Processing Narrative Coherence: Towards a Top-Down Model of Discourse

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Abstract

Models of discourse and narration elaborated within the classical compositional framework have been characterized as bottom-up models, according to which discourse analysis proceeds incrementally, from phrase and sentence local meaning to discourse global meaning. In this paper we will argue against these models. Assuming as a case study the issue of discourse coherence, we suggest that the assessment of coherence is a top-down process, in which the construction of a situational interpretation at the global meaning level guides local meaning analysis. In support of our hypothesis, we explore the role of executive functions (brain functions involved in planning and organization of goal-oriented behaviors) in coherence's establishment, discussing the results of several studies on narrative abilities of patients with brain injuries. We suggest that, compared to other models of discourse processing focused on comprehension, our model is a viable candidate for an integrated account of discourse comprehension and production.

1998 ACM Subject Classification I.2.7 Natural Language Processing

Keywords and phrases discourse processing, coherence, executive functions

Digital Object Identifier 10.4230/OASIcs.CMN.2013.61

1 Introduction

In spite of the criticisms to generative grammar in recent years, Chomsky's concept of language continues to be the standard model in cognitive science. At the base of this model are the assumptions that the structure of the internal constituents of the sentence represents the core of language and that, consequently, the general device at the basis of language is a module specialized in the analysis of the syntactic structure of the sentence. But what does this model tell us about human narrative abilities? Even if Chomsky does not address the issue explicitly, scholars who are inspired by universal grammar and who are interested in the study of narrative processing maintain that the building of the coherent flow of discourse (the basis of any narrative abilities) must be interpreted in terms of syntactic parser functioning. In their view, in fact, the principles that govern the sequence of sentences in the construction of the discourse are specified in some constituents of the sentence's structure. According

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Workshop on Computational Models of Narrative 2013.
Editors: Mark A. Finlayson, Bernhard Fisseni, Benedikt Löwe, and Jan Christoph Meister; pp. 61–75
OpenAccess Series in Informatics
OASICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

to this perspective, information processing that underlies narrative abilities has a strong "bottom-up" character: the global level of discourse is gained starting from the analysis of the single sentences actually said, through a sequential process of accumulation of information (e.g., [36]).

In this paper we propose an alternative model of language and narrative abilities. Against the Chomskian idea of the primacy of the sentence, we propose that the ability to process discourse takes priority over the ability to process sentences. Such a proposal, which we characterize as a "top-down" hypothesis, implies the adhesion to two aspects particularly relevant to the analysis of narrative abilities. First, sentence comprehension is driven by a prior comprehension of the coherence of the flow of discourse: the understanding of the narrative flow has logical and temporal priority on the comprehension of sentences. Second, discourse comprehension implies the involvement of cognitive devices other than those implicated in the analysis of the constituents structures of sentences. Contrary to the devices specialized in the analysis of the syntactic structure, indeed, the processing systems involved in the analysis of discourse have a specific character of projection. While the bottom-up model is firmly anchored to the processing of what the speaker effectively says in a given moment, the top-down model we are proposing is largely fueled by information on what she has already said (projections into the past) and on what she is going to say (projections into the future). What kind of devices can analyze this kind of information?

From a general point of view, our idea is that the projection devices responsible for the construction of discourse are similar to those involved in the processes of navigation. The relationship between narrative abilities and spatial navigation is a good metaphor empirically grounded. Experimental data corroborate, indeed, the idea that the devices involved in the analysis of discourse (ones that allow us to "keep the route" to reach the goal we have in mind) are closely related to systems that allow us to navigate through space and time [14, 18, 19, 20]. In this paper we will analyze only a limited aspect of the relationship between narrative abilities and navigation: the role played by a specific device of projection (the executive functions of action planning) in the building of the "global coherence" of discourse. In general, the projection devices can ensure a strong attachment of the expressions uttered in the flow of speech to the context. For this reason, the model of the navigation can explain the link between linguistic expressions and the extralinguistic context [14, 18, 20]. In this paper we focus the attention on the theme of global coherence. This theme leads us to consider the link between sentences in the intralinguistic context. The hypothesis that underlies our work is that human narrative abilities cannot be explained only in terms of local coherence (cohesion). In spite of the key role assigned to the syntactic constituents by the standard model, indeed, some properties of discourse may be explained only by referring to the global coherence. As we'll see, in this regard a key role is played by executive functions.

