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Correspondence concerning contributions and editorial matters should to be addressed to: Pier Marco Bertinetto, Redazione di *Rivista di Linguistica,* Scuola Normale Superiore, Piazza dei Cavalieri, 7 - I-56126 Pisa, (Italy) (Tel. +39/050/509111; e-mail: bertinet@sns.it; Fax +39/050/563513).
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Levels of processing for nouns and verbs: some issues and controversies

Alessandro Laudanna

The perceived awareness that nouns and verbs are different linguistic objects in that they correspond to different kinds of referents, is among the most usually shared metalinguistic pieces of knowledge. Since the beginning of the reflection on human language, nouns and verbs have been considered as the basic parts of speech. In corroborating this observation, a major role has been played by the semantic properties of the two classes of words. Suffice it to give just two examples drawn from the ancient philosophical thought. In the Fourth Century B.C., in his Dialogue entitled "Cratylus", Plato stated that nouns and verbs are two distinct classes of signs that are used in order to refer to the reality; the former would make reference to the truth: they would designate those who perform actions as well as those who are or behave in some way; on the contrary, the latter would indicate actions and ways of being. Few decades later, in his treatise "On interpretation", Aristotle argued that, while by a noun we mean a sound significant by convention which has no reference to time, a verb, in addition to its proper meaning, bears with it the notion of time and is always something either predicable of, or present in some other thing.

Likewise, there is no danger of overstatement in saying that, even nowadays, the distinction between nouns and verbs – often and unconsciously – appears to us as a way of organizing our learning, our thoughts, and our knowledge. First and foremost for speakers of Indo-European languages, language is arranged in such a manner that on the one side it compels to think of the world in terms of nouns as names for objects and verbs as names for actions. On the other side, the phenomenological experience of the world - made up of entities and processes - favours and/or strengthens the characterization of nouns and verbs as labels for the former and the latter, respectively. The naive way of thinking, but sometimes even the scientific reasoning [1], is based on this approach to a supposedly meaningful partition of the world. It goes without saying that this quite unsophisticated analysis assumes that the words' classes reflect ontological categories and takes into consideration just some of the prototypical

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instances of the two word classes of nouns and verbs. Thus, it does capture only a marginal part of the many existing differences between nouns and verbs. The real picture is much more composite: on the one hand, evidence from linguistics seems to suggest that the verb-noun distinction occurs on a continuum, and that in some languages it is far from being so obvious (Rijkhoff, this issue). On the other hand, in those languages where the boundary between nouns and verbs is less ambiguous, the distinction is articulated along several factors, and, even though different theoretical positions are maintained about the sources of the distinction, it is increasingly acknowledged that lexical, semantic, syntactic, morphological and pragmatic factors all operate, although in dissimilar fashions, in shaping the noun/verb distinction. Furthermore, it is very likely that these different factors are also at the basis of representational distinctions within each of the two word classes. For instance, in their paper in this issue, Tabossi & Collina show that in normal language production, the linguistic process of verb selection may be affected by extralinguistic phenomena such as speakers' conceptual organization of complex events.

Finally, and perhaps even more significantly, the noun/verb distinction is effective also at the cognitive and neural levels and, as such, it is referred to in some of the papers included in the present issue of the *Italian Journal of Linguistics* (see Cappa & Perani, this issue; Laudanna & Voghera, this issue; Luzzatti & Chierchia, this issue). One of the recurring questions in these papers is whether the observed behavioral and neurological differences between nouns and verbs are associated to semantic-conceptual differences or to other types of distinction (e.g., grammatical). Here we are faced with two alternative hypotheses.

The semantic-conceptual hypothesis reduces all the differences between the two categories to features - like concreteness and imageability - that are related to lexical meaning [2]. The focus, then, is on certain semantic dimensions typically related to prototypical nouns and verbs. With reference to this theoretical scheme, various semantic dimensions may be invoked: IMAGEABILITY, more frequently associated with nouns than with verbs; ABSTRACTNESS of semantic content, more or less pronounced depending on the presence of relational vs. sensory features; NUMBER OF SEMANTIC FEATURES which, according to some hypotheses, is on average lower for verbs than for nouns.

The concurrent hypotheses do not dispute that the distinction between nouns and verbs may be sometimes attributed to semantic factors. Rather, they state that there are some sets of linguistic and

experimental data that cannot be explained as the product of underlying semantic factors. In other words, it is true that some differences in processing nouns and verbs may be due to semantic features (as well as to other reasons such as the computation of the argument structure), but evidence of this nature cannot be used to exclude the possibility of differences grounded on other factors (Laudanna & Voghera, this issue).

The most reasonable answer to the debate arising from the cited papers, as well as from other published articles in the literature, is that it is probably wrong to speculate in terms of mutually exclusive explanations for the observed noun-verb dissociations. Since nouns and verbs differ along several dimensions, it is very unlikely that all the possible dissociations found may be ascribed to the same source. Nevertheless, the controversy between the semantic-conceptual hypothesis and the other, multidimensional, alternative hypotheses, leads back to the more general issue of how linguistic information is represented and organized in the mind/brain. A better understanding of this issue may be attained within the broader framework of cognitive science, looking at the representation, processing and use of nouns and verbs as computational processes, which manipulate several types of information, that has to be accessed and represented in a specifically organized way. From this point of view, the differences or the dissociations found between nouns and verbs may function as a possible crucial test for concurrent views of language processing. These views may be schematically summarized as follows.

On the one hand, cognitive accounts see the mind/brain as a computational device in which representations and computations operate on symbolically stored information. The internal knowledge about linguistic categories is taken to be modular, both anatomically and functionally. On this construal, the linguistic knowledge would be based on abstract levels of representation which define class membership. Cognitive explanations, even though embrace the view that the cognitive system exploits distinct representations in processing information, are not necessarily committed to any assumptions about the universality of the linguistic categories.

On the other hand, connectionist accounts like those underlying many computer simulations inspired either by the "classical" connectionist networks or by the artificial life style of modelling, hold that the cognitive-linguistic functioning is supported by a homogeneous network of interconnected units that generalizes frequently occurring input patterns on correlational bases and retrieves information in terms of the interaction of simple units which process elementary

variables (e.g., perceptual features). Linguistically based concepts articulated in terms of categories like "noun" and "verb" are supposed to be the epiphenomena of correlated clusters of elementary features. They are not thought to correspond to distinct cognitive representations; rather, they just mark different values of continuous variables like, for instance, perceptual features.

Obviously, the choice between the two alternative accounts cannot but be informed by empirical evidence, which can help us to choose which of the two classes of models is the most appropriate in explaining data deriving from linguistic, psychological and neuropsychological observations. The scrutiny of the majority of results reported and reviewed in the papers of this issue shows that the evidence from qualitatively different observations, at least for the present, is in favor of the existence of categorical representations, and cannot be explained as the result of the processing of simple and continuous properties. Another reason for assuming discrete, categorically based representations is that nouns and verbs are classes that not only mirror entities in the sensible world but also are repositories of linguistic knowledge that is essential for the appropriate language use in reference to morphological composition, phonological constraints, and syntactic production.

Summing up, it seems that the available patterns of results can be explained by assuming that processing occurs on categorically defined representations of nouns and verbs. Associationist explanations based on simulative models which substitute the several interacting components of symbolic models with a single input-output module fail to give an account of the different kinds of information putatively responsible for the results found. It remains to be ascertained whether these limitations of the simulation models reflect intrinsic inadequacies of associationist approaches or peculiar inadequacies of the available implementations (for a discussion on this issue see Laudanna, 2002).

One possibility to solve the controversy between semantic and non-semantic hypotheses about the cognitive and neural differences between nouns and verbs is given by the "semantic bootstrapping" hypothesis (Caramazza, 2001). This hypothesis holds that the correlation between verbs and actions, although not capable of explaining all the verb production deficits in patients with acquired disturbances of language, is worth in setting up the neural localization of knowledge about verbs during language acquisition. The relationships between the classes of objects and actions on the one hand, and nouns and verbs on the other, is useful to construe the basic rules of

syntax. Once these rules have been shaped, the syntactic-semantic correspondence can be loosened in such a way as to hold semantically non-prototypical examples of nouns and verbs. Based on this hypothesis, the initial categorization of actions as verbs is responsible for the localization of verb-specific syntactic information in brain areas adjacent to motor planning areas [3].

Despite the fact that the papers included in this issue represent only an attempt at clarifying the issue of interest, it is pleasing to conclude these brief introductory remarks by observing that, beyond the diversity in their approaches and contents, all of them, along with the many others in the scientific literature, testify how the research efforts expended in the fields of descriptive and formal linguistics, cognitive psychology and neuropsychology, neuroimaging and computer modelling, have broadened our understanding of the several dimensions along which nouns and verbs differ. More importantly, these papers not only deal with a number of these dimensions but also demonstrate, at least to some extent, how different levels of analysis and explanation may either directly collaborate in addressing the same issue, or be engaged in a parallel research effort such that the advancements achieved in one field increase the possibility to corroborate the results obtained in others or allow to generate new hypotheses for further research.

Address of the Author:

Department of Communication Sciences, University of Salerno, Via Ponte don Melillo, 84084 Fisciano (Sa), Italy <alaudanna@unisa.it> and Institute for Cognitive Sciences and Technologies - CNR, Viale Marx, 15, 00137 Roma, Italy <allaudan@ip.rm.cnr.it>

Footnotes

[1] For instance, some attempts at modelling the use and/or the acquisition of nouns and verbs by means of computer simulation are characterized (and probably undermined) by sets of assumptions of this form (see Parisi, Cangelosi & Falcetta, this issue).

[2] For sake of conciseness, I will not discuss other simple reductionist hypotheses that have been proposed: for instances, one of these states that the processing differences between nouns and verbs may be due to the fact that verbs determine the thematic and argument structures of sentences.

[3] Again with respect to acquisition, another important point relative to language use is raised by the paper by Longobardi & Camaioni (this issue). These authors review some interesting results showing that the proportion of verbs' and nouns' types and tokens produced by both mothers and children during the course

of acquisition is not universally fixed, but depends on the type and the characteristics of the language that is spoken.

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Nouns and verbs as grammatical classes in the lexicon

Alessandro Laudanna & Miriam Voghera

The present study addresses the issue of the distinction between nouns and verbs in the lexicon and investigates if and to what extent the grammatical properties of nouns and verbs play a role in organizing the lexical knowledge. Evidence from linguistics, cognitive psychology and cognitive neuropsychology of language is reviewed in order to support the conclusions that, among many other dimensions, nouns and verbs are represented as grammatical classes in speakers' lexical knowledge. Furthermore, the grammatical knowledge of the two classes of words plays the role of an organizational principle in the lexicon, and contributes to explain the organization and the format of words' representations as well as their possible neural and functional damages [*].

1. Introduction

Two deeply debated questions in the sciences of language concern the problems of how the lexical knowledge is organized and whether or not the grammatical properties of different classes of words play a role in this organization. Research carried out in linguistics, cognitive psychology and neurosciences has tried to answer these questions, investigating whether and to what extent the lexical representations of words depend on their grammatical features. Most of the studies have mainly investigated the distinction between nouns and verbs in the lexicon. Linguistic research has traditionally discussed the criteria on which the noun/verb distinction is built on. Research in cognitive psychology and neurosciences has mostly investigated the function of nouns and verbs as distinct parts and organizational principles of our lexical knowledge. The two questions are closely related, but conceptually independent. In this paper we will try to use and compare some data drawn from the three mentioned levels of investigation, focusing on the contribution given by the grammatical information in the noun/verb distinction.

One of the principles that holds of almost all languages is that among their words they all have types that correspond at least roughly to the categories of nouns and verbs. However, the broadening of inquiries to a larger number of non Indo-European languages made it clear that nouns and verbs, respectively, do not always repre-

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sent the same linguistic objects in every language of the world and/or are not always separate objects (Sasse 2001).[1]

Even assuming NOUN and VERB as theoretical categories whose linguistic manifestation can be differently shaped in different languages, the noun/verb distinction has to be further specified: what is the nature of this distinction? Is it possible to enumerate the necessary and sufficient features that define a noun or a verb? Are these features hierarchically ordered? Although different positions are maintained about these topics, it seems that, according to different theoretical positions (Bybee 2000), lexical, semantic, syntactic, morphological and pragmatic factors may act differently in shaping the noun/verb distinction, but none of them can be excluded *a priori*.

If we turn to the available evidence from linguistic, psycholinguistic and neuropsychological data, that will be briefly reviewed in the next section, the distinction between nouns and verbs still emerges as a multi-faceted issue, that cannot be reduced to a single dimension of language processing or language description. Moreover, it emerges that the noun/verb distinction: a) may be referred to in a variety of domains: modality (oral/written), tasks (oral production, reading, writing, picture naming, and so on), and behaviors (production/comprehension), and b) is likely to be modulated according to the specific intersection of modalities, tasks and behaviors we consider.

2. Nouns and verbs: a brief review

On cognitive bases, many experiment have investigated how nouns and verbs are processed and represented, providing consistent support for the noun/verb dissociation hypothesis, namely, the hypothesis that nouns and verbs are autonomously represented as grammatical classes in the lexicon. Studies from the field of neuropsychology have focused mainly on *output* mechanisms, for both spoken and written language (Rapp & Caramazza 1997). First of all, marked dissociations have been shown in the retrieval process of nouns and verbs in so-called agrammatic patients, with a relative impairment in verb retrieval as compared to noun retrieval (McCarthy & Warrington 1985; Miceli et al. 1988; Miceli et al. 1984; Zingeser & Berndt 1990). In these patients, deficits on verbs have been associated with the damage to the syntactic processing device - what appears to be, *prima facie*, a correct conclusion. Verbs are more intimately associated with sentence processing in speech production, since verbs' argument structure plays a central role in the assembly

of sentences, allocating lexical items to their appropriate slots within the syntactic frame. Thus, a dysfunction in the connections between syntactic processing and the lexicon would affect verbs much more than nouns.

Nevertheless, experimental observations on adults with selective disturbances of language have also shown double dissociations between the impairment of one grammatical class and the sparing of the other, in both comprehension and production tasks: in some cases, a selective impairment in verb processing has been shown (Caramazza & Hillis 1991; Daniele et al. 1994); in other cases, the opposite pattern – a selective deficit in noun processing – has been observed (Daniele et al. 1994; Zingeser & Berndt 1990). Interestingly, grammatical class effects are in some cases restricted to single modalities of output: for instance, some patients show a deficit in oral, but not in written production of verbs. In their study of patients HW and SJD Caramazza & Hillis (1991) found strong evidence in favor of the grammatical class deficit selectivity. The former patient showed a selective deficit for verbs in naming and oral reading but not in writing; the latter patient showed the same dissociation in written naming and spelling to dictation but not in speech. For the purposes of the present paper it is important to emphasize the modality-specific character of the deficits for two reasons. The first reason is that it seems to suggest that grammatical class information be represented in connection not only with word meaning, but also with word phonological and orthographic output representations. The second reason, (as we will explain more thoroughly in the next section), is that the modality-specific deficits seem to preclude an account of these deficits in terms of a damage to the semantic representations (Caramazza & Shapiro in press a).

When we turn to the neural localization of the lesions, we still find evidence for relevant dissociations: deficits in noun processing are often consequent to left temporal lobe lesions, while impairment in verb (and function word) processing are frequently associated with left frontal lobe lesions (Damasio & Tranel 1993; but see Perani et al. 1999). Damasio & Tranel (1993) make a specific assumption based on the three cases they report: following their explanation, nouns are represented in the left anterior and middle temporal regions, while verbs are represented in the left frontal region. More recently, on the basis of neuroimaging studies, two more specific hypotheses have been advanced: a) two distinct neural circuits subserve nominal and verbal morphosyntax: the first left fronto-temporal circuit would be associated with the processing of nouns; the second left fronto-pari-

etal circuit would be associated with the processing of verbs; b) the left prefrontal area is involved in processing words as grammatical objects (for instance, in carrying out morphological manipulations on verbs), independent of their semantic content (Caramazza & Shapiro in press b).

