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Narrative assessment in patients with communicative disorders

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Di recente numerosi studi hanno dimostrato che i tradizionali test per la valutazione dei disturbi linguistici in pazienti con afasia non sono completamente sufficienti a determinarne le reali competenze comunicative e linguistiche. Di conseguenza, tanto nella ricerca quanto nella pratica clinica si stanno affermando nuovi approcci per valutare queste abilità. Tra questi, l'analisi del loro eloquio spontaneo riveste un'importanza cruciale per il suo alto valore ecologico e la possibilità di esaminare contemporaneamente aspetti strutturali e funzionali del linguaggio. Il presente articolo descrive nel dettaglio una delle tecniche di analisi dell'eloquio narrativo che negli ultimi anni si sta affermando sia nella ricerca che nella pratica clinica. Si tratta di una metodologia per la Valutazione Multilivello dell'Eloquio Narrativo prodotto da pazienti con disturbi del linguaggio (cfr. Marini e coll., 2011). Questa metodologia si basa sull'analisi dei livelli di produttività linguistica, di elaborazione lessicale e grammaticale, di organizzazione narrativa e dei livelli di informatività raggiunti dal paziente. Questa metodologia è stata applicata con successo a numerosi tipi di disturbi, tanto in età adulta (ad es. afasie fluenti e non fluenti, traumi cranici, schizofrenia, demenza di Alzheimer) quanto in età evolutiva (ad es. Disturbi Specifici del Linguaggio, Sindromi di Down e di Williams, Disturbi dello Spettro Autistico).

Introduction

Over the past three decades, a growing interest in the way language is processed in daily communicative interactions (e.g. spontaneous language) has challenged the traditional views of linguistic assessment in persons with communicative disorders. Accumulating evidence suggests that an accurate assessment of these impairments cannot be limited to the evaluation of their phonological, lexical and grammatical skills, but must include also ways to analyze their pragmatic, discourse and conversational skills (for two comprehensive reviews on this topic see Armstrong, 2000 and Marini *et al.*, 2011a). In this contribution we will outline the major results from studies assessing also these higher level aspects of language processing in patients with communication disorders and will describe a comprehensive, multi-level procedure for the analysis of narrative discourse produced by neurological patients. As most of these efforts have been originally developed in the field of aphasiology, this contribution will initially focus on structural and functional approaches to the analysis of language impairments in persons with aphasia. We will then 1) outline the

features of a multi-level procedure for language analysis demonstrating its usefulness for the assessment of linguistic symptoms in these patients and 2) extend the discussion about the efficacy of this method also to other pathological conditions (i.e. persons with right hemisphere damage, individuals with traumatic brain injuries who did not develop aphasic symptoms, and persons with schizophrenia).

1. Structural and functional approaches to the analysis of language impairments in persons with aphasia

In a seminal study, Larfeuil and Le Dorze (1997) analyzed language recovery in 17 patients with aphasia by administering a traditional battery of linguistic assessment and a picture description task at 17 weeks post-onset and after 6 weeks of language stimulation. The standardised aphasia tests failed to show any improvement. However, patients exhibited better communicative effectiveness at post-therapy assessment, using more open-class words per time unit in connected speech. Similarly, Marini *et al.* (2007a) analyzed the linguistic skills of three patients with non-fluent aphasia whose speech was characterized by reduced information content and poor morpho-syntactic organization. These patients received two consecutive therapy programmes: the former consisted of stimulus-response exercises for producing well-formed sentences (Helm Elicited Language Programme for Syntax Stimulation – HELPSS; Helm-Estabrooks et al., 1981), the latter followed a functional approach aimed at increasing informativeness in storytelling (Promoting Aphasics' Communicative Effectiveness treatment – PACE; Davis & Wilcox, 1985). Interestingly, on the post-therapy assessment the traditional standardised aphasia tests showed minimal changes. Yet, informativeness of language samples increased significantly and this improvement was confirmed by naïve judges who were asked to rate the levels of informativeness of the produced descriptions. Overall, these findings highlight the need for a thorough assessment that allows clinicians to evaluate all linguistic levels of processing and to focus on both structural and functional aspects of language production. Indeed, language is a dynamic cognitive system, which is based on the integration of several competences along two main dimensions (e.g. Glosser & Deser, 1990): a microlinguistic dimension and a macrolinguistic one. The microlinguistic dimension is related to lexical and grammatical processing, It organizes phonological and graphemical sequences into morphological strings and words. It also constrains the syntactic context required by each word to generate well-formed sentences. The macrolinguistic dimension reflects pragmatic and discourse-level processing skills, deriving the contextually appropriate meaning of a word or a sentence and connecting sentences by means of linguistic and conceptual ties (i.e., cohesion and coherence, respectively).