This paper is divided into three parts: in the first (pars destruens) we discuss the nature and limits of the bottom-up model of language and discourse according to which the phrase has a logic and temporal priority on the discourse. In the second part (pars construens) we present a top-down model of language and narrative abilities in which the discourse has a logical and temporal priority on the sentence. In the third part, referring to the literature on narrative pathologies, we present empirical evidence for our model, analyzing the processing systems that regulate the coherence of the flow of discourse. We have to specify that, although discourse and narrative are two phenomena not completely equivalent, in this paper we discuss them together as we examine coherence that is a fundamental property that is common to both.

2 The primacy of the sentence and the bottom-up model of discourse

The idea of language that emerges from the perspective of classical modularity is reflected in the dedication that Fodor [23] addressed to Garrett:

> One day—it must have been five years or so ago—my friend, colleague, and sometime coauthor Merrill Garrett made what seems to me to be the deepest remark that I have yet heard about the psychological mechanisms that mediate the perception of language. "What you have to remember about parsing," Merrill said, "is that basically it's a reflex." This work is, in effect, a sustained meditation on Merrill's insight, and it is gratefully dedicated to him.

This idea that language is a reflex, actually means it is a way of treating language as a module. The similarity between modules ("stupid" systems that operate in an automatic and mandatory way) and reflexes depends on an evolutionarily significant reason: the processing speed [53, 46]. The stupidity of the modules is an adaptive strategy through which the cognitive system can process large amounts of information quickly. The amount of information that language can transmit is amazing. Without a fast processing system, human communication probably would be doomed to failure. But the speed comes at a cost. The devices specialized for the rapid processing of language must have an automatic and mandatory character; they have to be able to focus exclusively on certain aspects of the stimulus. Devices of this kind must have, in other words, specific bottom-up properties. The reference to bottom-up devices has important consequences for the understanding of the nature of human communication.

In the standard version of cognitive science, communication is interpreted in terms of the code model [48], a model that Fodor [22, p. 106] considers "not just natural but inevitable". According to this model, "we have communicated when you have told me what you have in mind and I have understood what you have told me" [22, p. 109]. The fact that verbal communication relates to the sharing of thoughts between speaker and listener raises a number of interesting questions. The most important one for our current purposes concerns what makes possible the transformation of thought into language. How is it possible that a mental state (the nature of which is abstract and conceptual) can be coded in a physical structure (a succession of sounds, in the case of verbal language) and, through this step, can be communicated to the receiver? How is it possible, in other words, that the structure of sounds is able to respect the structure of mental states?

The move taken by the proponents of the standard model to answer this problem is to question the structural isomorphism between language and thought. The argument of Fodor [22, 24] is clear: language can express thought because it reflects the basic structure of thought, the "logical form." The point is particularly relevant for our purposes. The primacy assigned to the phrase by the advocates of standard conception depends heavily on the propositional nature of thoughts. The thesis of the isomorphism between the constituents structure of thoughts and the syntactic structure of sentences that express them has a direct impact on the understanding of human communication. According to Fodor (as well as Chomsky and all the authors who adopt the standard model), the analysis of language is entirely governed by a device specifically used in the processing of the logical form (syntax, basically) of the utterances. From such a perspective, contextual information it is not only irrelevant but also harmful: everything needed to understand what the speaker said is encoded in the utterance.

The thesis of the isomorphism between language and thought fits perfectly with the idea that the processing devices have a bottom-up character. At the base of this character is the

mechanistic nature of the language module that is considered a self-sufficient processing system. Each time the linguistic device detects the appropriate stimulus in the environment (utterances that exhibit a logical form), the comprehension follows as a automatic and mandatory consequence of the processing of the stimulus. This mechanistic idea of comprehension is highlighted by Fodor, who argues that "one cannot avoid hearing a phrase that has been said (in a known language) as a phrase that has been said" [23, p. 91]. In this paper, we do not care to discuss this issue. What interests us here is to note that, in the standard version, the analysis of the logical form of the sentences is a necessary and sufficient condition for the comprehension of the content expressed by those sentences and that such analysis implies a specific processing device wired on the syntactic properties of the sentences.