Evidence in favor of the functional distinction between nouns and verbs comes also from experimental studies on normal adults. These studies have focused mainly on *input* mechanisms, mainly for written language, and in a number of languages. A very concise summary of the major findings follows.

CHINESE: Hsu et al. (1998) investigated Chinese compounds and detected syntactic effects at the sublexical level during word recognition. In particular, the results showed that different combinations of nominal and verbal morphemes within a compound influence lexical access: participants recognized faster compounds resulting by a combination of two words of the same grammatical class.

ENGLISH: it has been found that nouns are processed better and faster than verbs in comprehension tasks (Spenney & Haynes 1989). In a lexical decision task, Sereno & Jongman (1997 Exp. 1) investigated the representation of inflectional morphology in the lexicon and found that nouns were responded to faster than verbs. According to the authors' interpretation, these results are explained by one aspect of the different distribution of inflected forms in nouns and verbs (the relative frequency of base forms compared with the other forms is higher for nouns than for verbs).

HEBREW: also in Hebrew, a language relying on a non-linear morphology, it was shown that verbs and nouns elicit different response behaviors when submitted to a morphological priming condition (Deutsch et al., 1998; Frost, Forster & Deutsch 1997). In the Hebrew nominal system, masked primes determine facilitation on targets when they share the same root, while in the verbal system facilitatory effects are obtained when masked primes share both the same root and the word pattern as the target word.[2]

SERBO-CROATIAN: Kostic & Katz (1987) found processing differences between nouns, adjectives, and verbs in a set of lexical decision experiments on inflected words: they found a processing advantage for the nominative case in both singular and plural nouns and a strong influence of inflected form frequency for adjectival and verbal processing. Their conclusion was that inflectional processing depends on the number of inflectional alternatives for each grammatical class.

All these results, from both normal participants and patients with acquired disturbances of language, suggest that the grammatical class

of a word affects nearly all aspects of word processing (word production, word recognition, word comprehension) both when words are processed in a sentential context and when they are processed outside the syntactic context of a sentence. Moreover, categorial effects are consistently found not only in morphologically rich languages like Hebrew and Serbo-Croatian, but also in such languages as English, with a very poor inflectional morphology, both nominal and verbal.

In spite of the massive experimental evidence supporting the representational distinction between nouns and verbs, the interpretation of such distinction is far from being uncontroversial, given that several sources of information and/or processing components could be responsible, in principle, for the differences found. Noun and verb processing could be different by virtue of semantic factors: nouns have, on average, a higher degree of concreteness and imageability than verbs (Chiarello et al. 1999); noun and verb concepts have a different balancing of sensory and functional features. Nouns and verbs could also differ for their argumental structures: the argumental structure may be more or less complex in verbs, but it is present only in some classes of non-prototypical nouns, e.g., deverbal nouns (see Collina et al. 2001; Kim & Thompson 2000). Moreover, morphosyntactic factors are another potential source of variation between verbs and nouns: verbs are more functionally tied to sentential processing than nouns. We will turn again to this issue later. For the moment we only observe that all the cited factors would make the same prediction relative to the direction of the experimental effects: verb processing should be more difficult (or more vulnerable) than noun processing. Nonetheless, the patient EBA, (Hillis & Caramazza 1995), shows the opposite pattern, namely a more marked impairment for nouns than verbs in spoken production. More to the point, some data on normal processing show that grammatical information for verbs is not only activated in the syntactic component of the linguistic system, but is also represented in the *output* lexicon (Laudanna et al. 2002a).

In linguistics nouns and verbs have been considered as the basic parts of speech. The distinction between nouns and verbs is in one sense so pervasive that it is difficult to indicate *a priori* which linguistic level pertains: lexicon, morphology, syntax, semantics, pragmatics, and so on. Because of the variety and the number of researches, here we will try to sketch the focal questions related to the noun/verb distinction rather than give a survey.

We can distinguish two different approaches as far as the noun/verb distinction is concerned, that we can roughly called the

theoretical approach and the typological approach. The two perspectives are not mutually exclusive, but they usually try to answer different questions. Theoretical linguistics considers nouns and verbs as explanatory tools and does not necessarily take position about the reality of nouns and verbs as linguistic objects. On the contrary, typological linguistics has investigated the linguistic reality of the distinction in a large number of languages. Therefore, theoretical linguistics focuses on the relevant criteria for the distinction and on its status within the theory of grammar (Croft 1991), while typological linguistics focuses on the variety of nouniness and verbiness exhibited by the different languages of the world (Sasse 2001). The results are not always comparable since the perspective refers to different levels of representation of the nouns/verbs distinction, and there are not many studies that discuss the theoretical implications of typological approach (Ramat 1999). Yet many typological researches could open new perspectives even for theoretical aims. The broadening of our knowledge on a wider number of languages makes clear that not only the noun/verb distinction can be shaped in many different ways, but it can also be based on different criteria. In other words, the nature of language can determine which criteria can be used: "while most languages furnish both morphological and syntactic criteria, in extreme isolating languages such as Vietnamese only syntactic criteria can be used" (Evans 2000: 708).

Another issue deeply debated in typological studies is the degree of categoriality that must be assigned to the noun/verb distinction (Ramat 1999). It is known that there are languages for which the distinction between nouns and verbs seems to be just a question of degree. In fact, there are words belonging to classes which share some features of both nouns and verbs, such as the *vouns* and *nerbs* in Murrinh-Patha, a Northern Australian language (Sasse 2001).

In spite of all the differences reported, what is particularly striking from our point of view is that both theoretical linguistics and typological linguistics refer to the same inventory of features as explanatory tools. As Sasse (2001: 506) points out: "the discussion of the noun/verb distinction has predominantly centered around the question of word classes being more or less distinct; the possibility of 'otherness' is seldom taken into account". This means that there is a substantial convergence on the fact that nouns and verbs are (or should be) classes of words which share semantic, syntactic, morphological and pragmatic features (Givón 2001).

Generally nouns are defined as the class of words referring to entities and verbs as the class of words referring to processes. This

kind of semantic definition (or one of its variants) is so well established in the linguistic tradition, that nearly any author quotes it (Langacker 1987; Givón 2001). The semantic difference is clearly related to the fact that nouns and verbs tend to assign different thematic roles to their arguments. There is a general agreement that semantic and syntactic properties are deeply related (Anderson 1997; Anward 2001). The semantic selection should determine the syntactic category, i.e. the connection between thematic roles and syntactic categories is strongly predictable (Chomsky 1986). As lexical categories, nouns and verbs have different syntactic properties: it is the verb that assigns the case to any phonetically realized Noun Phrase (Chomsky 1981). This means that nouns normally have no argumental structure, while verbs necessary have it.

Both semantic and syntactic properties are related to discourse and pragmatic functions: nouns are typically subjects and themes, while verbs are typically predicates and comments (Andrews 1985). According to some authors, informational structure has a particular relevance in distinguish nouns because of its independence from syntactic and morphological factors (Hopper and Thompson 1984; 1985).

As a consequence of their different syntactic role, nouns and verbs differ also as far as morphological properties are concerned. These distinctions involve several morphological features, but one of the most relevant seems to concern the nature of inflection. According to Booij (1996), two types of inflections should be distinguished, inherent and contextual inflection. The former is not required by syntactic context, i.e. it is not specifically related to the role the lexical item holds in the sentence. On the contrary, the latter is totally depending on the syntactic role the lexical item holds in the sentence. Although nouns and verbs can exhibit both inherent and contextual inflection, inherent inflection seems to have a heavier weight in nominal morphology and contextual inflection a heavier weight in verbal morphology.

In some languages nouns and verbs have different phonological features, such as stress pattern in English. Cross-linguistic studies on intonation claim that nouns and verbs occupy systematic prosodic positions as far as the pitch accent is concerned (Kelly 1992). Since accent distribution depends on focus distribution, investigations on nouns and verbs location in prosodic patterns is strictly associated to their function in the informational structure of the utterance (Ladd 1996).

What is important to point out here is that, as a result of the described underlying differences at both cognitive and linguistic

level, nouns and verbs differ from each other also distributionally, at least in two senses. Firstly, in many languages the frequency of nominal and verbal stems is distributed over quantitatively different sets of word patterns. For instance, in Italian nouns result from the combination of a stem with a vowel suffix, and the number of inflected forms for a noun in most of the cases is two, one for the singular form and the other for the plural. On the other hand, verbs result from the combination of a stem with a suffix whose length may vary to a large extent, and the number of inflectional endings that a verb stem may combine with is about fifty. The different richness of inflectional paradigms could favor different modalities of processing.

Secondly, the distributions of nouns and verbs differ because of their diverging patterns of occurrence in oral vs. written texts. Nouns and verbs hold different roles even in the construction of different types of texts. In studies comparing spoken and written texts in various languages constant diverging patterns of occurrence of nouns and verbs have been found. Two variables seem to be relevant in determining the frequency of nouns and verbs in a text: the amount of dialogue and the amount of planning (Biber 1995; Biber et al. 1999; Blanche-Benveniste 2001; Voghera in press). In general, nouns are generally more frequent in monologues and planned texts, while verbs are more frequent in dialogues and spontaneous texts. Since spoken texts are basically spontaneous dialogues and written texts are basically planned monologues, nouns and verbs have a different relevance in speaking and writing. Thus, the underlying differences between nouns and verbs are reflected (at least in some languages) in diverging patterns of nominal vs. verbal inputs which the listener/reader is exposed to and, hence to putative differences in their resulting representations.

3. Nouns and verbs as lexical classes

In spite of the multidimensionality of the distinction between nouns and verbs, we do not hold a completely interactionist view. We will discuss one specific aspects of the noun/verb distinction, trying to disentangle this aspect from the many others at our disposal: the representation of nouns and verbs as grammatical classes in the lexicon. In other terms, we assume that grammatical knowledge is represented in the lexicon and plays the role of an organizational principle. The basic grammatical knowledge relates to the words' syntactic category, or grammatical class, and its major function is to provide the

means by which words can be combined in syntactic frames (Caramazza & Shapiro in press a).

Among the other issues, the categoriality of the distinction between nouns and verbs has been often addressed: it is implicitly taken for granted by some researchers and rejected by others. Given that linguistic, psycholinguistic and neuropsychological data do not always provide unambiguous answers, the representational distinction between nouns and verbs as grammatical classes is far from being uncontroversial, given that it can be confounded with several other sources of information and/or processing components: semantic factors, argumental structure, morphosyntactic factors, and so on.

On the basis of this consideration, Bates et al. (1991) have distinguished three classes of explanations that can be given for the noun-verb distinction in lexical knowledge:

a SYNTACTIC explanation, according to which nouns and verbs encompass different functions in assembling sentences;

a LEXICAL-GRAMMATICAL explanation, which suggests that the main divergence between nouns and verbs is in their different status as grammatical classes;

a SEMANTIC-CONCEPTUAL explanation, which focuses on the differences between nouns and verbs in terms of those semantic features (like concreteness and imageability) that are associated to lexical meaning.[3]

In what follows, the goal of this paper will not be to dispute that the distinction or the dissociation between nouns and verbs may be sometimes interpreted as a consequence of syntactic or semantic factors. Rather, we would like to show that some sets of experimental data are to be explained as the effect of differences genuinely due to grammatical class, with limited possibility of appeal to syntactic or semantic factors.[4]

In considering the "syntactic" hypothesis, we have already observed that the relative difficulty on verbs as opposed to nouns displayed by agrammatic patients has often been causally related to the impairment of the mechanisms of syntactic processing. However, Caramazza & Hillis (1991) reported the case of two patients who had a specific impairment in verb production, although they could speak fluently. Berndt et al. (1997) described the case of a patient who demonstrated problems in producing and comprehending sentences, but who produced verbs better than nouns in picture naming. More recently, Shapiro & Caramazza (in press b) reported the case of a patient who was impaired in producing verbs in a picture naming task, even though she was able to process verbs as syntactic object in

tasks that required the utilization of the morphosyntactic knowledge of verbs. Some data on normal processing of verbs also show that the activation of grammatical features of verbs takes place even outside a syntactic context (Laudanna et al. 2002 a). Hence, we can conclude that, although verbs are relevant for syntactic processing and some types of verb's impairment develop from a more general impairment to syntactic processing mechanisms, the association between syntactic processing and grammatical processing of verbs is neither necessary, nor universal.

Among those who opt exclusively for one of the three explanations outlined by Bates et al. (1991), the most common opinion is that all noun/verb differences depend on semantic grounds. In this case, the hypothesis made about the categorial representation of nouns and verbs is that it represents nothing but the epiphenomenon of a basic semantic distinction. For instance, it has been argued that the distinction is so universally grounded in the human cognition that it emerges even in absence of any linguistic input. Goldin-Meadow et al. (1994) reported the case of a deaf child who, even being not exposed to sign language, invented a self-styled gesture system in which gestures for nouns were neatly distinct from gestures for verbs under many respects. On theoretical grounds, Pinker (1984) states that the child uses innate knowledge of semantics-to-syntax correspondences (e.g., words referring to objects tend to be nouns, while words referring to actions tend to be verbs) in order to find out the basic syntactic rules and categories in the input. In the neuropsychological literature, it has been claimed that nouns are, on average, more imageable and richer in their semantic features than verbs, with the consequence that they are less likely to undergo an impairment (Bird et al. 2000). Furthermore, it has been found that argument complexity is a source of difficulties for some patients (Kim & Thompson 2000), even when grammatical class and imageability are controlled (Collina et al. 2001).

Under all these views, one could be tempted to argue that in the description of human languages, as well as in the explanation of linguistic representations in the mind/brain, the distinction between nouns and verbs, if not reduced to, might be sufficiently motivated on the basis of deep cognitive and semantic universals: e.g., the oppositions between objects and actions, or between entities and processes, or the fact that nouns tend to encode sensory features while verbs tend to include non-sensory features. If this hypothesis would be entertained, verb deficits could always be classified as the consequence of a general damage to the semantic system.

Thus, the first question to be answered is whether lexical-grammatical knowledge has a functional and neuroanatomical basis separate from other aspects of a word's representation: in order to solve this problem, selective deficits in the oral production of verbs relative to names have been reported in the neuropsychological literature, and those deficits have been generally associated to frontal lesions or to other neurological damages. However, the origin of these disturbs is still not completely clear: in other terms, it is not clear whether they originate from the way in which the grammatical classes are organized in the brain or they derive from the selective damage of the neural representation of actions vs. objects. We argue that the available experimental results (patterns of lexical processing deficits, but also some reaction time data) force us to postulate that grammatical class information is an organizing principle of the representation of lexical knowledge in the mind/brain.

The first piece of evidence in favor of the hypothesis that the grammatical class information is represented in the lexicon derives from the neuropsychological literature. While in some cases noun/verb dissociations are the consequence of damage to the semantic features that are more prototypical of either nouns or verbs, in a number of other reports patients are described who display a marked dissociation between nouns and verbs, even though their semantic knowledge is undamaged. The most representative cases are those in which grammatical class effects are restricted to single modalities of output: in other terms, patients are impaired just in one category (nouns or verbs) and only in one modality (oral or written) (Caramazza & Hillis 1991; Rapp & Caramazza 1998). If the performance of these patients was attributable to a deficit in their semantic knowledge, the impairment should involve both output modalities. These studies not only support the view that grammatical class is a significant aspect of the lexical knowledge, but also show that it is relevant in simple tasks like producing, reading or writing single words, performed without the involvement of any context.

Recently (Shapiro & Caramazza in press b), it has been reported the case of an aphasic patient (RC) who showed greater difficulties in the production of grammatical forms of words and pseudo-words used like verbs (*he judges*, *he wugs*) than in the production of the same words and pseudo-words used like names (*the judges*, *the wugs*). In this case, the use of homonyms also ruled out the possibility that the dissociation was due to formal factors of orthographic or phonological complexity. This performance constitutes an extremely clear demonstration that the grammatical aspects of the processing of verbs can

be selectively compromised as a result of a cerebral damage. The comparison of the behavioural and neurological profile of RC with the profile of an other patient (JR, Shapiro et al. 2000) who displays analogous difficulties with the names, supports the hypothesis that the grammatical processing of names and verbs involves distinct neural systems in the frontal lobe. This conclusion was further confirmed by neuroimaging results from fMRI.