Of note, an important role in connecting the two dimensions of processing is played by cohesive markers, i.e., those words that tie meanings among sentences and consequently establish relationships within discourse.
So far, two main approaches have been used in discourse analysis: a structuralist approach and a functional one (Armstrong, 2000). The structuralist approach, largely used in aphasiological research, considers discourse as the product of a complex interaction among different levels of processing (e.g. lexical, sentential, and pragmatic). As such, it can be quantitatively analysed by capturing phonological, lexical, grammatical and even pragmatic and discourse-level skills in patients with aphasia. To date, several techniques have been developed to elicit speech samples in these patients (e.g., single picture descriptions tasks - Nicholas & Brookshire, 1993; story retelling tasks - Saffran *et al.*, 1989; recounts of personal events - Glosser & Deser, 1990; and descriptions of procedures - Ulatowska *et al.*, 1983). It is believed that procedures of discourse analysis can be much more informative than traditional standardized linguistic tests as they might help clinicians to determine 1) the exact nature of the linguistic impairment, 2) the way specific microlinguistic difficulties might affect macrolinguistic processing, and 3) the putative efficacy of innovative rehabilitation protocols. For example, Mayer and Murray (2003) confirmed the usefulness of such analysis for patients with aphasia: using a picture description task and a conversation about familiar topics, they demonstrated that three measures derived from discourse analysis (i.e., % word retrieval, % substantive verbs, and % corrected errors) could capture the actual lexical skills of their patients much better that the naming task. Indeed, patients were more efficient (in terms of % word retrieval and % corrected errors) while producing discourse samples than in the naming task. Furthermore, Andreetta *et al.* (2012) showed that in persons with anomic aphasia the lexical impairment might affect the macrolinguistic organization of their speech samples.

The functional approach adopts a rather different methodology. It focuses mainly on the analysis of the patients' ability to convey relevant information. As such, it is highly focused on the macrolingustic dimension of processing. Informativeness, one of the main measures investigated within the functional approach, has been analysed by Yorkston and Beukelman (1980) through the *Content Units'* count. In their seminal study, the authors administered the Cookie Theft picture description task to a group of persons with aphasia and quantified the levels of informativeness in terms of content units, informative fluency (i.e., contents units per minute). According to them, a *Content Unit* is a relevant piece of information that has been mentioned by at least 1 of the 78 healthy individuals who had joined the study. The usefulness of this methodology had been proved in more than one study. Later on, Nicholas and Brookshire (1993) revised it by introducing the *Correct Information Unit* count. Correct

Information Units (CIUs) are those words that are relevant, accurate and informative with respect to the stimuli. This methodology, which uses both functional and quantitative measures, has high diagnostic sensitivity even in persons with mild fluent aphasia. Indeed, patients with mild aphasia can still generate speech samples with the same structural principles employed by healthy controls (Ulatowska *et al.*, 1983).

More recently, Sherratt (2007) examined the interaction between structural and functional aspects of narrative and procedural discourse. In this experiment 32 healthy individuals without brain damage were required to produce up to 14 speech samples, which included four narratives generated by picture sequences, four narratives related to personal experiences, and six procedures. These samples were analysed in terms of seven broad features (comprising 23 measures), relating to the levels of the multi-level discourse model (i.e. relevance, discourse grammar, clarity disruptors, productivity and syntactic complexity, clausal structure, cohesion, and fluency). A series of correlations showed that many of these measures do interact. For example, greater relevance was related to more appropriate discourse grammar, fewer non-specific elements, greater cohesion and syntactic complexity. Overall, the findings from this study suggest that a multi-layered approach to discourse analysis may prove useful in the assessment of linguistic skills of persons without and, possibly, with communication disorders, providing an additional perspective on how the different elements of a discourse interact.
In summary, several studies have shown that traditional standardized aphasia tests are not sensitive enough to adequately capture the features of the linguistic deficits in persons with aphasia or the exact patterns of their recovery. So far, two main approaches have been developed for the analysis of the language samples produced by these persons: a structural approach, which investigates the different levels of microlinguistic dimension of language, and a functional approach, which mainly analyses the informative skills of these patients. However, language is a dynamic cognitive system, grounded on both micro- and macrolinguistic dimensions of processing. For this reason, a method which is based on both dimensions and both approaches would be useful to correctly assess every level of the speaker's linguistic competence as well as their interaction in communicative skills.

2. A method for the assessment of micro- and macro-linguistic skills

In this paragraph, we will describe a method for the assessment of micro- and macro-linguistic skills in individuals with communicative disorders (Marini *et al.*, 2011a). This method employs both quantitative and functional measures. To obtain discourse samples two single picture

scenes and two picture sequences are used. The two single pictures are the *Cookie Theft* and the *Picnic* (Western Aphasia Battery, WAB; Kertesz, 1982); the two sequences are the *Flower Po*t (Huber & Gleber, 1982) and the *Quarrel* (Nicholas & Brookshire, 1993). Each participant is asked to describe the events portrayed in the stimuli. The participant can see the pictures during the whole time of his/her description, to avoid short-term memory limitations and to avoid referent sharing. Stimuli are administered using a laptop put in front of the participant. Samples are audio-recorded and transcribed verbatim, including phonological fillers, pauses, false starts and extraneous utterances. The duration of each speech sample is calculated.