Bottom-up models in cognitive science have always been considered, because of the emphasis on the mechanical and material aspects of the information processes, the trump card in the debate on the naturalization of the mind [23][1]. In spite of these considerations, our idea is that the bottom-up models based on the primacy of the phrase are founded on a highly abstract concept of language. Indeed, the processing device, focalized on the syntactic aspects of the phrases, has to operate independently from any background noise: so to speak, it must analyze the shape of the proposition in its "purity." The models that explain human narrative capabilities using the theoretical paradigm of the primacy of the phrase have enormous explanatory difficulties, as we shall see in the next section. These difficulties will lead us to change the interpretative model.

3 Processing coherence: how local and global processes are intertwined

According to standard compositional theories, sentences encode meaning by the means of a context-free rule-based combination of lexical–semantic features of the words within a sentence. This step of the comprehension process is considered necessary, and it corresponds to the level of sentences' truth conditions. Such a thesis is a "literal meaning thesis" and is the basis of all traditional semantic theories. According to the literalist thesis, the contribution of world knowledge to the truth conditions is limited to cases of indexicality and ambiguity; this means that the role of the context of utterance should be traceable to syntactic elements in the logical form of sentences. Currently, many scholars interested in language functioning recognize that processes of the type just described are not enough to account fully for language comprehension and production. They seem to agree that, at a certain point, context is taken into account. The disagreement is about when, exactly, this happens.

Here it might be useful to draw a distinction between a two-step model of linguistic comprehension and a one-step model. Classical theories of meaning are two-step models, according to which contextual information is considered only after establishing phrase or sentence local meaning. On the basis of a one-step model, contextual information may be used in a more top-down fashion, such that the local contribution of individual words or sentences is a function of the construction of a situational interpretation at the global meaning level. In this article we argue against two-step interpretations of language comprehension,

[1] It must be said that there have been multiple attempts to devise Chomsky-style narrative grammars (e.g., [39, 38]) and that these operate top-down. Nevertheless, although they represent a step forward compared with Chomskian perspective, our idea is that such attempts are ineffective to account for the global coherence of the discourse since it is a pragmatic property that cannot be explained in terms of universal grammar.

and we propose a one-step model according to which the wider discourse context has an immediate effect on the unfolding linguistic information.

From this perspective, our criticism extends also to some models of discourse elaborated in the field of discourse analysis. Even if from the 1980s onward the explicit goal of people working in that field has been going beyond the sentence, our specific charge here is that models of discourse elaborated within the classical compositional framework (e.g., [36]) are still characterized by the idea that sentence analysis has priority over discourse analysis. The model proposed by Kintsch and van Dijk [36], for example, is a bottom-up model, which is centered on the role of mental propositions expressed by predicate-argument structure. According to this model, the structure of a text or a discourse ("macrostructure") can be formally derived from the structure of the relations between sentences (which form the "microstructure") by the means of the application of some general rules. This model, then, fits into a two-step perspective of the interpretation process as discourse meaning is inferred only once sentences' analysis is completed. Such a model has been very popular among linguists during the last thirty years, and it still represents the dominant view on discourse processes. In spite of this, we argue that this model, as well as other two-step models, can be seriously undermined by challenging two key psycholinguistic assumptions that lie behind it.

First, the model assumes the incremental nature of the interpretative process, which means that the processing of coherence is based on a word-by-word analysis and integration. This is the very essence of two-step models because incrementality is consistent with the idea that local meanings are built up from the meanings of individual words, which in turn is consistent with compositionality principle. Second, the orthodox view of language comprehension is that the processes involved are fully completed, namely, that semantic information for each word is fully retrieved during the incremental process. For example, Just and Carpenter [35] state: "readers interpret a word while they are fixating it, and they continue to fixate it until they have processed it as far as they can" (p. 30).

From these two assumptions follows the classical compositional view that local coherence is established prior to global coherence and that a thorough check at the local level is part of the normal process of coherence establishment. In the current paper, these two assumptions are called into question, presenting arguments in favor of alternative claims that (1) discourse processing is driven by global processes oriented to topic maintenance as opposed to the maintenance between utterances, (2) the extent to which an item is analyzed at a local semantic level is a function of the general fit of that item to the discourse context. The higher the global fit of the item, the lower the accuracy of the semantic processing of that item is. In order to test these hypotheses, we focus on anomaly detection. In particular, the case study is the *survivor effect* observed in the way certain discourses are interpreted naturally by human subject, and described below.