Summing up, what makes the "semantic" hypothesis inadequate as an ubiquitous way of explaining dissociations of grammatical class is mainly the performance of patients showing selective disturbances in processing nouns or verbs either in speaking or in writing, and either in spoken or in written comprehension. Furthermore, it should be taken into account that there are also some patients who, at the same time, show greater difficulty in producing words of one grammatical class in speaking and words of the other class in writing. If the difficulties in producing one class of words were the result of a damage to the semantic system, they could not be visible selectively in only one modality of output, but would affect in the same manner both speaking and writing, or both oral and written comprehension.

Finally, studies based on the technique of rTMS (repetitive Transcranial Magnetic Stimulation) have shown that one area of the left hemisphere, the prefrontal area, is involved in processing grammatical properties of words (in particular verbs), independent of their semantic content.

Arguments in favor of the view that grammatical class is a critical feature of lexical representation come also from the cognitive psychology of language. Here we will describe the results of an experiment conducted on Italian verbs and nouns (Laudanna, Voghera & Gazzellini 2002 b). These results suggest that lexical access mechanisms are sensitive to grammatical class information, even when semantic or syntactic dimension are not sufficient to explain the human performance. As in the analysis of the acquired disturbances of language, in principle, experimental noun-verb differences might also be ascribed to semantic, syntactic, or orthographic/phonological factors: one of the goals of the research of Laudanna et al. (2002 b) was to circumscribe the analysis of differences between nouns and verbs to their representation as grammatical classes in the input mental lexicon. More specifically, we addressed the issue of the representation and processing of nouns and verbs with reference to the task of recognizing inflected words, by testing the hypothesis of a grammatical class distinction in the orthographic input lexicon. We employed experimental conditions

and stimuli which should allow to disentangle grammatical/morphological information from semantic, syntactic and orthographic/phonological information. We exploited the inhibitory priming effect between stem homographs reported by Laudanna et al. (1989; 1992). Stem homographs are unambiguous word forms with stems that are orthographically and phonologically identical but semantically and grammatically different (e.g., *colpire* "to hit" whose stem is *colp*-, V, 3rd Conj., vs. *colpa* "fault" whose stem is *colp*-, N, Fem.). When a word form containing a homographic stem like *colpa* is primed by a word form like *colpire* – a morphologically unrelated word with a homographic stem – a robust inhibitory effect on recognition, when compared with both an unrelated prime condition and an orthographically similar prime condition, is found.

The inhibitory effect on stem homographs has been interpreted as the result of the activation of the stem entry (*colp*-, V, 3rd Conj.) for *colpire*, which interferes with the subsequent attempt to activate the orthographically identical stem entry (*colp*-, N, Fem.) for *colpa*. This interference was hypothesized to reflect the lexical system's response to the presence of two entries with the same form. Since the goal of the access process is the activation of only one entry matching the input stimulus, if the lexicon has two grammatically distinct entries whose form matches that of the stimulus, then some mechanism must suppress the grammatically inappropriate entry.

In the experiment in Laudanna et al. (2002 b), it was assessed whether the inhibitory effect equally applies to nouns and verbs or there are selective differences between them, the assumption being that, if nouns and verbs are differently affected by the stem homograph effect, this could shed light on possible representational differences at the lexical level. Thus, the effect on target verbs like *voluto* ("wanted", past participle, masc., sing.) when primed by a verb stem homograph like *volava* ("s/he flied", V, 1st conj., simple past) was compared with the effect obtained on target verbs (*stilare* "to draft", infinitive), whose stem is *stil*-, (V, 1st Conj.) when primed by a noun stem homograph (*stile* "style" (N, masc., sing.). It was also compared the effect on target nouns like *colpa* ("fault" (N, fem., sing.)), when primed by a noun stem homograph like *colpo* ("hit" (N, masc., sing.) with the effect obtained on target nouns (*mora* ("blackberry" (N, fem., sing.)), whose stem is *mor*-, when primed by a verb stem homograph, for instance *morire* ("to die" (V, 3rd Conj.). All the experimental conditions had a control condition where targets were kept constant and were preceded as primes by orthographically similar words beginning with an orthographic sequence (a "pseudo-stem") that was the same

as the target's stem, and a second control condition, in which unrelated primes were included.

The results showed that the interference effect on verb targets was stronger than on noun targets. In other terms, the results not only confirmed the already reported inhibitory effect for stem homographs when compared with both orthographically related and unrelated control conditions. They also allowed to further specify the stem homograph effect, at least in the sense that the effect is modulated by the grammatical relationship between prime and target. This provided further support for the view that orthographic lexical representations encode grammatical class information, with a consequent functional distinction between verbs and nouns. In the case of the inhibitory relation among stem homographs, if we assume that the effect reflects the organization of the input lexicon, where lexical items are processed as forms, then the described results may be interpreted as a support for the hypothesis that verbal and nominal stimuli are differently processed and/or represented in the input lexicon, at least as far as Italian is concerned. The reason why these results constitute an argument for the grammatical class representation hypothesis is that in the effect we found the relevant words (stem homographs) were neither semantically related, nor presented within a syntactic context. Hence, at least in this case, the explanation has to be circumscribed to a level of representation of grammatical class that is not affected by syntactic or semantic factors.

In conclusion, linguistic, neuropsychological and psycholinguistic design a complex picture of the distinction between nouns and verbs, with many points of convergences and also some discrepancies. When considering the available evidence from neuropsychological and psycholinguistic data, the distinction between nouns and verbs appears to be not much disputable. Linguistic data are less clear-cut, depending on the theoretical options and the languages under examination. However, there is an unanimous convergence on the fact that the very distinction is multi-faceted and cannot always be reduced to a single dimension of language processing or language description. More specifically, within the several dimensions underlying noun and verb processing, the representation of nouns and verbs as grammatical classes must be taken into account in order to explain the organization of lexical knowledge, the format of words' representations in the lexicon, and their theoretically possible breakdown.

Address of Authors:

Alessandro Laudanna, Department of Communication Sciences, University of Salerno, Via Ponte don Melillo, 84084 Fisciano (Sa), Italy <alaudanna@unisa.it> and Institute for Cognitive Sciences and Technologies - CNR, Viale Marx, 15, 00137 Roma, Italy < allaudan@ip.rm.cnr.it>

Miriam Voghera, Dipartimento di Studi Linguistici e Letterari, Università di Salerno, Via Ponte don Melillo, 84084 Fisciano (SA)

Footnotes

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1 Because of the controversial evidence, in this paper we will not take position as far as the universality of the noun/verb distinction is concerned.

2 In Hebrew, all verbs and most of the nouns are comprised of two abstract morphemes, roots (typically consisting of three consonants) and word patterns (consisting of either a sequence of vowels or a sequence of vowels and consonants), and the phonemes of the two morphemes are interleaved.

3 In our view, the three classes of explanations should not be taken, as frequently happens, as mutually exclusive explanations for the observed noun-verb dissociations. Just for the reason that nouns and verbs differ along several dimensions, it is very unlikely that each possible dissociation must be always led back to the same cause.

4 Sometimes it has been argued that the dissociation arises because verbs are more difficult or more complex than nouns. This conclusion can be easily neutralized by the observation that there are several reports of patient whose performance is better on verbs than on nouns (e.g., Hillis & Caramazza 1995; Shapiro et al. 2000; Zingeser & Berndt 1990).

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The picture-word interference paradigm: conceptual effects in the production of verbs

Patrizia Tabossi & Simona Collina

In recent years, experimental research on language production has started to make increasing use of the so-called picture-word interference paradigm to explore lexical retrieval processes. While providing useful information on the production of nouns, the paradigm has not led, so far, to comparable results with respect to the production of verbs. The paper presents an experiment and provides a discussion aiming at clarifying some of the variables that affect verb production and render semantic interference effects difficult to observe.

1. Interference effects and the production of nouns

Interference paradigms have long been popular among psychologists studying cognitive phenomena. The technique is simple: participants are presented with a stimulus made up of two different components. Their task is to respond to one component of the stimulus, ignoring the other. For example, they could be presented with a word such as *blue* written in red ink, and requested to name the ink colour as quickly as possible (Stroop 1935).

When the two components of the stimulus are a picture and a word, the task is typically one of picture naming: participants are instructed to ignore the distractor word and to name the picture, producing a target word. Usually, experimental conditions are manipulated by the researcher who varies the relationship between distractor and target words or the time interval between the presentations of picture and distractor (SOA: Stimulus Onset Asynchrony).

Over a decade ago, in an influential study conducted in Dutch, Schriefers et al. (1990) employed this paradigm to study the production of nouns. They found that naming a picture (e.g., a dog) takes longer when the distractor is semantically related (e.g., *cat*) than when it is unrelated (e.g., *roof*) to the target (e.g., *dog*). This effect is observed when the distractor is presented shortly before or at the same time as the picture (SOA = -150/0 ms), but disappears when it is presented after the picture (SOA = + 150 ms). In contrast, when target and distractor are phonologically related (e.g., *dog/fog*) respon-

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ses are faster than when they are not (e.g., *dog/roof*), provided that the distractor is presented after the target.

Similar results were subsequently replicated in Dutch as well as in other languages (Miozzo & Caramazza 1999; Roelofs 1992). Levelt and co-workers explained the findings based on their model of language production, in which the lexicon is viewed as a three layer net (Levelt et al. 1999). The first stratum of the net contains interconnected conceptual nodes and the labeled links between them express the nature of the semantic relationships. Some conceptual nodes – the lexical concepts – have a bidirectional link with their corresponding lemma nodes at the successive stratum, where words' syntactic properties are specified (the lemma stratum). Each lemma, in turn, has monodirectional links to nodes belonging to the next layer of the network, containing words' phonological information (lexeme stratum). Once in the phonological/articulatory domain, the selected lemma must be translated into the appropriate articulatory gestures for execution.

In this model, word retrieval is represented as a spreading activation process. Whenever a lexical concept becomes activated, it spreads activation to all the connected concept nodes. Moreover, it activates its lemma. Among the lemmas receiving activation from the conceptual nodes, the lemma that has the highest level of activation gets selected. Once selected, it then sends activation to the corresponding nodes at the lexeme level (Roelofs 1992).

Within this framework, semantic effects are assumed to occur in picture word-interference experiments under the constraint that all distractors are also names of pictures. Furthermore, while a picture directly activates its corresponding concept and then its lemma, a word has direct access to the lemma and only through this to the corresponding lexical concept. Given these assumptions, semantic interference effects arise when the distractor and the target concepts are connected: due to these connections, activation from the distractor and target concepts will enhance the level of activation of the distractor lemma which will be higher than the level of activation of a lemma whose concept has no connection with the target concept. Therefore, the distractor lemma will be a stronger competitor for the target lemma when their concepts are related, and it will take longer before the level of activation of the target will exceed that of the related distractor, leading to a longer selection time.

As for phonological facilitation, it occurs only when the distractor word is presented after the target lemma has been selected. At this point, if the distractor is phonologically related to the target, the

activation it sends to the lexeme level reaches some of the nodes activated by the target lemma, enhancing their activation and thus facilitating the selection of the target's phonological representation.

Studies conducted with the picture-word interference paradigm have extended the empirical basis traditionally available in support of the notion that the production of a word occurs in two fairly distinct stages, one involving the retrieval of the word's semantic and syntactic information and the other involving the retrieval of the corresponding lexical-phonological information (Bock 1986; Caramazza 1997; Dell 1986; Levelt 1989). It was well-known that in word substitution errors occurring during normal speech the pronounced word often shares with the intended word a relation that is only semantic or only phonological (e.g., *dog-cat*; *dog-fog*), suggesting the independence of the two types of information (Fay & Cutler 1977; Garrett 1988). Consistently with speech errors data, neuropsychological research has indicated that while some aphasic patients show difficulties at the semantic level, resulting, for instance, in producing semantic paraphasias, others produce frequent phonological substitutions or random rearrangements in words' phonemes, showing impairments at the phonological level (Garrett 1982; Ellis 1985; Kohn 1985). The experimental findings obtained with the picture-word interference paradigm have provided new and independent evidence on the temporal difference between semantic and phonological effects such that while semantic effects occur in the early phases of word production, phonological effects appear only later in the process (Roefols, 1998; Schriefers et al. 1990).

In fact, interesting issues concerning the production of nouns have been addressed and clarified in picture-word interference studies. For example, Schriefers (1993) asked his participants to name a picture producing a noun phrase (e.g., 'de groene stoel'-'the green chair'). The study was in Dutch, a language in which determiners and adjectives are marked for grammatical gender. The results showed faster responses when the grammatical gender of the distractor and target nouns were the same rather than different. Subsequent work made it clear that the congruency effect, initially interpreted as a purely syntactic phenomenon, may occur late in the production process, when determiners' phonological forms must be retrieved (Miozzo & Caramazza 1999).

Recent studies have also shed light on the role played by the response set in determining semantic interference effects. As already mentioned, according to Levelt and colleagues, a crucial condition in order to obtain these effects in a picture-word interference study is

that distractor and target words all belong to a set of words – the response set – that participants are given prior to the experiment, so that they can pre-activate and select them from among all the words they know (Levelt et al. 1999; Roelofs 1992). In contrast with this claim, however, Caramazza and colleagues have shown that semantic effects can be obtained even when distractor words are not part of the response set, and whether the nature of the effects is one of interference or facilitation depends on the relationship between target and distractor: if they are co-hyponyms (e.g., *dog-cat*), they interfere with each other, but if the target is a hypernym (e.g., *animal)*, the distractor (e.g., *cat)* facilitates the response (Caramazza & Costa 2000; Costa et al. in press).

2. Interference effects and the production of verbs

As fruitful as it may be in the study of noun production, the picture-word interference paradigm, at least so far, has not proven very productive with verbs. In a work in which distractors were part of the response set, Roelofs (1993) asked his Dutch participants to name the picture of an action, producing a target verb in the inifinitive form (e.g., *drinken* - 'to drink'). Contemporarily with the picture, a verb distractor was also presented. The distractor was semantically related (e.g., *eten* - 'to eat') or unrelated (e.g. *niezen* - 'to sneeze') to the target. As in noun studies, participants were slower in the related than unrelated condition, showing semantic interference effects.

Since Roelofs' work (1993), production processes have become increasingly popular and verbs have attracted a considerable amount of interest in language research (e.g., Berndt et al. 1997; Breedin & Martin, 1996; Breedin et al. 1998; Pickering and Branigan 1998; Levin & Rappaport Hovav 1996). Yet, only two picture-word interference studies exploring verb production have appeared so far, and neither of them provides a clear replication of Roelof's findings (Schriefers, Teruel, & Meinshausen, 1998; Tabossi & Collina, 2001). Schriefers et al. (1998) obtained semantic interference effects, albeit restricted to transitive verbs, in a study that looked at sentence rather than word production, whereas Tabossi & Collina (2001) found semantic effects in the assignment of aspectual auxiliary during the production of Italian verbs.

More recently, we conducted a study whose main goal was to replicate Roelofs' findings and to assess the relevance of the response set in the production of verbs. The results indicated a semantic inter-

ference effect. Participants were slower in naming a picture of a verb in presence of a semantically related distractor than in presence of an unrelated one (Collina & Tabossi, submitted).

This study replicates in Italian the results obtained by Roelofs (1993), corroborating the view that like noun production, verb production may be sensitive to effects of semantic interference. Furthermore, in analogy with what Caramazza & Costa (2000) have shown for nouns, our data suggest that the effects can be found regardless of whether or not distractor verbs are part of the response set, thus strengthening the evidence that calls for a re-consideration of the selection mechanism proposed by Levelt and colleagues in their model of lexical access (Levelt et al. 1999).

However, the materials we used in that study were Italian translations of Roelof's verbs and in both studies semantic relatedness between distractor and target verbs was decided on purely intuitive grounds. Hence, it is still not clear whether Roelof's and our own results would hold with entirely different sets of verbs, possibly selected on a principled way.