The analysis focuses on four main aspects of linguistic processing: productivity, lexical and grammatical processing, narrative organization, and informativeness.

2.1 Analysis of Productivity

The measures used to assess productivity levels are summarized in Table 1. Productivity measures consist in the count of units and words and in computing speech rate and Mean Length of Utterance (MLU). A unit is any verbalization, including those that are not correct and appropriate with respect to language or to the context. For this reason, the unit count includes also neologisms and phonological paraphasias, false starts, sounds and syllable repetitions. These verbalizations are not included in the word count: the word count includes only phonologically well-formed words. The quantity of words is used to obtain the measure of speech rate, calculated in terms of words per minute. Also the number of utterances is calculated. Different criteria have been proposed to make a correct segmentation of the sample into utterances. As it is hardly possible to adopt just one criterion, in our experience we have identified a set of parameters that has gained high inter-rater reliability scores. Namely, we adopt a combination of acoustic, semantic, grammatical and phonological criteria. According to the acoustic criterion an utterance is segmented when the discourse is delimited by pauses that can be easily identified. Pauses may be empty or full. For instance, in the following sequence: “this is a *. . .* [silent pause of 5 seconds] child”, a clear empty pause can be perceived between the first chunk “this is a” and the second one “child”. We segment it then in two distinct utterances: /This is a (5 sec) / child/. A full pause can be also a non-lexical emission, such as “ehm”.” According to the semantic criterion we segment an utterance when there is a conceptually homogeneous piece of information such as a proposition. A proposition is formed when the semantic unit has the main predicate with its arguments and all embedded predicates and argument(s) associated with it (Olness, Matteson & Stewart, 2010). For instance, in the sequence “a

man is walking on the road. A flower pot falls on his head", we can distinguish two utterances, as the second one constitutes a new proposition. According to the grammatical criterion, we identify an utterance when there is a grammatically well-formed sentence, with or without subordinate clauses. For instance: /The man is walking on the sidewalk with a dog that looks very nice/, can be considered as a single utterance, even if it's long, with a subordinate clause. The speaker may also produce two coordinate sentences; in that case there would be two utterances: "/The man is walking on the sidewalk /and a dog is following him /". According to the phonological criterion, we segment an utterance when a word is abruptly interrupted. For instance, when we have a false start as in: "/and she is ca- /stroking his dog/", we identify two utterances. The utterances segmentation allows clinicians to derive the Mean Length of Utterance (MLU), calculated by dividing the total number of words by the number of utterances.

Measure	Description	Example
Words	All phonologically well-formed words	i.e. "cog" instead of "dog" (phonological paraphasia) can't be included in words count
Speech Rate	Well-formed words per minute	
Mean Length of Utterances (MLU)	Mean number of words that make up the utterances	

Table 1 – Measures of Productivity

2.2 Analysis of Lexical and Grammatical skills

As to the analysis of lexical and grammatical aspects of language production (summarized in Table 2), lexical measures are related to the speaker's ability to select semantically appropriate words and to access adequate morphological, morphosyntactic and phonological information relative to the selected words. The selection of conceptually appropriate words is calculated through a percentage of semantic and verbal paraphasias (Haravon *et al.*, 1994), obtained by dividing the number of semantic and verbal paraphasias by the number of phonologically well-formed words and multiplying this value by 100. The adequate access to morphological and morphosyntactic information relative to the selected words is calculated by dividing the number of paragrammatic errors by the number of phonologically well-formed words and multiplying this value by 100 (% of paragrammatic errors). Phonological skills are calculated by dividing the total number of phonological errors, such as false starts, phonological and phonetic paraphasias and neologisms, by the number of units and then multiplying this value by 100 (% of phonological errors).

Grammatical processing is analyzed in terms of percentage of complete sentences and of omissions of morphosyntactic information. A sentence is considered complete when all of the arguments required by a word are inserted correctly in its body without any omission of morphosyntactic information or substitution of free or bound morphemes. An omission of morphosyntactic information occurs when the argument structure of a given word in a sequence is not complete. Therefore, a sequence such as ⁄ the man is hit by the soldier ⁄ is considered a correct sentence, as both agent (i.e. the soldier) and patient (i.e. the man) are correctly inserted in the body of the sentence. Conversely, a sequence such as /the man is hit by.../ is not scored as a complete sentence because the information about the agent is missing. Therefore, in this utterance an omission of morphosyntactic information is counted. The percentage of complete sentences is calculated by dividing the number of grammatical sentences by the number of utterances and then multiplying this value by 100 (Saffran *et al.*, 1989; Thompson *et al.*, 1996). The percentage of omission of morphosyntactic information is calculated dividing the number of omissions of morphosyntactic information by the number of utterances and then multiplying this value by 100.