4 Towards a top-down model of discourse

The idea that discourse processing is based on the construction of a coherent mental representation of what is in the discourse is a widely accepted view. In particular, the aim of comprehension and production processes is the construction of an integrated representation that reaches a "coherence threshold." The question is how that threshold is reached. As mentioned, according to the standard compositional view, discourse processing proceeds in a bottom-up fashion, constructing a complete representation based on a thorough check of each sentence. From this perspective local meaning is established prior to global meaning [36, 44].

Accordingly, McKoon and Ratcliff [43] have proposed the minimalist hypothesis that claims people only try to establish global coherence when there is a break in meaning at the local level. Alternatively, discourse-level information may be used in a more top-down fashion, such that the local contribution of individual words or sentences is a function of the construction of situational interpretation at the global meaning level. In this latter view, partial or incomplete semantic analysis at the sentence level would often be sufficient to fulfill the comprehender's coherence need. Looking for discourse coherence, listeners would activate global instead of local processes, namely processes that are oriented to the maintenance of global coherence (topic maintenance), as opposed to local coherence (maintenance between utterances). A number of studies have provided evidence supporting this latter view.

For the purposes of this paper, studies concerning a well-documented effect during language processing, the "survivor effect," are particularly relevant. In the following example, subjects were asked to write solutions to a version of the subsequent problem (adapted from [6]:

> A tourist flight crashes in the Pyrenees, and wreckage is strewn equally in France and Spain. Where should the survivors be buried?

Results show that only 66% of the subjects noted that survivors are not the sorts of things that should be buried. Even more striking, when the term "survivors" was replaced by the phrase "surviving dead," only 23% of the subjects noted any anomaly. The extremely low detection rate suggests that local semantics of the phrase "surviving dead" is not computed prior to its incorporation into the more global representation of the text. If it were, the anomaly should be noted at that initial stage. It would seem that subjects understand the story by developing a global, situational interpretation of the discourse. To the extent that the coherence at the global level can be maintained (for example, "dead" is consistent with the global plane-crash situation), local problems are ignored and perhaps not even computed.

To support this conclusion further, it should be noted that if the critical expression ("surviving dead") is embedded within an incongruent context, for example a "bicycle accident," then subjects' reaction to the anomalous phrase is completely different. This time they will more easily notice the anomaly, and changing the scenario can manipulate the relevance of critical phrases. This is extremely significant as it shows that the extent of semantic analysis the critical item receives is a function of the general fit of the item to expectations based on context. If the global fit of phrases in the context is high, then more detailed, effortful, time-consuming analysis may not take place. In contrast to strict bottom-up, incremental interpretation, these findings are consistent with the idea that coherence's establishment is a top-down process guided by listener's expectations. Once the system has a satisfactory level of information supporting coherence, further analysis might not take place. That said, the question we need to address now is how exactly the process of coherence's evaluation works at cognitive architectural level. Which are the principles and the actual cognitive components that guide the top-down assessment of coherence?

We mentioned that cognitive processes of projection in space and time (i.e., navigational abilities) may have a crucial role in the processing of coherence. In the current paper we will not go into detail about the general navigational framework of communication (for an extended presentation of the model (see [14, 21, 20]). Here we will rather focus on a very specific aspect of navigational abilities, i.e., the contribution of executive functions. Before turning to this, we should note that our approach fits into a cognitive pragmatic conceptual framework and thus shares some general aspects of other pragmatic accounts of language, in particular Relevance Theory (RT;[50]. However, as we discuss elsewhere [14], several

characteristics distinguish our model from RT's model. For our current purposes, it will be sufficient to contrast a "theory of mind" account of pragmatics with a "navigation" framework on the basis of two related claims. First, we claim that a navigational model provides a richer notion of context compared to RT's model. According to a navigational model, the interpretative process is guided not only by the attribution of mental states to interlocutors, but also by the exploration of spatial and temporal perspectives that, even if activated by the current circumstances, represent alterative states of the actual situation. In this view, context is defined by the concurrent functions of grounding and projection [21], which allows the individual to take into account the extra-linguistic world by projecting himself toward spatial and temporal alternative scenarios.