Unfortunately, our knowledge of how semantic information is mentally organized is not as good for verbs as it is for nouns. Even though there may be occasional uncertainties, usually intuition, empirical data, and theoretical models all suggest that in our mental organization a canary and a hawk, for example, are members of the category of birds, which in turn are a type of animals, whereas a fork and a spoon are types of cutlery, whose superordinate category is that of utensils (Rosch 1975).

We do have intuitions on the meanings of verbs; we know, for example, that the meanings of *run*, *walk* and *jump* 'go together', but have no strong relation with the meanings of *think* and *imagine*, which are 'close' to each other. But we soon run into troubles. Let us assume, for example, that *run*, *walk* and *jump* are all verbs of movement, what other members would the category include? Would *travel* or *go* belong to the same category? And what would their hypernym be? Current theories reflect somewhat these difficulties and various suggestions have been put forward in recent years (Jackendoff 1983; Levin & Pinker 1991). In order to test how well these theories capture the way in which verb meanings are mentally organized we ran the experiment described below.

3. The experimental investigation

One interesting linguistic hypothesis assumes that the syntactic behaviour of a verb can be predicted on the basis of its meaning (Chomsky 1986; Hale & Keyser 1987). On this assumption, Levin (1993) proposed to organize a large number of English verbs in classes whose members while sharing meaning components such as motion, contact, change of state, causation, also exhibit similar syntactic behaviours.

Levin's syntactic analyses are restricted to English verbs. Moreover, she makes no claims on the psychological relevance of her classification. However, the hypothesis is rather influential among psycholinguists (Fisher et al. 1991; Pinker 1989), and many of the meaning components identified in her work are common to various cognitive theories (Jackendoff 1983; Levin & Pinker 1991; Miller & Johnson-Laird 1976). Accordingly, we decided to rely on Levin's classification to select in a principled way verbs and to use them in a new picture-word interference experiment in Italian.

3.1. Methods

3.1.1. Participants

Twenty-one Italian native speakers from the University of Trieste took part in the experiment.

3.1.2. Materials

Fourteen classes of verbs were chosen, and from each class (e.g., verbs of learning), we selected two pairs of verbs such that while in one pair the relation between the two verbs was intuitively apparent (e.g., *studiare* - 'to study' */imparare* - 'to learn'), in the other pair it was not (e.g., *pensare* - 'to think' */leggere* - 'to read'). These pairs were used to create two sets of materials: the intuitive set and the semantic set. In this study distractors were part of the response set; hence, for each word, a black and white 13 × 13 picture was created and paired with two distractor verbs: one semantically related to the target and one unrelated. Before the experiment proper, pictures were presented to a panel of ten participants who had to name the action depicted. Only the pictures named with the intended verb were used in the experiment.

3.1.3. Procedure

Participants were presented with a picture along with a distractor verb in the infinitive form. Pictures were presented on the centre of the screen and the distractor word appeared above or below the picture.

Each trial had the following structure: picture and distractor were presented contemporarily on the screen (SOA = 0) for 1500 ms and then erased. After 2500 ms the next trial began. Participant's task was to name the picture as fast as possible producing the infinitive form of the verb. Onset naming latencies were measured from the onset of the picture to the beginning of the response by means of the voice key.

3.2. Results

The following types of responses were scored as errors and were excluded from the analyses: (a) the production of verbs that differed from those designated by the experimenter; (b) verbal disfluencies (e.g. stuttering); (c) recording failures. The percentage of errors was 16.6%.

There were two independent variables: set of materials (intuitive vs. principled) and relatedness (related vs. unrelated).

Responses were submitted to two analyses: one by subjects and one by items. In both analyses the set of materials was a between factor and the relatedness was a within factor.

The difference between the mean response latencies in the related and unrelated conditions was reliable neither in the intuitive set (933 ms, SD 206 ms vs. 953 ms, SD 312 ms), nor in the semantic set (943 ms, SD 212 ms vs. 930 ms, SD 203 ms).

In no case we found any evidence of an interference effect ($F1(1,20) = 1.20$, $MSe = 1361$, $p = 0.28$; $F2(1,55) = 0.083$, $MSe = 4112$, $p = 0.77$). No sources or interaction were reliable.

Semantic interference effects failed to be observed either in the linguistically principled or in the intuitive set. The classes of verbs we chose to use for the principled set were among the least uncontrovertial in the linguistic and psycholinguistic literature (Fellbaum 1990; Miller & Fellbaum 1991). It may still be argued, however, that these classes are not psychologically real independently of the theories that propose them. But, in addition, our data fail to replicate Roelofs (1993) and Collina & Tabossi (submitted) providing no support to the notion that verb distractors that have an intuitive semantic relation

with their target interfere with their production. No doubts, negative results call for great interpretative caution. Yet the lack of any semantic effect in the intuitive set was an unexpected result.

Why did we fail to replicate Roelofs' and Collina & Tabossi's results? How do the verbs we used in this study differ from theirs?

4. Transitive and intransitive verbs

It has recently been observed that semantic interference effects are more likely to be found with intransitive than transitive verbs. In fact, in Roelofs (1993) and Collina & Tabossi (submitted) the most part of the verbs used were intransitive, whereas the majority of the verbs in the experiment we have just described were transitive.

The possible relevance of this difference found some empirical ground in a series of five experiments where Schnur, Costa & Caramazza (submitted) observed that the transitivity value of a verb modulates the probability of getting semantic interference effect.

Tabossi & Collina (in preparation) directly compared the ability of transitive and intransitive verbs to give rise to semantic interference effects. What they found was a clear-cut interaction: naming latencies were reliably slower in the related than the unrelated condition when the verbs were intransitive. However, when the verbs were transitive no reliable effect was observed. This suggests that the transitivity of the verbs in Tabossi & Collina (in preparation) may in fact be responsible for the failure to detect semantic interference effect in that study. But why? Undoubtedly, there are semantic differences between intransitive and transitive verbs, the most obvious of which, perhaps, is that intransitive verbs are used to say something about entities, whereas transitive verbs are used to express relations among entities (Chierchia & McConnell-Ginet 1990). However, it is difficult to see how these differences could lead to a mental organization of the two types of verbs such that, while related intransitive verbs compete with each other in order to be selected during production, transitive verbs do not. Perhaps, a more promising way to explain the difference is one that considers the role of the context in word interpretation.

It is well-known that words may receive different interpretations depending upon the sentential contexts in which they occur. Anderson & Ortony (1975), for example, showed that *basket* is a better memory cue than *bottle* for a sentence like *The container held the apples*, whereas the reverse is true for a sentence like *The container*

held the cola. Context-dependent encoding, however, is not restricted to nouns. In fact, the sentence *The housewife cooked the chips* suggests that the housewife fried the chips. Hence, *fried* is a better recall cue for the sentence than *cooked*. But *fried* is not a better cue than *cooked* for *The housewife cooked the peas*. This sentence suggests that the housewife boiled the peas, and hence *boiled* is a better recall cue for it than *cooked* (Garnham 1979).

In this paradigm, pictures used to prompt the production of an intransitive target verb typically represent an individual performing an action (e.g. to laugh). However, a picture used to prompt a transitive verb requires, in addition, the representation of the object that is being acted upon and the selection of this object may determine the type of event actually represented. For instance, if the picture for *to write* depicts a person writing an essay, the event represented would be one of learning, whereas if the person is writing a letter, the event would be of a different type, namely one of communication. Thus a distractor verb (e.g., *to study*) which may be related to the target verb in one of its realizations (e.g., writing an essay), may not be in another (e.g., writing a letter), preventing semantic interference effects from being observed.

The entities involved in the action expressed by a verb play, in general, a crucial role in determining its interpretation, but the nature of transitive verbs seems to render their interpretation more dependent on context than the interpretation of intransitive verbs (Schnur et al., submitted). We assessed the difference by looking at the number of different uses listed for transitive and intransitive verbs. Our search, that used a recent Italian dictionary (Sabatini-Coletti 1997) and was restricted to frequent words only (using the option 'Dizionario di base'), revealed that the number of uses that a noun or a verb may receive is on average 3.82, in a range that goes from 1 to 26. Verbs, in general, have more distinct uses than nouns (4.60 vs. 3.04). However, among verbs, transitives have the largest number of uses (M = 5.37) compared not only to intransitives (M = 4.27), but also to modals (M = 4.88) and reflexives (M = 3.50). A one-way independent ANOVA which directly compared transitive and intransitive verbs showed a reliable difference in the number of contexts in which they appear ($F(1, 1807) = 41.9$; MSe = 3.76; $p = 0.000$). As rough as it is, the dictionary count gives a simple indication of the fact that transitive verbs are used to refer to a larger variety of events than intransitive verbs.

It is possible that this difference has an effect in the context of the picture-word interference paradigm. Some support to this

hypothesis comes from a recent study in which we explored the possibility to obtain interference effects with transitive verbs. Indeed, we found that the production of a target is slowed down by a distractor even though this is not semantically related [1], provided that the two verbs are related in the event represented in the picture. *To load*, for example, interfered in the production of *to shoot*, when the picture showed a shooting event.

People have intuitions on the semantics of verbs. We know, for example, that *to shoot* is close to *to fire* and far from *to load*. Likewise, we know that the meaning of a verb like *to write* is 'close' to the meanings of verbs like *to read* or *to study*, and far from the meaning of a verb like *to send*, which is close to the meaning of *to receive*. However, our findings seem to suggest that verb production in picture- word interference studies is sensitive not so much to semantic relation, as to the conceptual organization of complex events like TO BUY A NEW DRESS, TO COMMUNICATE BY MAIL, TO MAKE MUSIC TO USE WEAPONS. We know that in an epistolary exchange, for instance, we may write letters, read them, post, send, stamp, and receive them.

Work on knowledge representation has shown that events are mentally structured and are organized in basic, superordinate and subordinate levels just like objects' (Barsalou 1985; Barsalou et al. 1998; Morris & Murphy 1990). However, notions such as goal and time, which play no major role in the mental organization of objects, are central in the organization of events (Barsalou & Sewell 1985). A complex event such as TO BUY A NEW DRESS, for example, would include actions like TO SELECT A DRESS and TO PAY, which would be stored along with the specification that the latter action must occur after the former.

Probably, conceptual effects are particularly evident with transitive verbs for the joint effects of two factors. First, the relational nature of these verbs makes their interpretation very dependent on the specification of their arguments, in particular their themes (Schnur et al., submitted). Second, this characteristic becomes apparent in picture-word studies in which the use of a visual stimulus makes it impossible to avoid the pictorial realization of verb's arguments. However, there is no reason to believe that the conceptual phenomena are restricted to the production of transitive verbs or to verbs only. To the contrary, the effects we observed suggest the need for a careful scrutiny of the nature of the effects we observed in picture-word interference studies.

5. Concluding remarks

In language production research, the picture-word interference paradigm is currently used to study word production, including the processes of word selection. In this framework, semantic interference effects have typically been interpreted as evidence of competition for selection of two lemmas whose meaning is related.

Levelt and colleagues argue for the correctness of this interpretation. In particular, Schriefers (1990) found that the effect of interference disappears when the naming task is changed into a non verbal task such as categorizing the pictures as new or old by pressing a button.

Unfortunately, our discussion seems to indicate that the linguistic process of verb selection may be affected by extralinguistic phenomena such as speakers' conceptual organization of complex events. If the hypothesis is correct, it has two main consequences. On the one hand it casts doubts on the adequacy of the picture- word interference paradigm in the study of the linguistic processes involved in verb production. On the other hand, however, it highlights the fact that our semantic knowledge is probably so tightly interwound with conceptual knowledge that studying one ignoring the other maybe actually prove to be impossible.

In current psycholinguistics, it is usually agreed that the meaning of a word is the same of the concept (Bock & Levelt 1984; Levelt et al. 1999). The meaning of the word apple is the same of the concept APPLE. Consider, now, a verb like *escort*. According to Levelt and colleagues, the meaning of *escort* is represented by all the links the concept ESCORT (X, Y) has with other concepts, like its hypernym ACCOMPANY (X, Y). Semantic relations such as class inclusion reflect people's linguistic intuitions whereby if, for instance, *Mary escorts Peter* is true, *Mary accompanies Peter* must also be true.

However, in addition to these relations, discussed by Levelt and colleagues, ESCORT (X, Y) may have other types of conceptual relations. In a domain organizing our knowledge of balls, for example, escorting is an act of courtesy in the context of a dancing situation, whereas in the domain of anti-crime initiatives in Sicily, it is a dangerous activity to protect judges' threatened lives. All these types of information, concerning the lexical knowledge of meaning as well as the world knowledge, are likely to be normally available to people when they speak or listen to discourse. Almost 30 years ago, Miller & Johnson-Laird produced an in-depth analysis of the kind of conceptual organization that is necessary to explain our linguistic beha-

viour. Since their seminal work, much progress has been made. Research on concepts has developed into an independent field (Ross & Spalding 1994), and current computational tools no longer include the decision tables employed by Miller and Johnson-Laird. However, their theory is probably the most developed conceptual theory of meaning to date. It provides an analysis of core concepts and operators that we use to organize our experience into semantic fields. Concepts are part of different semantic fields and within each field the relations they have with one another depend upon the field's conceptual core, i.e. the abstract conceptualization of the field.

According to Miller & Johnson-Laird (1976), our verb knowledge is captured in two ways: lexical concepts of events are organized in fields that reflect our knowledge of the relations among those concepts. In addition, each of these concepts participates in other fields that organize longer chunks of experience.

In our view, the picture-word interference is sensitive to both types of knowledge.

Perhaps, researchers have underestimated the complex relationship between the two, and this may account for some of the difficulties and the inconsistencies faced so far in the use of the paradigm at least in the study of verbs.

Most of these problems, however, may probably be overcome by a more careful consideration of the factors that intervene in naming a depicted event. In this way the picture-word interference paradigm might become a valuable tool in the study of how verb knowledge is mentally organized and retrieved during speech.

Address of the Authors:
Patrizia Tabossi, Dipartimento di Psicologia, Via Sant'Anastasio 12, 34134 Trieste <tabossi@univ.trieste.it>
Simona Collina, *idem* <collina@psico.univ.trieste.it>

Footnotes

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1 A panel of twenty participants judged on a scale from 1 to 7 the semantic relation between the verbs (MEAN = 4.79; SD = 0.98).

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On the nature of selective deficits involving nouns and verbs

Claudio Luzzatti & Gennaro Chierchia

In this paper we address the status of Verb-Noun (V-N) dissociation in aphasic patients, building on the results of a large-scale study (Luzzatti et al. 2002). We first briefly review the main positions that have emerged in the rich debate on this topic. We then reconsider the findings of Luzzatti et al. in light of such debate, offering a partially novel interpretation of their results. Our main (tentative) conclusions are the following. First, Luzzatti et al. do provide further evidence that V-N dissociations cannot be wholly explained in terms of extralinguistic aspects of our sensory/conceptual system. Second, such evidence can be accounted for, perhaps optimally, under the assumption that argument structure is what is involved in damage to verbs. A damage to argument structure would, in fact, not only selectively affect verbs over nouns; it would also arguably determine the type of compensatory strategy to be used in such cases. In particular, the easier it is for an action to be coded in mental visual images, the easier it will be to restore the corresponding argument structure (by extracting from the events the corresponding theta-roles). Selective damage to nouns, on the other hand, cannot as readily be accounted for in terms of damage to argument structure and, in fact, it must be caused by different underlying mechanisms.[*]

1. Introduction

As is well known, aphasics often show a Verb-Noun (V-N) dissociation. In some patients use of verbs is impaired, while use of nouns is relatively spared. In other patients the opposite pattern may emerge. This is an area of study in which neuropsychology and linguistics can fruitfully interact, and in fact have already done so. In this paper we would like to discuss the status of the ongoing debate on this topic, as we perceive it, building on a large scale study of aphasic subjects, presented in Luzzatti et al. (2002). The present paper is organized as follows. First, in the rest of this introduction we review some of the relevant background. Then, in section 2, we summarize the results of Luzzatti et al. (2002). In section 3, we discuss such results against the background of the debate reviewed in the introduction. We offer a partially new interpretation of such results, in the light of current linguistic theory, and discuss some problems

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that remain open. Finally, in section 4, some (tentative) general conclusions are offered.