Measure	Description	Example
% Semantic and verbal paraphasias	The percentage of words that are classified as semantic or verbal paraphasias.	i.e. “table” instead of “chair” is a semantic paraphasias (semantically related). “flower” instead of “chair” is a verbal paraphasias (semantically unrelated)
% Paragrammatic errors	The percentage of words that are classified as paragrammatic errors.	i.e. in Italian “batte da una porta/ he is knocking from a door” – is a paragrammatic error because the speaker used the function word “da” instead of “a”.
% Phonological selection	The percentage of phonologically well-formed words with respect to all uttered units .	
% Complete sentences	The percentage of grammatically well-formed utterances.	The sequence “The man is hit by.../” can't be considered a complete sentence because the information about the agent is missing.

Table 2 – Measures of Lexical and Grammatical processing

2.3 Analysis of Narrative Organization

The narrative organization of a speech sample is analyzed in terms of production of errors of cohesion and coherence (both local and global; see

Table 3). Cohesion reflects the structural connectivity among contiguous utterances. Indeed, cohesive errors occur when there is a misuse of cohesive ties, such as anaphoric pronouns, errors in number and gender agreement between pronouns or noun phrases across utterances, misuse of either cohesive function words or semantically related content words and abrupt interruption of utterances. The abrupt interruption of an utterance is defined *aposiopesis* (Haravon *et al.*, 1994). If the utterance following an aposiopesis completes the previously introduced information, then just a cohesive error will be scored, otherwise also a *topic switch* would occur (see below). As noted above, some cohesive errors can be linked to micro-linguistic processes. Consider the following sequence: /the man is staring at . . . /the man is watching the dog /. This is a case of self-repair that reflects the complex relationship between micro- and macrolinguistic errors. In the first utterance there is an omission of morphosyntactic information, then at the microlinguistic level. However, this omission also influences the macrolinguistic organization of the narrative, as the abrupt interruption of the first utterance (where an *aposiopesis* is scored) causes the speaker to reformulate the sentence in the subsequent utterance or to omit pieces of information that may be important for the comprehension of the story. In this case the second utterance completes the flow of thoughts introduced in the first one, then no local coherence errors are scored (see below). The percentage of cohesive errors is calculated by dividing the number of cohesive errors by the number of utterances and multiplying this value by 100. Local coherence refers to the extent to which each utterance is conceptually related to the preceding one. Consequently, local coherence errors occur when referents are ambiguous or when they are omitted. As mentioned above, a local coherence error is also scored when an utterance is abruptly interrupted and, after the aposiopesis, the following utterance does not complete the current thought but new information is introduced: in this case a *topic switch* occurs. For instance, in the sequence: /he's trying to... / these two girls are watching the dog /, the first utterance remains unfinished, while the second utterance introduces new information. Missing referents errors refer to those parts of discourse when the referent of a pronoun or the implicit subject of a verb are not clear or even incorrect. For instance, in the following sequence: / Qui stanno litigando furiosamente /Poi dice /(in English: /Here they are quarrelling furiously / Then [implicit pronoun] says /), there is a missing referent in the second utterance because it's not clear to whom the verb “dice” (“says”) is referring to. The percentage of local coherence is calculated by dividing the number of local coherence errors by the number of utterances and multiplying this value by 100. Global coherence is related to the ability to semantically relate remote utterances within the discourse. Errors of global coherence are: production of tangential utterances, conceptually

incongruent with the story, propositional repetitions or fillers (Christiansen, 1995). A tangential utterance occurs when there is a derailment in the flow of discourse with respect to the information already provided in the previous utterance. For example, in the following sentence: ⁄It is a picnic ⁄I like picnics ⁄I have made several picnics in my life ⁄, the second and the third utterance are tangential, as they provide irrelevant information. An utterance conceptually incongruent differs from a tangential utterance: a conceptually incongruent information occurs when it includes ideas not directly addressed by the stimulus. For instance, in the following sequence, where the *Cookie Theft* was administered: ⁄the children are trying to get the cookies ⁄the TV is out ⁄, the second utterance is incongruent because in the picture there is no TV. A propositional repetition occurs when the speaker repeats information that he/she had already provided without adding any other. A filler utterance occurs when the speaker produces an utterance that is not providing any additional information, as in: ⁄the man and the woman are eating ⁄my God, and now? ⁄ah, yes, I get it ⁄, where the last two utterances are considered fillers. A percentage of global coherence is calculated by dividing the number of global coherence errors by the number of utterances and multiplying this value by 100.