The second relevant aspect concerns more closely the very notion of coherence. We would like to point out that most of the models of discourse processing discussed so far emphasize the comprehension side of the interpretative process. Classical compositional models are focused on mental processes of understanding what an interlocutor or a text expresses, providing a bottom-up analysis of such a process. However, RT's model acknowledges the role of top-down processes, but it also seems to be limited to the analysis of linguistic comprehension. Indeed, the notion of relevance, which is the key notion of RT's model, is much more concerned with comprehension than production. In the last part of this paper we will argue that this aspect may be considered a "side effect" of RT's model and that a more powerful unifying model, in which comprehension and production are placed side by side, can be reached by elaborating on the notion of coherence. As we will see, the one-step model we are proposing, according to which coherence is processed in a top-down fashion and guided by the role of executive functions, presents itself as a viable candidate for a unifying model of discourse processing.

5 It is not only a matter of relevance: coherence intuitions

Our idea is that, in order to propose a unified model of discourse processing, it is necessary to analyze not only the processes of interpretation, but also the processes of production. We discuss this idea through the analysis of the cognitive devices involved in the establishment of coherence. To clarify the issue, we begin by highlighting once again the aspects that distinguish our model of pragmatics from that of RT's.

According to the model proposed by Sperber and Wilson, verbal communication's burden falls mainly on the listener, who engages to reconstruct, through inferential chains, the speaker's intention. In fact, the main reason why RT's is primarily a model of comprehension lies in the adoption of Grice's assumption according to which, in the communication processes, the starting point is the intention of the speaker [30]. From this point of view, the speaker's intention is a phenomenon already given and each verbal cue introduced by the speaker it is necessary for the listener in order to reconstruct that intention. Now, while Grice [31] through the formulation of conversational maxims, tried to give an account of the processes involved in language production, in RT's model an explanation of this kind lacks.

Sperber and Wilson [49] argue that the main purpose of RT's model, and more generally of pragmatics, is to clarify the nature of the processes and the skills that allow the listener to reconstruct inferentially the intention of the speaker on the basis of the sentence's meaning. In fact, they characterize pragmatics as inferential comprehension oriented to relevance detection. As Wilson [55] points out, "the main aim of relevance theory in the domain of verbal communication is to explain how utterances are understood" (p. 58). At a general level, the inferential comprehension is made possible by a specific cognitive system, the theory

of mind (ToM) module, that underlies the ability to attribute mental states such as beliefs, intentions, and feelings to others and to explain and to predict the actions that derive from them (e.g., [5, 37]). What is important to note is that relevance theorists see pragmatics as a specific component, a relevance-based comprehension module, of the ToM module with its own proprietary concepts and procedures distinct from general ToM module [11, 49]. This means that the relevance principle characterizes, from a pragmatic point of view, the essence of pragmatics.

RT's model (heavily focused on the aspects of language comprehension and on principle of relevance) evidently represents an overly limited view of pragmatics and, consequently, a limited view of human communication [1]. Relevance, indeed, is not the only principle that governs communication. As highlighted, for example by Giora [27, 28], "speakers and hearers are not constrained only by the search for relevance. In addition, coherence considerations constrain communication and play a major role in discourse structuring and understanding" [27, p. 31]. To see how this is possible, one must analyze some verbal expressions and discuss them in reference to the notions of RT's model. Though such an analysis may appear extremely technical, it is important for the purposes of our argument to show that 1) relevance is not the only property of communication and 2) discourse coherence has a key role in pragmatic processes.