1.1. Cognitive neuropsychology and neurolinguisitcs

Cognitive neuropsychology (i.e. the branch of experimental psychology that studies cognitive functions) enables us to test multicomponential models of complex cognitive capacities structured in a modular way. In particular, during the 80's much important work has shown how one can investigate such capacities through the study of patients suffering from neuropsychological damage (Fodor 1983; Marshall 1984; Caramazza 1986). Typically, models of the normal functioning of a given capacity hypothesize different subunits that play a role in processing the relevant material. The behavior of a certain pathological subject may confirm or disconfirm the functional independence of the hypothesized subunits and/or their hierarchical organization. More specifically, two subcomponents may be damaged independently of each other, and hence we expect to find a double dissociation of the two corresponding functions. If such dissociation is indeed found we have confirming evidence of the independence of the subunits. Usually, though not always, such independence may have an anatomical basis (e.g. when lesions involve two separate areas of the brain).

The study of aphasia is a prime example of the effectiveness of this research paradigm, as we hope to illustrate through our review of V-N dissociation. For this purpose it may be useful to recall some basic information on aphasic language impairments and their description.

Aphasia is a language impairment that affects the production and comprehension of verbal messages in individuals with a normal language acquisition history. Typically, this acquired disorder results from a left-hemisphere brain lesion and it involves, in general, different linguistic units and modalities.

The description of language disorders is usually based on the characteristics of the spontaneous speech output (see table 1). These include the fluency dimension and the degree of impairment of the individual linguistic units. The variables used for a fluency judgement are fairly heterogeneous, ranging from impairments of the articulatory motor control (apraxia of speech), reduced rate of speech (verbal inertia), and primary damage to the syntactic realization of

sentences. The latter impairment may emerge in two antithetical types of damage, a first one characterized by lack of grammatical complexity and omission of functional elements (agrammatism), a second one by normal sentence complexity, however with improper use of functional elements (paragrammatism).

Table 1. Major types of aphasia and principal deficits

Major types of aphasia	Principal deficits
Fluent aphasia	
Wernicke's aphasia	Lexical, phonological and morpho-syntactic
Conduction aphasia	Phonological
Anomic aphasia	Word retrieval
Transcortical sensory aphasia	Lexical-semantic both in production and in comprehension
Nonfluent aphasia	
Agrammatism (Broca's aphasia)	Telegraphic speech output
Nonagrammatic nonfluent aphasia (nonagrammatic Broca's aphasia)	Slow and effortful speech; reduced syntactic structure, but no telegraphic output (± apraxia of speech)
Global aphasia	Severe articulatory, lexical, phonological and morphosyntactic

FLUENT aphasic output is abundant; articulation, prosody and phrase length are normal; sentences have a complex syntactic structure, but do contain many interruptions, agreement errors and substitutions of function words (see Table 1). The lexical component is impaired as evidenced by the presence of word finding difficulties and lexical substitutions, and phonology is affected, resulting in phonemic substitutions and phonemic neologisms. Wernicke's aphasia is the prototypical fluent language disorder: patients show an almost homogeneous impairment of the phonemic, syntactic and lexical-semantic components. In contrast, a lexical access disorder is prominent in anomic aphasia, a phonological impairment (and therefore a repetition deficit) typifies conduction aphasia, and a semantic deficit (or a deficit of the lexical-semantic interface) characterizes transcortical sensory aphasia. The impairment of comprehension varies according to the severity of the language disorder, is minimal

or mild in conduction aphasia and anomic aphasia, and severe in transcortical sensory aphasia.

NONFLUENT speech output is sparse, phrases are short, words are produced with effort and with little prosody, or are poorly articulated; sentence structure is simplified and lacks of subordinate clauses; function words are often omitted. *Broca's aphasia* is the prototypical nonfluent language disorder. Nonfluency is caused either by the impairment of syntactic structure (agrammatism), or by an articulation deficit (apraxia of speech). Global aphasia is the most severe type of nonfluent language disorder. Speech is usually reduced to a few stereotyped utterances and there is almost always a severe disorder of articulation. Comprehension and repetition are also severely impaired.

Various types of aphasia give rise to the phenomenon of double dissociations, which is directly relevant for testing the structure of language processing units. An example of double dissociation that may be observed in aphasic subjects affects names of natural versus artificial objects, a dissociation whose basis is as of yet not fully understood. As a consequence of inferior temporal lesions a peculiar impairment can emerge in the use of names of natural objects and/or of the underlying conceptual knowledge that leaves the corresponding abilities concerning artificial objects intact. A patient with this impairment can for example name or describe a wrench, a corkscrew or a sledge, but not a strawberry, a zebra or a snake. Interestingly the opposite dissociation is also attested. Category-specific deficits such as these have been explained on one side in terms of a separate functional and anatomical organization of lexical or lexical-semantic knowledge of natural versus artificial objects (Hart et al. 1985; Caramazza & Shelton 1998). However, the same data can also be accounted in terms of the different type of knowledge that underlies the two classes of objects (as opposed to a categorial distinction in the lexicon). According to this hypothesis, natural objects are coded through prevalently visual information (e.g., form and color), while artifacts rely on prevalently functional information (e.g. their typical use) (Warrington & McCarthy, 1983; Warrington & Shallice 1984). Evidence in favor of this view comes from those patients who, for example, cannot describe the mantle of a tiger but have extensive knowledge of its typical dispositional properties (e.g. it is ferocious, lives in the jungle, etc.). From this perspective, the double dissociation stems from the separate anatomical organization of visual and functional attributes, with the former located in the visual associative *temporal-occipital* cortex, and the latter in the *parietal* cortex.

The different conceptual representation underlying natural objects and artifacts is confirmed by several imaging studies (e.g. Perani et al. 1995; Martin et al. 1996), which showed temporal activation during tasks requiring semantic judgements on natural items and parietal activation for semantic judgements on artifacts.

1.2. Dissociated impairment of verbs and nouns

Turning now to our main concern, the V-N double dissociations have been the object of intense investigation over the past decades (for an overview, see Luzzatti et al., 2002 and references therein).

Originally it was believed that verb retrieval was more impaired in agrammatic patients, while anomic patients had greater difficulty with nouns (McCarthy & Warrington 1985; Zingeser & Berndt 1988, 1990; Chen & Bates 1988; Bates et al. 1991; Daniele et al. 1994). However it soon emerged that this generalization was untenable, since several cases of *verb retrieval damage* in *non-agrammatic* patients were found (for instance, Williams & Canter 1987; Kohn et al. 1989; Berndt et al. 1997).

More recently, Jonkers & Bastiaanse (1998) suggested that verbs and nouns dissociate in *one direction* only, as *all aphasic* patients have more difficulty retrieving verbs than nouns. The opposite dissociation would be an artifact resulting from linguistic and psycholinguistic variables that are relevant in determining word retrieval, and word-retrieval deficits.

In a similar vein, Bird and coworkers (2000) explained V-N dissociations in terms of the different weight of the underlying perceptual and lexical-semantic features. This type of account builds on the one offered by Warrington & McCarthy (1983) to account for dissociations between natural vs. artificial objects. Essentially, knowledge of verbs would be predominantly functional, while knowledge of (concrete) nouns predominantly visual. The interest of this hypothesis lies in the fact that it enables one to explain V-N dissociation without direct appeal to grammatical categories, thereby, reducing the relevant phenomena to an independently established and undoubtedly real functional and anatomical distinction.

We shall come back extensively to this issue later. We may, however, notice already at this preliminary stage that it is implausible that this line of explanation extends to *all cases* of Verb-Noun dissociations. For example, Caramazza and coworkers describe cases of Noun- and Verb-superiority in *single* oral or written, input or output modalities. I.e. certain patients confronted with the picture of an

action could name it orally (verb naming), but not in writing (Caramazza & Hillis 1991), while another patient made many errors on nouns in spoken naming, but showed greater impairment for verbs in written word comprehension (Hillis & Caramazza 1995). Finally, a third case showed a higher rate of impairment for nouns in spoken naming, but for verbs in written naming (Rapp & Caramazza in press). These findings (a) are inconsistent with the idea that Verb-Noun dissociation are caused by the impairment of the underlying associated knowledge, and (b) seem to suggest selective damage of specifically linguistic categories.

The work of Caramazza and coworkers views V-N dissociations as a specifically linguistic deficit. For the present purposes we can view language as a structured lexicon and a combinatorial apparatus; and with regard to this distinction, the deficit in question, according to Caramazza, concerns primarily the structured lexicon. But other hypotheses are also conceivable. For example, Friedmann et al. (2000) locates the problem of V-N dissociation in the combinatorial apparatus. In particular they suggest that the verb retrieval deficit observed in agrammatic patients "shall not be explained as a selective lexical impairment, but as a syntactic impairment causing inability to move verbs to the relevant functional categories, and to inflect them correctly". The idea is that agrammatic patients have a simplified clause structure where the upper portion of the syntactic tree (that typically encodes "functional" information about tense, aspect, etc.) gets "pruned". Accordingly:

> "When agrammatics have to inflect a verb and move it to a pruned position, they sometimes prefer not to produce the verb at all. The deficit, then, is not a purely lexical deficit in the 'verb lexicon'. It is modulated, rather, by syntactic structure, and can be explained within the framework of pruned trees and the resulting verb movement deficit. Thus, verb omissions may result from the same deficit that causes verb inflection errors: a syntactic deficit." (Friedmann, 2000).

In considering verb impairments, it should also be kept in mind that verbs are associated with different argument structures. It has occasionally been noted that type/complexity of argument structures does play a role in the performance of verb-impaired patients (Thompson et al. 1997). However, the results obtained so far in this domain have not lead as of yet to the identification of robust empirical generalizations (1).

Summing up, the result of previous work on V-N dissociations shows rich and differentiated landscape. On the one hand several important cases of such dissociations have been documented in detail. On the other hand many different kinds of accounts have been offered. Some such accounts emphasize the role of the extralinguistic knowledge that underlies the Verb-Noun distinction; others put the burden of explanation on grammar specific notions (be they located primarily in the lexicon or primarily in the syntactic combinatorics). It is against this background that the work of Luzzatti et al. (2002) finds its main justification. Such a work studies a relatively large sample of 58 aphasic patients with the intent of sorting out the weight of different factors that may be involved in the dissociation in question. The objectives of the study were: (i) to assess the prevalence of selective impairment of verbs and nouns; (ii) to ascertain whether verb- or noun-superiority is associated with a particular type of aphasia; (iii) to ascertain whether there are differences among verb types; (iv) to elucidate the mechanisms underlying verb-noun dissociation. We now turn to a brief presentation of the main results of such work.

2. Main results of Luzzatti et al.'s (2002) study

The study consisted of a picture naming task (of objects and of actions) involving 58 aphasic patients and 45 normal controls. Thirty-six of the aphasic patients were suffering from fluent language disorders, and 15 from nonfluent language disorders. Thirteen of the fluent aphasic patients were classified as suffering from anomic aphasia and 23 from Wernicke's aphasia. Of the 15 nonfluent aphasic patients, six showed typical agrammatic speech output, with omission of function words, verbs in non-finite form, etc., while the remaining nine showed slow rate of speech and simplified syntactic structure, but no classic telegraphic output. Seven patients were affected by a language disorder that could not be classified unambiguously into any of the major aphasic groups.

Participants were given a visual naming task with 30 objects and 40 actions.

The major lexical (oral word frequency, age of acquisition) and semantic variables (familiarity with the underlying concept, imageability) that have been shown to influence lexical retrieval were considered.

Verbs were distinguished by principal functional classes: i.e.

transitive, and intransitive verbs (the latter further divided in unergative and unaccusative verbs). Sixteen pictures elicited the production of a transitive verb (e.g. *legare* 'to bind'; *misurare* 'to measure'; *tagliare* 'to cut'; *versare* 'to pour'). Following contemporary linguistic principles, intransitive verbs were divided in two further groups. Twelve pictures elicited the production of unergative verbs (e.g. *dormire* 'to sleep'; *camminare* 'to walk'; *nuotare* 'to swim'; *piangere* 'to cry'), 12 items of unaccusative verbs (e.g. *cadere* 'to fall'; *crollare* 'to collapse'; *scivolare* 'to slip'; *scoppiare* 'to explode'). On the surface, unaccusative verbs, like intransitive verbs, do not take a direct object. However, typically, the grammatical subject of unaccusative verbs is not the agent but the theme of the action. This makes active unaccusatives similar to the passive of transitive verbs. In fact, as in passive sentences, Italian unaccusative verbs take the auxiliary *essere* (to be) rather than *avere* (to have). The unergative verbs are, per contrast, the *avere*-selecting intransitive verbs.

Unaccusative verbs

(1)	la casa crolla	la casa è crollata [auxiliary: *essere*]
	'the house collapses'	'the house has [lit.: *is*] collapsed'

Unergative verbs

(2)	la ragazza dorme	la ragazza ha dormito [auxiliary: *avere*]
	'the girl sleeps'	'the girl *has* slept'

Transitive verbs

(3)	la ragazza taglia la torta	la ragazza ha tagliato la torta [auxiliary: *avere*]
	'the girl cuts the cake'	'the girl *has* cut the cake'

Transitive passive sentences

(4)	la torta è tagliata (dalla ragazza) [auxiliary: *essere*]
	'the cake *is* cut (by the girl)'

The data obtained from the naming task were compared among the major aphasic subgroups and analyzed as single cases using a logistic regression procedure.

On the group study, fluent aphasic patients obtained a performance for nouns that is slightly better than that for verbs (N = 49%; V = 41%). Such a difference was much larger in the Wernicke's patients (N = 48%; V = 33%), while in the anomic patients there was a better performance with verbs, a difference however that did not reach the significance level (N = 51%; V = 55%). Nonfluent aphasic

patients, on the contrary, performed much better on nouns than on verbs (N = 67%; V: 43%). This mean difference was even larger in agrammatic patients (N = 71%; V: 34%).

For what concerns the naming ability of different verb classes, fluent aphasic patients did not show any difference of performance (unaccusatives 36%, unergatives 42%, transitives 43%), whereas non-fluent patients - with and without telegraphic speech - were significantly more impaired on unaccusative (34%) than on unergative verbs (50%). Furthermore, the agrammatic cases were severely impaired also on transitive verbs (25%).

The authors also wanted to analyze variations in the performances of the individual patients. Single case analysis (Logistic regression: Mc Cullagh & Nelder 1983) made it possible to study the effects of the variables that might have influenced the naming performance. Variables were both categorical (verbs versus nouns) and continuous (word frequency, familiarity, imageability).

Twenty-six patients showed dissociated naming ability of verbs and nouns. Naming of nouns was more impaired in 6 cases, that of verbs in the remaining 20. Five of the 6 agrammatic patients were significantly more impaired with verbs. Among the 13 patients suffering from anomic aphasia, 7 obtained a dissociated naming impairment, 5 of them with verb- and 2 with noun-superiority. On the contrary, of the 23 Wernicke's patients, 7 had superiority for nouns and 1 for verbs.

The logistic regression procedure also allows to test the effect of continuous variables (e.g. word frequency and imageability) to explain the naming performance of the single aphasic patients on each individual item. It turns out that word frequency has significant effect on the naming performance of 11 patients and in particular of 5 from the 6 patients with specific impairment of nouns. On the contrary, imageability has significant effect in 29 patients, and in particular in all 20 patients with specific impairment of verbs. Finally, among the 32 non-dissociated cases, the effect of word frequency and of imageability is significant in only 4 and 7 cases, respectively.