Measure	Description	Example
% Cohesion errors	The percentage of contiguous utterances whose structures were not correctly connected.	In the sequence “The man is hit by…” an aposiopesis (abrupt interruption of the flow of discourse) is scored. This error reflects the structural connectivity among contiguous utterances.
% Local coherence errors	The percentage of utterances that were not accurately connected because they presented local coherence errors.	In the sequence “here they are quarrelling / then [implicit pronoun] says” we score a local coherence error (missing referent) in the second utterance.
% Global coherence errors	The percentage of utterances that were violating global coherence rules.	Tangential utterance: i.e in the sequence “It is a picnic/I have made several picnics in my life” the second utterance is tangential. Conceptually incongruent utterance: i.e. in the sequence “the children are trying to get the cookies/the dog is watching them” the second utterance is conceptually incongruent because there is no dog in the Cookie Theft picture.

Table 3 – Analysis of Narrative Organization

2.4 Analysis of Informativeness

The informative levels of a discourse sample are measured through two main levels, which are the production of appropriate lexical information and the identification of the thematic units contained in the language sample (see Table 4). Appropriate lexical information units (LIUs) are those content and function words that are phonologically well-formed and also appropriate from a grammatical and pragmatic point of view. Consequently, those words that have been classified as semantic or verbal paraphasias, lexical fillers, lexical repetitions, paragrammatic errors, words without clear referents, or words included in tangential or conceptually incongruent utterances must be excluded from the LIU's count. The percentage of lexical informativeness is calculated by dividing the number of LIUs by the number of words and multiplying this value by 100. This measure proved to be particularly useful in the assessment of communicative effectiveness in people with neurological or neuropsychiatric disorders (see section 3). Also an index of informative speech rate can be calculated (LIUs/minute) which provides additional information about the informative efficiency of the speaker. These two measures roughly correspond to the functional measures proposed by Nicholas & Brookshire (1993), who in the CIU analysis method evaluated discourse efficiency with respect to the time required to produce the narrative (Words per minute=Ws/m' and Correct Information Units per minute=CIUs/m') and extension of the sample (% CIUs=percentage of Words in the sample that are Correct Information Units). Informativeness can be measured also through the identification of the thematic units contained in the language sample. A thematic unit is a main idea or detail in the story. Each stimulus had a series of concepts that provide the backbone of the plots: thematic units were identified with a methodology described in Marini *et al.* (2005a). Thus, it is possible to measure how many thematic units the participant produced with respect to all ideas that are expected to be elicited by each stimulus. A percentage of thematic selection is calculated by dividing the number of thematic units produced in each story by the total number of all potential thematic units for that story and then multiplying this value by 100. This value is considered an index of the amount of conceptual and informational content that the speaker is able to derive from the stimulus (e.g. Marini *et al.*, 2005b).

Measure	Description	
Lexical Information Units	All content and function words which are phonologically well-formed and also appropriate from a grammatical and pragmatic point of view.	
Identification of thematic units	All the main ideas or ideas of the story identified by the speaker.	

Table 4 – Analysis of informativeness

3. Application of the method: behavioural and anatomo-functional data

The multi-level procedure for structural and functional analysis of narrative discourse outlined in the preceding paragraph has proven useful in the assessment of language deficits not only in persons with aphasia (Marini *et al.*, 2007a; Andreetta *et al.*, 2012; Carlomagno *et al.*, 2013; Marangolo *et al.*, submitted 2013a, 2014; Marangolo *et al.*, 2013b) but also in other neurogenic populations including individuals with right hemisphere damage (Marini *et al.*, 2005a; Marini, 2012), traumatic brain injury (Carlomagno *et al.*, 2011; Marini *et al.*, 2011b; Galetto *et al.*, 2013), schizophrenia (Marini *et al.*, 2008a; Perlini *et al.*, 2012), children with specific language impairment (Marini *et al.*, 2008b) or with Williams' syndrome (Marini *et al.*, 2010), and people suffering from Duchenne muscular dystrophy (e.g. Marini *et al.*, 2007b). Furthermore, it has allowed us to provide an initial sketch of the potential epicenters of the neural network implicated in discourse planning and effective production (Marini and Urgesi, 2012; Marini *et al.*, submitted; Ferretti *et al.*, 2013). In this paragraph we will outline a brief sketch of the major findings obtained by some of these studies.

Marini *et al* (2005) compared the narrative performance of persons with right hemisphere damage (RHD) with a group of persons with left hemisphere damage without aphasia and a group of healthy control participants. The three groups were administered three story description tasks. In the first condition, they were asked to retell previously read stories. In the second, they described what was going on in a set of cartoon picture stories. In the third condition, they had to arrange a set of pictures to reconstruct a well-formed story. In the first condition, all groups performed quite well on both within- and between-sentence measures. In the two picture description tasks, however, the performance of the persons with RHD was poorer than that of the remaining two groups when examined in terms of information content and coherent aspects of narrative production. These findings agree with the hypothesis that persons with RHD are impaired in deriving from visual information the mental model of a

story and confirm that clinical methods for analyzing structural aspects of discourse are a good means to identify these symptoms. However, an additional factor that needs to be carefully addressed regards the potential contributions of different portions of the right hemisphere to the process of narrative production. For this reason, in a second experiment Marini (2012) compared the narrative skills of non-aphasic RHD individuals with those produced by a group of healthy participants. Both groups scored within normal range on tests assessing their level of global cognitive impairment, logical visuospatial reasoning, general linguistic skills, and the potential presence of hemineglect. As expected, the individuals with RHD produced descriptions with normal levels of microlinguistic processing but with more tangential errors and conceptually incongruent utterances that lowered their levels of informativeness. Interestingly, further analyses revealed that these deficits were most evident in persons with anterior lesions to the right hemisphere. These findings lend indirect support to the hypothesis of a major involvement of frontal right hemispheric areas to the process of organization of information in a narrative discourse.