According to Sperber and Wilson [50, 56] an input (e.g., an utterance or a memory) is relevant to an individual when it connects with background information she has available to yield conclusions that matter to her. More in detail, an input is relevant to an individual when its processing in a context of available assumptions yields a positive cognitive effect, that is to say, a worthwhile difference to the individual's representation of the world (e.g., a true conclusion). The most important type of cognitive effect achieved by processing an input in a context is a contextual implication, a conclusion deducible from the input and the context together. Besides the cognitive effect, relevance of an input relies also on processing effort. Other things being equal, the greater the processing effort, the lower the relevance of an input to an individual in a given time. Thus, the relevance of an input for an individual at a given time is a positive function of the cognitive benefits that he would gain from processing it and a negative function of the processing effort needed to achieve these benefits. Giora points out that there are cases where the verbal productions are inappropriate from a pragmatic point of view because they lack coherence, but they are relevant (in Sperber and Wilson's terms) to an individual. To illustrate the point, Giora starts from a central notion of RT's: the choice or selection of the context. Sperber and Wilson argue that in communication the context is not given beforehand, but is open to choices and revisions during the process of comprehension. There are several ways through which it is possible choose or expand a context. For example, the listener, in order to understand a specific statement uttered during a conversation, can include in the context the interpretation of preceding utterances and/or the interpretation of her responses during the course of the dialogue. The relevant point is that, according to Sperber and Wilson, relevance determines the selection of the context; the set of assumptions that allows to get the best balance between processing effort and cognitive effect is chosen as the appropriate context.

According to Giora [27] an idea of this type is problematic because it may lead to situations in which the information may be relevant (in Sperber and Wilson's terms), although pragmatically inappropriate because it lacks coherence. To clarify the point, Giora discusses an example proposed by Sperber and Wilson [50, p. 125]. Consider the context composed by a), b) c) and the utterances 1), 2), 3), 4) and 5) below:

- a) People who are getting married should consult a doctor about possible hereditary risks to their children.
- b) Two people with thalassemia should be warned against having children.
- c) Susan has thalassemia.

1. Susan, who has thalassemia, is getting married to Bill.
2. Bill, who has thalassemia, is getting married to Susan.
3. Bill, who has thalassemia, is getting married to Susan, and 1976 was a great year for French wines.
4. Susan and Bill should consult a doctor about possible hereditary risks to their children.
5. Susan and Bill should be warned against having children.

The point is to establish what utterance is the most relevant, that is to say, what has the greater cognitive effect at the minimum processing effort. Sperber and Wilson state that (1) and (2) are equally difficult to process because they are similar in length and require the same context (a-c). However, (2) has greater cognitive effects (contextual implications) than (1), while (1) has only one contextual implication. For example (4), (2) has an additional contextual implications (5). So, Sperber and Wilson state that (2) is more relevant that (1).

Giora [27]; ([28], however, on the basis of the assumption that contexts are searched for, states that the context needed to render (1) relevant is smaller than that needed to render (2) relevant. In fact, in order to render (1) relevant, only two assumptions (a, c) should be activated. Instead, to process (2), it is necessary to add (b) to the context. So, (2) is not really more relevant than (1); (2) has more cognitive effects than (1), but it also needs more effort processing, necessitating the expansion of the context.

The same procedure (of extending the context) may apply to render a discourse such as (3) relevant, albeit inappropriate. Sperber and Wilson affirm that (2) is more relevant than (3); they have the same amount of contextual implications, but (3) requires more effort because the extra information in (3) is completely unrelated to the given context and, consequently, has no contextual effect. However, since contexts are searched for, it is possible to extend the context so as to render (3) relevant. For example, the speaker and hearer of (3) should have heard that a neighbor bought them a 1976 bottle of French wine. In the initial context (a, b, c) now there is a new assumption:

- d) Our neighbor bought us a 1976 bottle of French wine.

This extended context (a, b, c, d) renders (3) as equally relevant to the context as (2) is. While (3) requires more processing effort than (2), it also has more contextual effects. Thus, the utterance (3) "Bill, who has thalassemia, is getting married to Susan, and 1976 was a great year for French wines" is the more relevant in the context (a, b, c, d).

However, Giora outlines that, in spite of its relevance, (3) is an incoherent text that the people evaluate as inappropriate: the hearer must be left puzzled as to how the two propositions in (3) are related to each other (rather than to a context). Then, because (3) is more relevant than (2), the information that listener evaluates as the most relevant is (2) (even after the extension of the context). Why? Giora's hypothesis is that such a evaluation depends on the fact that the speaker and the listener are driven in communication processes not only by intuitions of relevance, but also by intuitions of narrative coherence. If relevance's detection were the only basic principle of human communication, in fact, the hearer (given the expanded context) should automatically consider (3) as the most pertinent information. But, although relevant, (3) is pragmatically inappropriate. Now, important for the scope of our argument is that the inappropriateness of (3) depends on the fact that