A multivariate logistic regression was carried out on those patients who showed a significant ($p < .05$) verb- or noun-superiority combined with a significant effect of one (or more) of the concomitant variables. The objective of the analysis was to assess whether verb- or noun-superiority held independently of the effect of the continuous variables. After the introduction of word frequency in the regression model, three of the five patients with verb superiority no longer reached significance. On the other hand, after the introduction of

imageability, only two of the 20 noun-superiority cases remained significant. Such a reduction of noun-verb dissociations indicates that the superiority of either grammatical classes depends of – at least in some of the cases – on word frequency and imageability differences between nouns and verbs. However, the effect remained significant in 2 verb-superiority and in 2 noun-superiority cases even after the imageability and word frequency effects had been factored out.

The results of our single case studies are provided in Table 2. The main empirical generalizations emerging from such results can be summarized as follows:

(1) The V-N dissociation is bidirectional. Most aphasic patients show verb deficits; but the opposite condition also unequivocally emerges.

(2) Selective impairments of verbs is the only form of dissociation observable in agrammatic patients. Both V>N and N>V dissociations can instead be observed among fluent aphasic patients.

(3) Nonfluent patients (whether agrammatic or not) have difficulty with unaccusative verbs. A deficit affecting transitive verbs only emerges in agrammatic patients; they appear to be sensitive to the number of arguments in a verb entry.

(4) In the majority of cases, word frequency and imageability correlate with dissociation patterns in a significant manner. Word frequency affects noun retrieval; imageability verb retrieval.

(5) In about 1/3 of the cases, a genuine grammatical class effect persists, even when imageability and word frequency effects are factored out.

We now turn to a general discussion of these findings.

3. Discussion

We will start out by discussing some general issues our methodology raises. We will then turn to a discussion of the main effects we found (imageability, word frequency, argument structure, etc.).

A preliminary point concerning the status of the categories Nouns vs. Verbs in current linguistic theory should be addressed. Such categorial contrast manifests itself differently in different languages. In fact, even for languages like English or Italian it has been argued that nouns and verbs may well have a common underlying

Table 2. Results of the multiple single-case study for the 26 patients with dissociated naming ability on verbs and nouns (from Luzzatti et al., 2002).

					Superiority effects (verbs vs nouns) univariate a.		bivariate analyses				Effect of the concomitant variables on the naming ability on verbs and nouns					
Pt	Sup	Aph type	%N	%V	N-V X^2	*p*	N-V + WF X^2	*p*	N-V + IM X^2	*p*	WF X^2	*p*	IM X^2	*p*	FAM X^2	*p*
9	V>N	A	13	58	12.1	<.001	10.1	<.005	3.2		7.5	<.01	10.3	.001	4.7	<.05
5	V>N	A	7	45	9.3	<.005	8.0	.005			8.4	<.005	4.3	<.05	10.4	.001
20	V>N	W	13	40	5.5	<.05					1.6		2.6		6.0	<.05
8	V>N	A	37	65	5.4	<.05	2.7				8.1	<.005	1.5		15.0	<.001
7	V>N	A	13	38	4.7	<.05	3.3				6.6	.01	1.5		6.5	.01
13	V>N	A	43	68	4.0	<.05	2.6				4.2	<.05	3.6		5.6	<.05
21	N>V	W	73	8	23.4	<.001			0		0.3		19.2	<.001	7.7	.01
49	N>V	Agr	87	30	18.1	<.001			1.6		0		17.9	<.001	0.8	
24	N>V	W	57	8	15.6	<.001			0.3		1.4		14.9	<.001	5.1	<.05
58	N>V	NC	53	5	14.4	<.001			1.4		0.3		12.8	<.001	2.5	
48	N>V	Agr	83	35	14.2	<.001	12.6	<.001	0.4		4.1	<.05	15.1	<.001	0.1	
42	N>V	nF-	53	3	12.6	<.001			0.7		0.7		12.2	<.001	3.6	
32	N>V	W	47	10	10.3	.001			0		0.2		11.0	<.001	0.5	
16	N>V	W	87	48	10.0	<.005	14.7	<.001	5.2	<.05	4.3	<.05	6.7	<.01	1.8	
51	N>V	Agr	80	45	8.1	<.005			0		0.9		9.7	.005	5.5	<.05
6	N>V	A	80	45	8.1	<.005			1.1		0		7.4	<.01	2.4	
53	N>V	NC	47	15	7.8	.005			0.8		0.5		10.3	.001	1.9	
30	N>V	W	47	15	7.8	.005			0.2		1.6		9.5	.005	9.7	<.005
1	N>V	A	70	40	7.3	<.01			1.4		1.7		6	<.05	1.4	
47	N>V	Agr	70	38	7.0	<.01			0.4		0		6.8	<.01	3.1	
54	N>V	NC	70	38	7.0	<.01			0.1		0.2		7.5	<.01	6.0	.01
50	N>V	Agr	70	40	6.0	<.05			0.2		0.3		6.3	.01	4.5	<.05
25	N>V	W	70	40	6.0	<.05			3.8	.05	0.6		12.2	.001	2.7	
52	N>V	NC	57	28	5.9	<.05			1.0		0		9.2	<.005	5.4	<.05
27	N>V	W	27	5	5.4	<.05			1.7		0.8		6.6	<.01	3.5	
57	N>V	NC	70	45	4.2	<.05			0.1		0		5.9	<.05	0.9	
Verb superiority cases					6				5 (83%)				2 (33%)		6 (100%)	
(“) after disentangling for WF							2									
Noun superiority cases					20				2 (10%)		20 (100%)		7 (33%)			
(“) after disentangling for IM								2								

Pt = patient; Sup = noun- or verb-superiority (univariate analysis); Aph type = aphasia type (A = anomic, W = Wernicke's, Agr = agrammatic, nF- = non-agrammatic nonfluent, NC = non classifiable aphasia); N = naming of nouns; V = naming of verbs; 1V = univariate, 2V = bivariate analysis; WF= word frequency; IM = imageability; FAM = familiarity. P-values for bivariate analyses refer to the N-V parameter only (the p-value for the concomitant variables included in the model (WF or IM) being implicitly significant ($p < .05$)).

source. For example, there might bean underspecified stem that can be realized either as a verb or as a noun, depending on the morphosyntactic processes it enters into. While this is an interesting hypothesis which might well turn out to be correct, the fact remains that through a variety of devices (ranging from morphology to positions in the clause) languages do seem to distinguish, at some point, verb roles from noun roles. The former (i.e. verbs) are typically heads of predicative complexes. The latter (i.e. nouns) typically play the role of arguments in predicative structures. We are going, therefore, to assume (in keeping with much current work) that there is a derivational phase or level of grammatical representation (in the lexicon or, possibly, in the syntax) where Nouns and Verbs are structurally (categorially) distinguished. Our concern in the present study is whether such distinction (which we take to be well motivated on linguistic grounds) also manifests itself in tangible forms in language processing and/or in the functional organization of the brain.

With regard to our experimental methodology, one of the chief characteristics of our study is that we are dealing with a relatively large and varied sample of subjects, whose members present different kinds of damage. Hence the causes of their dissociation patterns (even when such patterns appear to be similar) are likely to be as varied as the population. The present technique doesn't allow us to readily tease apart potential causes of the dissociation. It may, however, help us identify tendencies which remain constant across various kinds of deficits. To exemplify concretely, suppose, drawing from grammar based accounts, that in some patients, N>V superiority is caused by a syntactic damage consisting in the loss of certain functional categories associated with verbs (say T(ense), as suggested by Friedmann), while in other patients it is caused by a lexical damage to the category V (possibly in the form of loss of information coded in verb lemmas). Our methodology wouldn't be able to tease apart these two a priori equally conceivable causes. This is so, among other reasons, because it is presently unclear whether answers in picture naming of nouns and verbs are "reduced" sentences (which would require producing a significant portion of clause structure) or simple words (which is likely to call upon a prevalently lexical knowledge). It is, therefore, hard to sort out problems centered on the lexicon from problems having to do with the computational system. It follows that if we find a common effect across N>V patients, it must be something that the different causing factors may have in common. Our experimental procedure does give us information capable of constraining theoretical proposals, as we will see.

A further factor to bear in mind is that pictures are static. This makes them suitable to unambiguously portray concrete, typically static objects (e.g., chairs or hammers) such as those identified by sortals (i.e. names of sorts or kinds of entities). But it makes them less suited to portray relational nouns (like uncle, or neighbor) and dynamic verbs (run, kiss), or psychological statives (know, love). Thus, for example, the higher rate of N>V vs. V>N superiority cases might be caused, at least in part, by some difficulty in decoding movement from a static snapshot, rather than with anything having to do with language [2]. A particularly interesting case to consider, in this connection, is the following. Imagine the picture of an explosion. It can be obviously described equally well through the noun 'explosion' or the verb 'explode'. Testing V-N dissociations for minimal pairs of this sort may be particularly telling, as some of the most highly relevant factors (like imageability) remain clearly constant in cases of this sort (while other factors, like word frequency, which may vary, can presumably be balanced).

3.1. The imageability effect in patients with N>V superiority

Turning now to the effects we found in our study, a quite robust one is that imageability affects significantly naming of actions. Performance improves if the action is more 'imaginable'. Moreover, if we factor imageability out (through a multivariate analysis), N superiority in many cases (18 out of 20 in our sample) disappears. At one level, this is not so surprising. As noted above, part of the problems with verbs may be due simply to the difficulty of encoding actions in pictures. If an action is more imaginable, it will be easier to match the stimulus with a stored mental structural description of the action. So, it is to be expected that the task of finding the appropriate lexical item will be somewhat facilitated by enhanced imageability.

However, even when we factor out imageability, there are cases in which naming of pictures with verbs remains significantly more impaired than naming of pictures with nouns. This supports the conclusion that difficulty with verbs in aphasics cannot be wholly reduced to the inherent difficulty one has in representing dynamic and/or less imaginable eventualities.

While this might be in and of itself interesting, there is still something to understand here, having to do with the robustness of the imageability effect. Why is it that patients that have difficulty with verbs perform so much better when verbs refer to actions that

are more imaginable (while no similar effect is detected in patients who have difficulty with nouns)?

Suppose you have a word processor that in normal conditions can read and process the symbols 'N' and 'V', attached to words. Suppose, furthermore, that your machine gets damaged and looses its capacity to recognize one such symbol. Suppose, finally, that such machine has some compensatory strategy that enables it to learn words that are particularly frequent and easy to imagine. Would you expect an imageability effect only on the words marked V and a frequency effect only on those marked N? It would seem not. Why not the other way around? Or why not, more plausibly, some graded effect of both imageability and frequency on both categories? If we think in terms of a damage to categories 'N' or 'V' as such, we are at a loss in understanding the pattern we actually find. To try to understand what goes on, we have to look more closely at the different structure of nouns vs. verbs. In what follows, we offer some preliminary considerations in this direction, drawing from contemporary linguistic theory. To anticipate, our hypothesis is the following. What gets actually damaged is argument structure on the one hand and/or something like the case checking mechanism or perhaps referential schemata on the other. The first kind of damage is what affects selectively verbs, the second nouns. If we adopt this hypothesis the existence of an imageability effect on the former and of a frequency effect on the latter arguably falls into place.

A fundamental characteristic of verbs is that they are argument taking. They represent eventualities typically in the form of relations among the protagonists of such eventualities. For example, *give* characterizes an event *e* which involves a three place relation between an agent (x_{AG}, the giver) a theme (y_{TH}, what is given) and a goal(z_{GO}, the end point of the transaction). This is captured in many different ways in current approaches (see, for example, Dowty 1989 for a discussion of influential linguistic approaches and Jonkers 2000 for a review of the impact of such approaches on aphasia research). One is to assume that as part of the information stored in the lexical entry of verbs we find the following:

(5) a. /run/ $RUN(e, X_{AG})$
b. /eat/ $EAT(e, X_{AG}, y_{TH})$
c. /give/ $GIVE(e, X_{AG}, y_{TH}, z_{GO})$

The formulae in (5) can be thought of as listing the obligatory

arguments of a verb, i.e. its *adicity*, as it is often called. We assume, in keeping with most current proposals (see e.g. Parsons 1990), that all verbs have an implicit (i.e. covert) argument ranging over eventualities, which gets modified by temporal and aspectual operators and, possibly, adverbs. The remaining arguments indicated in (5) are the participants in the event. They have a label (agent, theme, goal, ...) indicating their thematic role. The external argument (intuitively, the one corresponding to the subject) is marked in boldface. As is well known, some verbs (unaccusatives and so called impersonal ones like *seem*) do not have an external argument. Obligatory arguments (whether external or internal) must be syntactically projected, i.e. there must be corresponding nodes in the syntactic tree suitably filled with lexical material that provides the argument slots of the verb with semantic content. Within parametric/minimalistic frameworks the syntactic projection of obligatory arguments is governed by the Projection Principle. The exemplification provided in (5) is, to be sure, a gross oversimplification. However, we are not so much concerned here with the details of formalization, as with the general idea that information about argument structure and how it mediates between syntax and semantics must be part of verb entries (a fact that any framework must somehow accommodate).

Now, it is important to underscore that a given eventuality can often be coded through several entries of varying adicity. Consider for example food-consumption. One and the same eventuality of food consumption by John might be couched in any of the following ways:

(6)	a. John is dining	a'. *John is dining pasta
	b. John is eating	b'. John is eating pasta
	c.*John is devouring	c'. John is devouring pasta

Even though the action of food consumption typically involves two components (an agent and a theme), it can be lexicalized as involving fewer protagonists. The verb *dine* is obligatorily intransitive; *eat* can be transitive or intransitive; *devour* is predominantly transitive. Facts of this sort are well known and much discussed in the literature (see e.g. Dowty 1989, and references therein). Another standard illustration can be given by minimal pairs of the following sort:

(7) a. This picture (SUBJ.) pleases John (DIR.OBJ.) very much
b. John (SUBJ.) likes this picture (DIR. OBJ.) very much
c. Questo quadro (SUBJ.) piace molto a Gianni (IND. OBJ.)

SUBJ. = subject; DIR. OBJ. = direct object; IND. OBJ. = indirect object

In this case the same psychological state can be lexicalized by coding the experiencer as the object (direct, (7a), or indirect, (7c)) or as the subject (7b). The general point illustrated by these examples is that typically, an event has a canonical number of participants. But how many of such participants are taken as obligatory arguments by a lexical entry and in which form they are coded may vary, to a degree, both within a language (as (6-7) illustrate) and crosslinguistically (cf. (7b) vs. (7c)). In other terms, the path from an event or state of affairs to its linguistic coding (i.e. the lexicalization of an event) partly is constrained by the inherent nature of the event, but partly appears to be a relatively autonomous grammatical choice. This in turn entails that our perceptual/conceptual representation of an action and its encoding in grammar have a degree of independence. This may well be relevant in trying to understand what is going with aphasics. Let us see how.

For one thing, we now have a *theoretical* reason to doubt that direct damage at the level of perceptual/conceptual representations should by itself give raise to an impairment in, say, verb use. Our reason rests on the observation that representation of verb structure is likely to be, as we just saw, to a certain extent, autonomous of the perceptual/conceptual representation of eventualities. Hence it is unclear why damage at one level should automatically carry along a damage at the other. At the same time, it may well make good sense that in presence of damage to argument (thematic) structure, imageability might have an impact on performance in use of verbs. Let us see why.