Further evidence in favour of the application of a multilevel approach to narrative discourse analysis comes from the assessment of the linguistic skills of persons who, even if not aphasic, show impaired linguistic and/or narrative abilities. For example, Marini *et al.* (2011b) analyzed the features of narrative discourse impairment in a group of non-aphasic adults with severe traumatic brain injury (TBI) in the phase of neurological stability. A selection of neurologically healthy participants matched for age, level of formal education and sex formed the control group. The cognitive, linguistic and narrative skills of both groups of participants were thoroughly assessed. Confirming the absence of aphasic symptoms, the group of individuals with TBI had normal lexical and grammatical skills. However, they produced narratives with many errors of cohesion and coherence due to the frequent interruption of ongoing utterances, derailments and extraneous utterances that made their discourse vague and ambiguous. They produced a normal amount of expected concepts in their narratives. However, this information was not correctly organized at micro- and macrolinguistic levels of processing. A Principal Component Analysis showed that a single factor accounted for the production of global coherence errors, and the reduction of both propositional density at the utterance level and proportion of words that conveyed information. Consequently, the authors hypothesized that the linguistic deficits observed in the participants with TBI might reflect a deficit at the interface between cognitive and linguistic processing rather than a specific linguistic disturbance. Carlomagno *et al.* (2011) further examined the relationship between standardized measures of informativeness (i.e., Correct Information Unit analysis) and language processing errors at the macrolinguistic level by comparing the performance of a group of non-

aphasic TBI adults with that of a group of healthy control participants on a narrative discourse task. Again, the participants with TBI did not produce relevant within-sentence errors and information content of their narratives was not different from that of the healthy participants. However, their production of errors of cohesion, local coherence and global coherence was significantly greater. Most importantly, the production of these macrolinguistic errors predicted reduced levels of information efficiency.

Language disturbance is one of the main diagnostic features also of another disorder: schizophrenia. Indeed, schizophrenic patients show linguistic deficits which are very selective and subtle at the microlinguistic level. However, deficits become more pervasive and severe at the macrolinguistic level when patients need to organize what they want to communicate at the pragmatic-communicative level and generate appropriate mental models. Unfortunately, their difficulties in these respects are not easy to detect and quantify. For this reason, Marini *et al.* (2008a) studied the narrative skills of a group of individuals with schizophrenia in the phase of illness stability. Three narratives were elicited with the help of a single-picture stimulus and two cartoon stories with six pictures each. A modified version of the Mental Deterioration Battery (Carlesimo *et al.*, 1996) was used to assess selective cognitive performances. The multilevel assessment clearly showed that these patients produced a relatively high amount of semantic and morphological errors whose occurrence was determined by the production of macrolinguistic errors (e.g., tangential utterances). Most interestingly, these macrolingusitic deficits were predicted by the patients' impaired performance on tests assessing sustained attention and executive functions. Therefore, the multilevel procedure for narrative analysis allowed us to determine the exact nature of the patients' semantic and morphological errors and to infer the potential interconnections between executive functions, discourse planning and processes of lexical selection and access. In a subsequent study, Spalletta *et al.* (2010) further examined the characteristics of narrative processing in schizophrenic individuals by correlating the linguistic scores obtained with the multilevel procedure for discourse analysis with cortical and subcortical gray matter volumes. The authors found that the production of lexical information units (LIUs) significantly correlated with volume changes in the dorsal aspect of the left inferior frontal gyrus (lIFG). Even if this study provided only correlational evidence on the association between brain volume change in the lIFG and the ability to retrieve appropriate words in patients with mental disorders, this result is particularly interesting. Indeed, it suggests that this part of the lIFG may play a major role in a wider network for the controlled selection of contextually adequate words from the mental lexicon. To further explore the crucial role played by the lIFG in semantic processing and lexical retrieval in a discourse production task, Marini and Urgesi

(2012) performed an experiment with an off-line repetitive TMS protocol targeting at the area found correlated with the production of LIUs in Spalletta *et al.* (2010). Namely, the authors applied rTMS over a dorsal aspect in the anterior lIFG and right IFG (rIFG) at the border between the pars opercularis and the pars triangularis (BA 44/BA 45) and tested the effects of the stimulation on the narrative abilities of healthy individuals. The results clearly showed that rTMS over the dorsal portion of the anterior left, but not right, inferior frontal gyrus reduces the levels of lexical informativeness and global coherence of narratives produced by healthy individuals. Interestingly, levels of productivity and microlinguistic processing were unaffected by the stimulation. These results suggested that the dorsal aspect of the anterior left inferior frontal gyrus is an epicenter of a wider neural network subserving the selection of contextually appropriate semantic representations.