it violates the listener's intuitive expectations of coherence. Thus, the hearer's reluctance to consider (3) more relevant than (2) is because (3) is incoherent. The existence of such reluctance shows that relevance is not the only principle that regulates the communicative exchanges. An important role in this regard it also played by the principle of narrative coherence. Now, although the examples just described are related to the intuitions of the listener (i.e., to the interpretive processes) as previously mentioned, our idea is that in order to give an account of the cognitive devices involved in the processing of discourse it must analyze the processes of both comprehension and production. In the next section we will see how the reference to executive functions as the processing systems of coherence allows us to present a unifying one-step model of discourse processing that takes into account both interpretative and productive processes.

6 The key role of executive functions in the building of narrative coherence

As we have seen, coherence refers to conceptual organizational aspects of narration at the suprasentential level. Thus, the coherence of a narrative discourse depends, at least in part, on the speaker's ability to maintain thematic unity [2]. When is a discourse coherent? A dominant idea, especially among linguists, is that the coherence of a narration depends on the linear relations between adjacent sentences, that is to say on cohesion between pairs of consecutive sentence (e.g., [7, 10, 32, 52]). For example, consider the following text:

> After the forming of the sun and the solar system, our star began its long existence as a so-called dwarf star. In the dwarf phase of its life, the energy that the sun gives off is generated in its core through the fusion of hydrogen into helium [8, p. 2].

In this text the sentences are connected through lexical cohesion; the lexical cohesive relations hold among the lexical items sun, solar system, star, dwarf star and dwarf phase in the text. Now, although the cohesive relations (the local meaning) have an important role in the expression and recognition of coherence relations, the cohesion between consecutive sentences seems an unnecessary and insufficient condition for the narrative coherence (see also [26]). With reference to this a crucial distinction is that between global and local coherence. Global coherence is the manner in which discourse is organized with respect to an overall goal, plan, theme, or topic; it refers to the relationship between the content of a verbalization with that of the general topic of narration. Local coherence concerns the conceptual links between individual sentences or propositions that maintain meaning in a text or discourse [29]. Now, while the local coherence is made possible by cohesion relationships, the same is not true for global coherence. Consider for example the following text:

> I bought a Ford. The car in which President Wilson rode down the Champs Élysées was black. Black English has been widely discussed. The discussions between the presidents ended last week. A week has seven days. Every day I feed my cat. Cats have four legs. The cat is on the mat. Mat has three letters. [16, pp. 110–111].

In this text the sentences are connected through the cohesive mechanism of repetition. However, the set of sentences, despite the abundance of cohesive ties, is not perceived as a coherent whole. In this text the sentences do not hang together in a reasonable way; the text lacks of global coherence. So we can argue that global coherence of a narration is independent from cohesion, that is to say, the macrostructure of a narrative discourse cannot be formally derived by the microstructure of the sentence.

The idea that global coherence of a narration is independent from cohesion has received much evidence in recently from neurolinguistics research (e.g., [15, 40, 42]). These studies have highlighted the dissociation between the abilities that underlie sentence processing (microstructure or microanalysis) and those that underlie narrative processing (macrostructure or macroanalysis). Particularly relevant for our purpose are the data that come from studies of patients with traumatic brain injury (TBI). These subjects generally have impairments of specific prefrontal areas. Such impairments cause deficits of executive functions. Executive functions (EFs) is an umbrella term for a wide range of cognitive and behavioral skills whose main neural substrate is constituted by the prefrontal cortex. EFs have a key role in regulating the equilibrium between the organism and the environment. In fact, they are implicated in the temporal organization of goal-oriented behaviors (e.g., [4, 25, 51, 54]). EFs allow formulating a plan, starting its execution, and maintaining attention (perseveration) on that plane until its realization. Moreover, EFs allow the rapid shift of attention for the adaptation to novel contexts, while they inhibit inappropriate behavioral responses to the current situation.