Structures such as those in (5) must wind up eventually being linked to the concrete eventualities they describe. Evidently, such a link must go through the way in which we represent the relevant eventualities (e.g. eating, jumping, kissing, etc.) at the perceptual and/or conceptual level. There must be some kind of schemata we use to link up linguistic information to our environment. And for eventalities that have a relatively high degree of imageability (like verbs expressing concrete actions, as opposed to ones expressing, e.g., psychological states), visual mental representations will naturally tend to play a central role in establishing the relevant link. Suppose now that something in the lexical entry of verbs gets damaged. Let us assume that a lexical entry is a structure containing all the information for its competent use specific to an item. This assumption is pretty standard in linguistics, as well as in psycholinguistic theories of lexical representations (cf. e.g. Levelt et al.'s (1999)) notion of *lemma*). At the present level of generality, the details of how the lexic-

al items are structured don't really matter (though we may assume, for concreteness, they involve representations such as those in (5)). What really counts is that lexical entries must code argument/thematic structure. Now, we don't know exactly *what* may get damaged in an entry. It could be a damage to argument structure as such (for example, the loss of representations such as those in (5), or an impaired ability at decoding them, or at using them in creating syntactic structures, etc.). It could also be a damage to some other aspect of the entry (say something affecting the category VERB as such), which would, however, necessarily have an impact on other information associated with verbs. However, the (complex) details may eventually be fleshed out, the primary impact of any damage to lexical entries of verbs will be on the linguistic coding of argument structure, simply because this is absolutely central to their use. Verbs *are* their argument structure, so to say. How could, then, one make up for such an impairment? What kind of compensatory strategy might our cognitive system seek? The task is linking a visual stimulus (a picture) to a linguistic representation (a word or a reduced sentence, as the case may be) endowed with argument structure. We have conjectured that argument structures are linked to concrete eventualities through perceptual and conceptual schemata. In the case of concrete actions, such schemata will rely on mental images, which will be all the more vivid, as the relevant action becomes easier to imagine. It is plausible that such stored mental images will enable one to recover the lost argument structure. From a visual characterization of an act of eating, we will be able to identify, at least as a default, two canonical protagonists, an agent and a theme. We said that there is no necessarily unique path from events to argument structures. But there surely are constraints and defaults. For example, an eventuality that typically has two protagonists will be encoded through a word that takes (at least optionally) two arguments. Thus, accessing such visual mental representations we might well be able to access and even partly restore the fuzzy/damaged lexical entry. So under the view that verb deficits involve a damage to argument/thematic structure we do come to indeed expect an impact of imageability on performance that very much goes in the same direction we found in the present experiment.

Consider, per contrast, the case of nouns. Many nouns simply do not have argument structure in the relevant sense. They are not argument-taking. In particular, this is the case for all the nouns used in the present experiment. They are all sortals referring to concrete objects. This has at least two immediate consequences. First, if some-

thing specifically damages argument structure, it won't affect nouns; at least not those considered in the present experiment, for they have none. And second, our capacity to represent (dynamic) events through visual mental images will play no role in however the lexical entry of nouns is linked to the objects they apply to.

A few caveats are in order. There are of course nouns that are, in some sense, argument taking. We mentioned above the case of inherently relational nouns, like *neighbor*, *enemy*, *mother*, etc. A further important type is that of deverbal nouns, and, more generally, nouns that are morphologically related to verbs (such as *arrive*/*arrival*, *destroy*/*destruction*, *attack*/*attack*, etc.). Nouns of this kind are particularly interesting, as they seem to inherit fully the thematic structure of the related verbs. Consider for example the following phrases:

(8) a. John donated a rare book to the library
b. John's donation of a rare book to the library

So what of our hypothesis? It may seem that we are predicting that damage to thematic structure should affect these kind of nominals much like it affects verbs. Though conceivable, this conclusion is not wholly warranted. Even if some preservation of thematic structure is clearly present here, it is also clear that the way in which nominals can be said to be argument taking is clearly very different form the ways in which verbs are. This is certainly the case for languages like English or Italian; but possibly it holds universally. The clearest fact in this connection is that nominals, in contrast with verbs, never take their arguments obligatorily. This is illustrated by the following contrasts:

(9)	a. * donated	a'. the donation
	b. *John donated	b'. John's donation
	c. * John donated to the library	c'. John's donation to the library
	d. John donated a rare book to the library	d'. John's donation of a rare book to the library

The constructions to the left in (9a-c), involving verbs, are not well formed, while those on the right (involving nouns) are. Again, here too there are many accounts available. One way of thinking about what is going on is that derived nominals are simply predicates of eventualities and have representations of the following sort:

(10) a. DONATION(e)[to be read as "event e is a donation"]
b. EXPLOSION(e)
c. ATTACK(e)

Such nouns are derived by closing off existentially the arguments of the verb. To be reactivated such arguments need special constructions (e.g. prepositions of the right sort, or the genitive). It's as if in nominals the argument structure of the verb, while in a sense still there, is somehow de-emphasized. Be that as it may, it is a fact that nouns can be used without their arguments, while verbs typically cannot. More specifically the capacity to project arguments does not seem to be a prerequisite to the use of nouns in the way it seems to be to the use of verbs. Thus something affecting specifically argument structure may leave even deverbal nouns intact. Clearly there is something to test here. We need to test how V/N dissociations impact on closely related pairs involving verbs and the corresponding event-nominals, as that will be informative both for the study of the pathology and as a testing ground for grammatical hypotheses.

Summing up, under the hypothesis that language pathologies may directly affect argument (or thematic) structure we seem to come to an understanding of why imageability may play an important role in the performance of aphasics with N superiority, while no comparably strong effect is found in patients with V superiority. First, damage to argument structure will affect directly only verbs (as nouns either don't have argument structure or, roughly put, they can be used also without it). Hence, damage to argument structure will give raise to a selective impairment on verbs. Second, imageability's function is that of helping extracting the protagonists from the perceptual/conceptual coding of a dynamic eventuality. As there is a natural mapping from these to the structure of lexical entries, the more imaginable the eventuality, the more performance with verbs will be enhanced (and the damage compensated for).

How does our hypothesis of a grammatical deficit centered on argument structure fare vis-a-vis other hypotheses concerning impairments in verb use, like Friedmann's idea that it is the tense system that might actually get damaged? Generally speaking, such hypotheses are consistent with each other, in the sense that both aspects of grammar might conceivably be independently impaired. It is however unclear to us how Friedmann's hypothesis by itself could account for the imageability effect we found. For one thing, we don't know whether our subjects are producing (fragments of) sentences or words. Friedmann's hypothesis would seem to be relevant only in the

former case. Moreover, Friedmann's account is offered only for agrammatic patients; but there are also fluent patients who show the same pattern of impairment. Finally, recall that her idea is that syntactic structure gets truncated right above the functional category dominated by the tense node. This prevents (tensed) verbs from rising to the appropriate position to check their morphological features, and hence use of verbs is hampered. As she points out, however, truncation of (high) functional structure does not generally prevent untensed (e.g. infinitival) verbs from staying within the VP (or climbing to a 'low' functional category) and assigning their theta roles in the usual manner. If imageability affects argument structure, it shouldn't have a particularly strong affect according to Friedmann's account. So agrammatic patients should not, it would seem, be subject to strong imageability effects, in so far as we can make out. With respect to our sample, the symptomatology compatible with her conjecture is that of N-superiority patients that are not significantly affected by imageability.

But couldn't imageability be connected to the particular grammatical meanings of tense, aspect or actionality? For example, in much recent work it has been proposed that the inflectional layer of the verb is structured in a series of nested functional heads, which include information pertaining to 'actionality' (e.g. telicity vs. atelicicty), aspectuality (e.g. perfectivity vs. imperfectivity) and temporal location (e. g. present vs. past). The verb raises through this series of functional heads, thereby incorporating the morphemes that code such information. Under such a view the lexical verbal head is largely underspecified while a significant part of information is coded in the functional layer, so much so that its semantic richness may eventually explain why more imaginable verbs are easier to retrieve in verb impaired subjects. While this view deserves a closer look, we do not think, at present, that it offers many chances of success, for the following reasons. Consider the case of actionality. Visualize a particular event like, for example, the earth revolving around the sun. You can describe it as "the earth is revolving around the sun" (which is an atelic event or, in Vendler's famous terminology, a process). Or you can describe it as "the earth is completing a revolution around the sun" (which is a telic event, i.e. an accomplishment in Vendler's terms). Or you can even describe it as "the earth is in orbit around the sun", which is, in fact, a state. The same goes for aspect proper. As is well known, one and the same event can be described as culminating or as in progress, depending on whether we put it in the perfective or in the imperfective aspect. Ditto for tense: a past event can

be put in the present tense depending on the narrative dynamics. So, the inherent imageability of an event seems to have no bearing on the information typically coded in temporal and aspectual features (i.e. in the functional layer associated with the category V). Hence, if these features are the sole or the main locus of a selective damage, as on Friedmann's hypothesis, one doesn't see why verbs associated with inherently more imaginable eventualities should be easier to restore.

3.2. Effects of different kinds of argument structure

A second major family of effects that we found, related to argument structure, concerns the correlation of aphasia types and verb classes (transitive, unaccusative and unergative). With regard to transitives, we found they are selectively impaired in agrammatic patients (vis-a-vis monoargumental verbs). This effect (which must be taken with particular care, given the relative small sample of items submitted to our subjects) is perhaps not so surprising. If something hits argument structure it is to be expected that more complex ones will create more difficulties than simpler ones. Our results are in agreement with those obtained by Thompson et al. (1997) and only partly in agreement with other findings. In particular, Jonkers (2000) reports on a picture naming experiment similar to ours with Broca's aphasics, in which, however, patients were instructed to reply in two modalities: with words in isolation and with sentences. He found that Broca's aphasics at the word level were uniformly better with transitive verbs than with intransitives; at the sentence level, instead, they split into two subgroups. One subgroup was better with intransitive verbs, the other with transitives. He argues that the greater ease with transitives found at the word level is a word frequency effect (transitives being more frequently used in spontaneous speech than intransitives). The difficulty found (in one group) at the sentence level is instead due, according to him, to the increased load on the processor that stems from sentences with transitive verbs. In general, we did not find better performance with transitives. Most of our aphasia groups (namely, Wernicke's, anomics and non agrammatic nonfluent ones) seemed to behave (*mutatis mutandis*) similarly to the normal control, with respect to how they handled transitive verbs relatively to other verb types. Agrammatics showed, instead, a particular difficulty with transitives, significant in comparison to Wernicke's. Part of this may be due to the fact that some of them were implicitly trying to construct sentences. This

would be in accord with Jonkers's findings. But it is unlikely that what we found can be wholly explained in these terms (for some of them might well, instead, have been trying to give single words). This issue evidently calls for further experimentation.

Particularly interesting is the behavior of unaccusative verbs (a result that has never been reported on so far). In virtually all types of aphasic (except anomic) patients, unaccusative verbs appear to create significantly more difficulties than intransitive (unergative) verbs. This is particularly evident in Broca's patients. A simple complexity measure that merely counts number of arguments does not lead one to expect this effect. There are several possible explanations that might be entertained, all of which call for further experimentation. If action naming involves building (reduced) clauses, the difficulty might be syntactic in nature, due to the necessity to move the internal argument of the unaccusative verb into the canonical subject structure. Accordingly, these subjects ought to display analogous difficulties with other kinds of NP movement (i.e. passive and raising) which seems to be the case (cf., e.g. Grodzinsky 2000). One might object, however, that NP movement with unaccusatives is often optional. For example, in Italian the subject of unaccusatives may be left in its original postverbal site. If there is no movement, there are no traces, and hence the difficulty that aphasic patients seem to encounter with unaccusatives cannot be blamed on any difficulty related to traces. However, there are other factors that may well play a role. When the argument of unaccusatives is left in situ (as in *è arrivato Leo* 'has (lit. *is*) arrived Leo'), it is generally assumed that the subject position is filled by a null expletive element (i. e. a silent counterpart of English 'it'). Now aphasic and, in particular, agrammatic patients are known to loose various aspects of functional structure. Perhaps, the difficulty with unaccusatives is linked to a more basic difficulty with expletive elements. Aphasic patients may loose the ability to insert expletive elements in the appropriate required positions and hence sentences with unaccusatives cannot be generated. If this is so, the relevant subjects ought to have difficulties with other kind of constructions requiring expletives (like weather verbs, and extraposed or inverted subjects).

It is a bit trickier to imagine what might go wrong with unaccusatives for subjects that are not trying to build up sentences, but simply uttering words in quotation form, which ought to involve merely the lexical representation of words. Clearly unaccusativity must be lexically coded. Somehow the lexical entry must contain the information that relevant verb lacks an external argument. Accord-

ing to some (cf. e.g. Bresnan 1982 for an early formulation) the relevant information might be deduced from the fact that these verbs lack an agent (i.e. they wind up with a non agentive subject). This idea has been challenged, to our mind successfully, by much of the subsequent literature (see e.g. Rosen 1984). According to others (e.g. Van Valin 1987), it is the Aktionsart of the verb (in particular, its telicity) the predictor. But this too is highly controversial (though there certainly is a strong link between unaccusativity and actionality of the verb). Be that as it may, it remains to be seen why exactly the lexical entry (the lemma) of unaccusatives ought be somehow more complex than that of unergative intransitive. It is as if having an external argument, makes the verb more 'visible' and less amenable to undergo damage in argument structure. The lack of an external argument is a property unaccusative share with raising verbs (like *seem*). Hence these types of verb too ought to cause problems. This prediction won't be straightforward to test by our procedures as raising verbs like *seem* are psychological verbs, virtually impossible to represent pictorially.

It may be worth noticing that a selective damage to specific subcategories of verbs is clearly inconsistent with the hypothesis of a *total* loss of their argument structure (for that would imply a loss of capacity of differentiating such subclasses from each other). What we are proposing, however, is either a partial damage to argument structure or to its processing. So, for example, mapping a more complex argument structure onto a syntactic tree requires more processing resources. Analogously, if the structure is richer, retrieving the appropriate argument structure from a visually presented event (which is how we understand the imageability effect) will be harder.

Taking stock, the effect we found with unaccusitives, if confirmed through further experimentation is particularly interesting. It is generally consistent with our main hypothesis, viz. that argument structure is one of the aspects of verb representation, which is most likely to get damaged in N superiority patients; but it is also consistent with a variety of more syntactic accounts. Further work is needed to sort the relevant issues out.

3.3. Word frequency effects on V>N patients

A further major effect we found concerns patients with V-superiority. While imageability has essentially no effect on them, word frequency does. I.e. the performance of noun impaired patients tends to improve as nouns become more frequent. As with N-superiority, how-

ever, not all cases of V-superiority disappear once word frequency is factored out. This suggests that also V-superiority probably is ultimately due to some grammar specific deficit selectively affecting the mental representation of nouns. The question is why frequency matters in such a case.

To address this question, we should have a better grasp of the forms that a selective impairment of nouns may take. As noted above, argument structure of nouns is either absent or is represented in such a way as not to constitute a prerequisite to their use. Hence damage to argument structure should leave nouns unaffected. A damage that selectively affects nouns should concern some morphosyntactic property specific to them. For example, within parametric and minimalistic frameworks, nouns must get structural case; if the capacity to check nouns for structural case gets impaired use of nouns would be compromised. Also conceivable is that something in the semantic representation of nouns gets damaged. For example, nouns are semantically associated with sorts or kinds of objects (viewed as a specifically linguistic category – see, e.g. Carlson 1977). If the capacity to refer to kinds is somehow impaired, use of nouns would become more difficult than use of verbs (that do not involve kind reference).

Further possibilities are certainly conceivable. At this point we have no less speculative considerations to offer. Be that as it may, the central point is the following. If something specifically damages the category N (or something uniquely associated with it) as such, what could partially compensate for such a damage? What could enhance performance, in such a case? Recall that in our experiment we are dealing primarily with nouns of various kinds of natural objects or artifacts. Their linguistic structure is, in a sense, simpler than that of verbs. Such nouns don't require arguments and generally rank higher in terms of imageability. Actually, it is intuitively clear that the mental images associated with them must actually be qualitatively different from that associated with verbs. In the case of verbs, we are dealing (in our sample) with dynamic actions; in the case of names with static objects. The low impact of imageability on nouns can be presumably traced to these differences. The relative differences in imageability among nouns of the sort we tested is just too minimal to have an impact. In naming the picture of an action some decoding is necessary as we are not seeing the whole action. No such difficulty arises in naming an object. Hence the only factors that are left to play a role are plausibly (i) word frequency and (ii) the underlying perceptual and or conceptual knowledge associated with nouns. The

role of (i) is obvious: the more frequent a noun, the easier it will be to restore the corresponding lexical entry. Concerning, instead (ii), as with verbs, nouns are presumably linked to their referents through some cognitive schemata (i.e. images, prototypes, functional knowledge, etc.). Depending on the nature of such damage (i.e. whether it is more sensory or more functional/conceptual), different categories of nouns may be affected (as suggested by Warrington & Shallice, 1984).