Conclusions

The multi-level procedure for narrative assessment proved successful in characterizing the linguistic and communicative features of patients with brain lesions as well as persons with psychotic symptoms and even healthy individuals. Indeed, this procedure 1) allows clinicians to simultaneously evaluate different aspects of linguistic functioning; 2) provides an insight on the interactions between macro- and microlinguistic competence; 3) captures symptoms that may not be identified by traditional batteries of tests focusing only on microlinguistic skills. Furthermore, this approach has potential to contribute to our understanding of the neural underpinning of important aspects of human communication. This will be the goal of future research.

References

Andreetta, S., Cantagallo, A. & Marini, A. (2012): Narrative discourse in anomic aphasia. Neuropsychologia. 50 (8), 1787-1793.

Armstrong, E. (2000): Aphasic discourse analysis: The story so far. Aphasiology, 14, 875-892.

Carlesimo, G.A., Caltagirone, C. & Gainotti, G. (1996): The Mental Deterioration Battery: normative data, diagnostic reliability and qualitative analyses of cognitive impairment. The Group for the Standardization of the Mental Deterioration Battery. Eur. Neurol. 36, 378–384.

Carlomagno, S., Giannotti, S., Vorano, L. & Marini, A. (2011): Discourse information content in non-aphasic adults with brain injury: A pilot study. Brain injury, 25(10), 1010-1018.

Carlomagno, S., Zulian, N., Razzano C., de Mercurio, I. & Marini, A. (2013): Coverbal gestures in the recovery from severe fluent aphasia: a pilot study. Journal of Communication disorders. 46 (1), 84-99.

Christiansen, J.A. (1995): Coherence violations and propositional usage in the narratives of fluent aphasics. Brain and Language, 51, 291-317.

Davis, G. & Wilcox, M. (1985): Adult aphasia rehabilitation: Applied pragmatics. Windsor, UK: NFER-Nelson.

Ferretti, F., Adornetti, I., Cosentino, E. & Marini, A. (2013): Keeping the route and speaking coherently: The hidden link between spatial navigation and discourse processing. Journal of Neurolinguistics. 26, 327-334.

Galetto, V., Andreetta, S., Zettin, M. & Marini, A. (2013): Patterns of impairment of narrative language in mild Traumatic Brain Injury. Journal of Neurolinguistics, http://dx.doi.org/10.1016/ j.jneuroling.2013.05.004

Glosser, G. & Deser, T. (1990): Patterns of discourse production among neurological patients with fluent language disorders. Brain and Language, 40(1), 67–88.

Haravon, A., Obler, L. & Sarno, M. (1994): A method for microanalysis of discourse in brain-damaged patients. In R. Bloom, L. Obler, S. De Santi & J. Ehrlich (Eds.), Discourse analysis and applications: Studies in adult clinical populations (pp. 47-80). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Helm-Estabrooks, N. A., Fitzpatrick, P. M. & Barresi, B. (1981): Response of an agrammatic patient to a syntax stimulation programme for aphasia. Journal of Speech and Hearing Disorders, 46, 422–427.

Huber, W. & Gleber, J. (1982): Linguistic and non-linguistic processing of narratives in aphasia. Brain and Language, 16, 1-18.

Kertesz, A. (1982): Western aphasia battery. New York: (Grune & Stratton).

Larfeuil, C. & Le Dorze, G. (1997): An analysis of the word-finding difficulties and of the content of the discourse of recent and chronic aphasic speakers. Aphasiology 11(8), 783-811.

Marangolo, P., Fiori, V., Calpagnano, M.A., Razzano, C., Caltagirone, C. & Marini, A. (2013a): tDCS over the left inferior frontal cortex improves speech production in aphasia. Frontiers in Human Neuroscience, 7, 539, 1-10.

Marangolo, P., Fiori, V., Campana, S., Calpagnano, M.A., Razzano, C., Caltagirone, C. & Marini, A. (2014): Something to talk about: enhancement of linguistic cohesion through tdCS in chronic aphasia. Neuropsychologia, 53, 246-256.

Marangolo, P., Fiori, V., Calpagnano, M.A., Di Paola, M., Razzano, C., Caltagirone, C. & Marini, A. (2013b): How Conversational Therapy influences language recovery in chronic non-fluent aphasia. Neuropsychological Rehabilitatio, 23(5):715-31.

Marini, A., Carlomagno, S., Caltagirone, C. & Nocentini U. (2005a): The role played by the right hemisphere in the organization of complex textual structures. Brain and Language, 93(1), 46-54.