Although there no precise taxonomy of executive functions (see [3, 34]), it is possible to delineate some aspects of convergence among the neuropsychological models. There is a general agreement that EFs are implied in processes such as planning, working memory, inhibition, and mental flexibility, as well as in the initiation and monitoring of action [12]. Numerous studies have shown that TBI subjects generally have deficits in EFs of action planning and monitoring. Because of such deficits, the behaviors of TBIs appear confused and disordered; they cannot organize and complete goal-oriented behaviors because they are not able to conceptually formulate and execute a sequence of actions [17, 47, 57]. Our hypothesis is that the deficits of planning and monitoring in these patients are the principle causes of their problems in narrative discourse. Our idea, in fact, is that EFs of planning and monitoring play an important role also in building the global coherence of a narrative. As global coherence is the manner in which discourse is organized with respect to an overall goal, plan, theme, or topic [29], the building of narrative coherence should be conceived as a specific case of goal- oriented behavior. From our perspective, it is possible to conceive coherence as the way to achieve the general goal (the general topic) toward the narrative discourse tends. Thus, the establishment of coherence implies a form of goal planning (a conceptual formulation of the general topic) and a form of organization of the single steps necessary to achieve that goal (organization of the single verbal expressions tied to the general topic). Moreover, during the execution of a plan—that is, during the stage of narrative production—it is necessary to continue estimation of the task in order to make sure that the elements introduced are in accordance with the general topic of conversation [19].

Analyses of the narrative production of TBI patients confirm this idea. Many neurolinguistics studies have shown that these patients connect sentences correctly by using cohesion ties (grammatical devices), but they are unable to construct and maintain the global coherence of their verbal productions because they cannot relate the individual sentences to a plan or to a more general purpose, and often introduce material that is irrelevant to the current context in their verbal productions (e.g., [9, 29, 33, 41, 13]). Coherence appears to be controlled by a higher-order conceptual process, whereas lexical cohesion may be driven by more automated linguistic processes that are not disrupted after TBI. As an example of this fact, consider the following narrative produced by a TBI subject:

> I have got faults and. my biggest fault is. I do enjoy sport. it's something that I've always done. I've done it all my life. I've nothing but respect for my mother and father and. my sister. and basically sir. I've only come to this conclusion this last

two months. and. as far as I'm concerned. my sister doesn't exist. [45, p. 305].

In this text the sentences are well formed from a strictly syntactic a point of view; the single local sentences are not problematic. However, taken as a whole, this fragment of speech is pragmatically inappropriate because it lacks global coherence. In fact, it is characterized by sudden and irrelevant changes of topic. What is important to note is that, as Biddle and colleagues [9, p. 463] pointed out, "the narrative impairment of adults and children with TBI [...] appeared to be the result of problems with planning, production and monitoring discourse".

Our idea is that examples of this kind, which show a dissociation of microlinguistic and macrolinguistic cognitive functions, provide support for the distinction between microstructural and macrostructural discourse component. More specifically, confirming the idea that coherence is processed in a top-down fashion, they support a unifying top-down model of discourse processing according to which the global meaning of a narration constraints in a substantial way the local meaning of the sentence.

7 Conclusions

Classical models of language functioning in cognitive science have been characterized by bottom-up models, which are centered on sentences' analyses. In this paper we have argued that the priority given to sentences' analyses undermines classical models' capacity to explain narrative processing because it undermines their capacity to explain a crucial property of narration: coherence. In particular, we have suggested that coherence processing is a top-down process in which the construction of an interpretation at the global meaning level takes priority over local meaning analysis. Analyzing the processing systems that underlie narrative coherence, we have shown that such a property has to be explained by focusing on macro-analysis rather than on microanalysis. Evidence regarding narrative abilities of TBI supports the distinction between microstructural and macrostructural discourse component and suggests that the processing of discourse and the processing of sentence are based on different cognitive devices. Specifically, these data show that discourse processing does not rely on devices involved in the structural analysis of the internal constituents of the sentence. Moreover, they support our hypothesis that coherence is processed in a top-down fashion by cognitive systems oriented to the future (anticipation of the general theme of narration). This general top-down account of coherence processing, according to which discourse global meaning constrains local meaning analysis in a substantial way, provides a unifying framework for discourse comprehension and production processes.

Acknowledgements. This work is the outcome of a collaborative effort. For the specific concerns of the Italian Academy, we specify that for the final draft Erica Cosentino has written sections 3 and 4, Ines Adornetti sections 5 and 6, Francesco Ferretti sections 1 and 2.

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