R. (2007b), *Language, Consciousness, Culture: Essays on Mental Structure*, Cambridge MA, MIT Press.

Jeannerod M. (2006), *Consciousness of action as an embodied consciousness*, in S. Pockett, W. P. Banks, S. Gallagher (eds.), *Does consciousness cause behavior?*, Cambridge MA, MIT Press 2006, 25-38.

Koechlin E., Jubault T. (2006), *Broca's area and the hierarchical organization of human behavior*, in «Neuron», 50, 963-974.

Libet B. (1992), *The neural time-factor in perception, volition and free will*, in «Revue de metaphysique et de morale», 97, 255-271.

Levelt W. J. M. (1989), *Speaking: From intention to articulation*, Cambridge MA, MIT Press.

Mazzone M. (2011a), *Intentions as complex entities*, in «Review of Philosophy and Psychology», 2, 767-83.

Mazzone M. (2011b), *Schemata and associative processes in pragmatics*, in «Journal of Pragmatics», 43, 2148-2159.

Mazzone M. (2013), *Automatic and controlled processes in pragmatics*, in A. Capone, F. Lo Piparo, M. Carapezza (eds.), *Perspectives on Linguistic Pragmatics*, New York, Springer 2013, 443-467.

Mazzone M. (2014a), *A Generative System for Intentional Action?*, in «Topoi», 33, 77-85.

Mazzone M. (2014b), *Mental states as generalizations from experience: a neuro-computational hypothesis*, in «Philosophical Explorations», 17(2), 223-240.

Mazzone M. (in press), *Crossing the associative/inferential divide: ad hoc concepts and the inferential power of schemata*, in «Review of Philosophy and Psychology».

Mazzone M. (in preparation), *Beyond modularity in pragmatics. The role of associative processes and conscious attention in comprehension*.

Mazzone M., Campisi E. (2013), *Distributed intentionality: A model of intentional behavior in humans*, in «Philosophical Psychology», 26, 267-290.

Pastra K., Aloimonos Y. (2012), *The minimalist grammar of action*, in «Philosophical Transations of the Royal Society B», 367, 103-117.

Roby-Brami A., Hermsdorfer J., Roy A. et al. (2012), *A neuropsychological perspective on the link between language and praxis in modern humans*, in «Philosophical Transations of the Royal Society B», 367, 144-160.

Schank R.C., Abelson R. (1977), *Scripts, Plans, Goals, and Understanding*, Hillsdale NJ, Earlbaum Associated.

Sperber D., Wilson D. (1986/1995), *Relevance: Communication and Cognition*, Oxford, Blackwell.

Sperber D., Wilson D. (2002), *Pragmatics, modularity and mind-reading*, in «Mind and Language» 17, 3-23.

Tettamanti M., Weniger D. (2006), *Broca's area: a supramodal hierarchical processor?*, in «Cortex» 42, 491-494.

Whiten A., Flynn E., Brown K. et al. (2006), *Imitation of hierarchical action structure by young children*, in «Developmental Science», 9, 574-582.

Wilson D., Sperber D. (2004), *Relevance theory*, in L. Horn, G. Ward (eds.), *Handbook of Pragmatics*, Oxford, Blackwell 2004, 607-632.