Marini, A., Boewe, A., Caltagirone, C., & Carlomagno, S. (2005b): Age-related differences in the production of textual descriptions. Journal of Psycholinguistic Research. 34(5), 439-463.

Marini, A., Caltagirone, C., Pasqualetti, P. & Carlomagno, S. (2007a): Patterns of language improvement in adults with non-chronic non-fluent aphasia after specific therapies. Aphasiology, 21(2), 164-186.

Marini, A., Lorusso, M.L., D'Angelo, G., Civati, F., Turconi, A.C., Fabbro, F. *et al.* (2007b): Evaluation of narrative abilities in patients suffering from Duchenne Muscular Distrophy. Brain and Language, 102 (1), 1-12.

Marini, A., Spoletini, I., Rubino, I.A., Ciuffa, M., Bria, P., Martinotti, G., Banfi, G., Boccascino, R., Strom, P., Siracusano, A., Caltagirone, C. & Spalletta, G. (2008a): The language of schizophrenia: An analysis of micro and macrolinguistic abilities and their neuropsychological correlates. Schizophrenia Research, 105, 144-155.

Marini, A., Tavano, A. & Fabbro, F. (2008b): Assessment of linguistic abilities in Italian children with Specific Language Impairment. Neuropsychologia, 46, 2816-2823.

Marini A., Martelli S., Gagliardi C., Fabbro F. & Borgatti R. (2010): Narrative language in Williams' Syndrome and its neuropsychological correlates. Journal of Neurolinguistics. 23, 97–111.

Marini, A., Andreetta, S., Del Tin, S. & Carlomagno, S. (2011a): A multi-level approach to the analysis of narrative language in aphasia. Aphasiology, 25(11), 1372-1392.

Marini, A., Galetto, V., Zampieri, E., Vorano, L., Zettin, M. & Carlomagno, S. (2011b): Narrative language in traumatic brain injury. Neuropsychologia, 49, 2904-2910.

Marini, A. (2012): Characteristics of Narrative Discourse Processing after Damage to the Right Hemisphere. Seminars in Speech and Language, 33(1), 68-78.

Marini A., Urgesi C. (2012) Please get to the point! A cortical correlate of linguistic informativeness. Journal of Cognitive Neuroscience. 24(11), 2211-2222.

Marini, A., Piras, F., Spalletta GF. (submitted): The coherent brain: how the brain keeps narrative coherence.

Mayer, J.F., & Murray, L. (2003): Functional measures of naming in aphasia: word retrieval in confrontation naming versus connected speech. Aphasiology, 17, 481-497.

Nicholas, L. & Brookshire, R. (1993): A system for quantifying the informativeness and efficiency of the connected speech of adults with aphasia. Journal of Speech Hearing Research, 36(2), 338-350.

Olness, G.S., Matteson, S.E. & Stewart, C.T. (2010): “Let me tell you the point”: How speakers with aphasia assign prominence to information in narratives. Aphasiology, 24(6-8), 697-708.

Perlini, C., Marini, A., Garzitto, M., Isola, M., Cerruti, S., Marinelli, V., Rambaldelli, G., Ferro, A., Tomelleri, L., Dusi, N., Bellani, M., Tansella, M., Fabbro, F. &Brambilla, P. (2012): Linguistic production and syntactic comprehension in Schizophrenia and Bipolar Disorder. Acta Psychiatrica Scandinavica. 126(5):363-76.

Prins, R. & Bastiaanse, R. (2004): Analyzing the spontaneous speech of aphasic patients. Aphasiology, 18 (12), 1075-1091.

Saffran, E.M., Berndt, R.S. & Schwartz, M.F. (1989): The quantitative analysis of agrammatic production: Procedure and data. Brain and Language, 37, 440-479.

Sherratt, S. (2007): Multi-level discourse analysis: A feasible approach. Aphasiology, 21(3/4), 375–393.

Spalletta, GF, Spoletini, I., Cherubini, A., Rubino, I.A., Siracusano, A., Piras; F., Caltagirone, C, Marini, A. (2010): Cortico-subcortical underpinnings of narrative processing impairment in schizophrenia. Psychiatry Research: Neuroimaging, 182, 77–80.

Ulatowska, H.K., Freedman-Stern, R., Doyel, A.W., Macaluso-Haynes, S., & North, A.J. (1983): Production of narrative discourse in aphasia. Brain and Language, 19(2), 317-334.

Thompson, C.K., Shapiro, L.P., Tait, M., Jacobs, B., & Schneider, S.L. (1996): Training wh-question production in agrammatic aphasia: Analysis of argument and adjunct movement. Brain and Language, 52, 175-228.

Yorkston, K.M., & Beukeman, D.R. (1980): An analysis of connected speech samples of aphasic and normal speakers. Journal of Speech and Hearing Disorders, 45, 27-36.