So, in presence of a damage specific to nouns, imageability is not expected to play a visible role, as nouns rank high on this score. This leaves word frequency as well as kinds of knowledge linking nouns to their referents (sensory vs. functional) as factors possibly determining word retrieval.

4. Conclusions

Our results lead us to conclude that V-N dissociations cannot be wholly reduced to (i.e. explained by) problems with extralinguistic aspects of our sensory/conceptual system. One cannot go from purely sensory/conceptual deficits to an understanding of why a certain grammatical category is relatively spared with respect to the other. The crucial damage has to be located, it would seem, at a specifically grammatical level of representation. More specifically, in presence of a damage to argument structure, verbs are going to be selectively affected. If this is so, the easier it is for an action to be coded in mental visual images the easier it might be to restore the corresponding argument structure (by extracting from the events its protagonists) and hence to somehow retrieve or rebuild the relevant linguistic representation. In case of a selective damage to nouns (that lack an argument structure in the relevant sense) no similar effect is expected. Word frequency and kind of knowledge that links nouns to their referents (sensory vs. functional) are thus the remaining factors that can facilitate the task of retrieving the corresponding linguistic representations. This hypothesis requires further testing (e. g. with deverbal nominals). Moreover, it should be kept in mind that several sources of damage may occur and interact with each other. For example, we do not think that damage to argument structure is necessarily the *only* source of verb deficit. Other kinds of damage (e.g. lexical damages to the category V, or damage to *specific* argument structure – like unaccusative, or damage to the functional layer of verbs – a la Friedmann) are clearly conceivable and, in fact, can coexist across different types of aphasia. What comes out of our study (with its lim-

its due to our use of a single naming task with a relatively large sample of aphasics) is that (for verbs) direct or indirect damage to argument structure may provide us with an account that covers the largest number of cases. Be that as it may, the categorial status of the V-N distinction (as well as its rich interaction with extra grammatical modules) appears to be well supported by our data on language pathology.

Address of the Authors:

Claudio Luzzatti, Dipartimento di Psicologia, Università di Milano-Bicocca, Milano, claudio.luzzatti@unimib.it
Gennaro Chierchia, Dipartimento di Psicologia, Università di Milano-Bicocca, Milano, gennaro.chierchia@unimib.it

Footnotes

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1 Thompson and coworkers (Thompson, Lange, Schneider & Shapiro, 1997) found that verbs taking *more* arguments are *harder* for agrammatic patients to produce, *even when retrieved as single words*. Jonkers (2000) found that Broca's aphasic patients could name transitive verbs better than intransitive verbs. However, this difference could not be generalized to all Broca's patients and also emerged on fluent aphasic patients. The superiority of transitive verbs found by Jonkers is consistent with the results reported by Davidoff and Masterson (1996) who found that transitive Verbs are acquired earlier than intransitive verbs**.** However, De Bleser (2000) found the opposite difference both in language acquisition and in Broca's patients. Intransitive verbs are acquired earlier and are less impaired.

2 However, Berndt et al. (1997), using static and dynamic stimuli did, not find different rates of performance across tasks.

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Nouns and verbs: neurological correlates of linguistic processing

Stefano F. Cappa & Daniela Perani

This paper provides a comprehensive review of neuropsychological, neurophysiological and neuroimaging studies dealing with the neural correlates of noun and verb processing. There is considerable clinical evidence from patient studies indicating the existence of a double dissociation between noun and verb processing. This dissociation appears to be reflected in differences in the site of brain damage. Patients with a selective verb impairment usually have lesion centred on the fronto-parietal areas, while isolated noun impairments are observed in patients with damage limited to the temporal lobe. Imaging studies in normal subjects have provided further information, indicating that, while the left temporal neocortex plays a crucial role in all tasks involving lexical-semantic processing, additional regions of the left dorsolateral prefrontal cortex are recruited during the processing of words related to actions. One crucial question is whether the observed neurological correlates are related to conceptual differences (prototypical nouns and verbs being related, respectively, to objects and actions), or to the grammatical distinction between nouns and verbs. The aim of future studies should be to tease apart the contribution of semantic and grammatical differences to the observed neurological dissociation.

1. The noun-verb dissociation after brain damage: a "classic" finding

The observation that brain damage can affect differentially the ability to retrieve nouns and verbs is not new, and can be traced back to Giovanbattista Vico. In the *Principj di Scienza Nuova* (1744), Vico writes: "Finalmente gli autori delle lingue si formarono i verbi, come osserviamo i fanciulli spiegar nomi, particelle, e tacer i verbi. Perché i nomi destano idee che lasciano fermi vestigi; le particelle, che significano esse modificazioni, fanno il medesimo; ma i verbi significano moti, i quali portano l'innanzi e 'l dopo, che sono misurati dall'indivisibile del presente, difficilissimo ad intendersi dagli stessi filosofi. Ed è un'osservazione fisica che di molto appruova ciò che diciamo, che tra noi vive un uomo onesto, tòcco da gravissima apoplessia, il quale mentova nomi e sì è affatto dimenticato de' verbi". Several studies have unequivocally indicated that a double dissociation between noun and verb processing can be observed in selected aphasic patients. For example, after brain damage, some individuals have a

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disproportionate difficulty in naming objects, while their ability to name actions is largely unaffected, while other show the reverse pattern of impairment (see, for example, Miceli, Silveri et al. 1988). These observations are important not only for psycholinguistics, but also for neuroscience, as they suggest that the noun-verb distinction be honoured also at the level of brain structure and function. In particular, these findings are compatible with the idea that there are different neural correlates for noun and verb processing in the human brain.

The aim of the present paper is to review the available evidence, stemming from neuropsychological, neurophysiological and functional imaging, about the neural correlates of noun and verb processing, and to discuss the possible implications for models of language organization in the human brain.

2. Modern evidence from neurological patients

This section will consider evidence coming from investigations of patients with focal and with degenerative brain pathologies.

2.1. Focal lesions

The first hints about a possible different localisation of the lesions associated with defective processing of nouns and verbs can be derived from group investigations in aphasic patients, in which the ability to name objects and actions was compared. A group study by Goodglass, Klein et al. (1966) showed that Broca's aphasics are more impaired in naming actions, fluent aphasics in naming objects. Within the limits of the localisation of aphasic syndromes, these findings indicate that posterior (retrorolandic) lesions affect object naming more than action naming, while an involvement of pre-rolandic areas appears to be required for the presence of defective action naming. This early study was based on a limited number of test items, and was missing any direct information about the localisation of neurological damage. Subsequent reports (see Miceli, Silveri et al. 1988) established, using adequate testing material, the existence of patients with selective, or relatively selective, disorders in naming and comprehension of nouns and verbs. While these case studies were not aimed at the definition of the anatomical correlates of the observed dissociation, an analysis of the reported lesion sites, assessed with computerised brain tomography, appeared in general

to support the anatomical localisation suggested by the Goodglass, Klein et al. (1966) study. Most of the patients with selective disorders of noun processing had lesions centred on the left temporal lobe, while verb impairment was associated to damage involving, or limited to, the left prefrontal cortex. The first careful anatomical study was reported by Damasio & Tranel (1993), using structural Magnetic Resonance Imaging (MRI). Two patients had selective impairments for nouns: one had bilateral mesial and lateral temporal lesions; the other had a left anterior temporal lesion. The patient with selective action naming impairment had a left premotor frontal lesion. These observations were expanded in a recent lesion study (Tranel et al. 2001). The aim of this investigation was to test the hypothesis of the existence of a double dissociation between action naming and naming of concrete entities, such as animals and tools. The a priori hypothesis was that selective action naming disorders were expected to be associated with lesions in the left premotor/prefrontal region, while selective disorders of the naming of concrete entities were expected to be associated with left anterior/inferior temporal lesions. The results were more complex. While damage to a region involving the left frontal operculum, the inferior sector of the pre-central and post-central gyri and the anterior part of the insula was actually associated to severe action-naming impairment, patients with lesions involving this area were often impaired also in object naming. Moreover, damage to other posterior areas (mesial occipital cortex, white matter underlying the posterior temporo-parietal region) was associated with action naming impairment. On the other hand, lesions limited to the left anterior-inferior temporal lobe affected object naming in a selective way, sparing action naming. Other case reports further indicate the complexity of the pattern of anatomical correlations. The lesion of the patient, reported by De Renzi & Di Pellegrino (1995), with spared action naming and verb generation, involved the temporal lobe, but extended to the frontal cortex. Lesions centred in the left parietal lobe were observed in several patients with a disproportionate deficit in verb processing (see, for example, Silveri & Di Betta 1997).

What can be concluded from the lesion studies is that lesions circumscribed to the left anterior-inferior temporal lobe result in disordered object naming, and spared action naming. Conversely, patients with a selective difficulty in action naming and, maybe, also of other aspects of language processing involving the grammatical category of verbs are as a rule affected by lesions which involve the frontal and parietal part of the left perisylvian language areas, and spare the

anterior temporal lobe. The investigation of patients with category-specific semantic disorders has indicated that an anatomical correlation can be observed in the same regions within the category of nouns. Damage to the anterior part of the temporal lobe selectively affects the naming of animals, while defective naming of man-made entities is usually associated with damage to the perisylvian temporo-fronto-parietal areas (Saffran and Schwartz 1994; Damasio, Grabowski et al. 1996). These findings indicated a possible relationship between tool naming and action naming, which is compatible also with neuroimaging evidence (see below).

2.2. Degenerative conditions

In degenerative conditions, usually associated with dementia, brain damage is progressive, affecting multiple brain regions in a sequence. Daniele, Giustolisi et al. (1994) reported three cases of noun-verb dissociations in patients with degenerative conditions. Two patients with evidence of frontal lobe involvement were more impaired in naming actions than in naming objects; one patient, with left temporal involvement, showed the reverse dissociation. Cappa, Binetti et al. (1998) reported action naming was more impaired than object naming in patients with probable Alzheimer's disease, the most common cause of dementia, associated with involvement of associative cortices. The discrepancy between action and object scores was however much larger in patients with a clinical diagnosis of fronto-temporal dementia. These two conditions, which are associated with a distinct neuropathology at the microscopic level, usually differ quantitatively in the extent of involvement of the frontal lobe at the macroscopic level. The specificity of this correlation is supported by the observation of a severe disorder of action naming and comprehension in motor neuron disease patients, with pathologically verified involvement of Ba 44 and 45 (Broca's area) (Bak, O'Donovan et al. 2001).

In conclusion, the results from investigations of patients with degenerative brain disorders are in agreement with the evidence from patients with localised lesions, suggesting a link between frontal involvement and action naming impairment.

3. Imaging the function of the normal brain

The neural correlates of noun and verb processing in the normal brain can be investigated using functional neuroimaging methods,

which allow a direct visualisation of the brain areas which are engaged during the performance of a cognitive task. As in the case of clinical studies, it must be underlined that many investigations have been concerned with the retrieval of knowledge about actions. An early PET study by Petersen, Fox et al. (1989) used the generation of a verb associated with a presented noun as "semantic processing task". This was followed by several studies of word retrieval, which can be actually considered as investigations of the neural correlates of action knowledge. These studies have reliably shown extensive activations in the left dorsolateral frontal cortex. Similar patterns of activation have also been observed when the subjects had to generate object names on the basis of phonemic and semantic cues (Paulesu, Goldacre et al. 1997). A direct comparison between noun generation and verb generation revealed only minor differences in activation in the temporo-parietal and frontal areas (Warburton, Wise et al. 1996). A comparison between colour naming and action naming (Martin, Haxby et al. 1995) indicated selective activations related to action naming in the left fronto-parietal cortex, the middle temporal gyrus and the cerebellum. Damasio, Grabowski et al. (2001) have recently reported another PET study of action naming. Naming actions, compared to a perceptual baseline (verbal judgement of the orientation of unknown faces) resulted in left frontal, temporal and parietal activations. A comparison of naming actions performed with an implement, with naming tools and implements resulted in bilateral activations in area MT in the temporal lobe, a region associated with motion processing.

Two more recent imaging studies have investigated the noun-verb difference using tasks, which allow going beyond the retrieval of action knowledge typically elicited by visual naming and generation task. In a PET experiment with lexical decision Perani, Cappa et al. (1999) compared respectively, nouns referring to tools and psychological states, and manipulation and psychological verbs. The results indicated the existence of incompletely overlapping neurological substrates for verb and noun processing. There was no double dissociation between frontal and temporal cortex, but only the presence of "verb specific" areas (Broca's, left middle temporal gyrus). Noun and verb processing equally activated the other areas, associated with the lexical task. No significant interactions between grammatical class and semantic content were observed, suggesting that the observed difference is verb-specific. A similar study has been recently reported by Tyler, Russell et al. (2001), with negative results. No differences were found between closely matched nouns and verbs, both in a lexi-

cal decision and in a semantic judgement task. The reason for this discrepancy is unclear, and deserves further investigation.

Another interesting source of evidence for possible differences between noun and verb processing are evoked potential studies. Different topographies of brain responses have been reported during lexical decision on object names and action verbs, with a frontal positivity at 200 ms specific for verbs (Preissl, Pulvermueller et al. 1995). Similarly localised differences in high-frequency bands were observed in a later time window (Pulvermueller, Lutzenberger et al. 1999). In an attempt to clarify the meaning of these differences, Pulvermueller, Mohr et al. (1999) used a similar task, dividing nouns in a group with strong visual association, and another with strong action association. The lack of difference between the latter nouns and the action verbs led to the suggestion that the frontal difference is related to semantic content (i.e. action) rather than to grammatical differences. Using subcategories of action verbs referring to different body parts, the same group (Pulvermueller, Haerle et al. 2000) was able to estimate (on the basis of current source density) somatotopically arranged differences in cortical activity, again in favour of a semantic origin of the differences. One of the few studies using nouns and verbs in sentential contexts, and not limited to action verbs is reported by Federmeier, Segal et al. (2000). A left anterior early positivity was specifically observed for unambiguous verbs, but only in verb-appropriate contexts (i.e. when following a "to").

Finally, reversible interference with brain activity using transcranial magnetic stimulation (TMS) has also been used to assess noun-verb differences. A recent study by Shapiro, Pascual-Leone et al. (2001) reports a selective lengthening of response latencies in the production of tense markers of verbs, while number markers of nouns were unaffected. An important finding of the study was the replication of the observed effect in the case of pseudoverbs (compared to pseudonouns). This appears to rule out an interpretation of the interference effect as due only to semantic factors, and suggests that the left prefrontal cortex be preferentially engaged by verbs as "grammatical objects". On the other hand, it must be underlined that we have observed a selective effect of high-frequency repetitive TMS on action naming after left, but not right, prefrontal stimulation (Cappa, Sandrini et al., 2002).

4. Conclusions

Taken together, the available evidence leads to the conclusion that there is consistent evidence for the existence of different cerebral correlates for the processing of object nouns and action verbs. Whether it is possible to consider this result as a "grammatical class" effect remains however an open question.

In the first place, the hypothesis that a strong determinant of the observed differences is actually the conceptual reference should be carefully considered. The results of several investigations related to action observation and action representation may provide some relevant evidence. Recognition of actions is an ability, which is highly developed in humans and non-human primates. In primate, "mirror neurones", which become active when the same action is actively performed by the monkey or when it is made by the experimenter and observed by the monkey have been observed (Gallese, Fadiga et al. 1996). Many neurones with these features have been described in the left rostral part of the inferior area 6 (the so-called F5), in the prefrontal cortex. Imaging studies have provided evidence for similar neural mechanisms in humans. Broca's area (Ba 44 and 45) has been found to be active during a task in which normal subjects were required to form a mental imagery of the hand and rotate it (Parsons, Fox et al. 1995) and during the mental simulation of actions (Decety, Perani et al. 1994). An activation was present in a comparable location in the human brain while the subjects were observing the grasping of real objects with the right hand (Rizzolatti, Fadiga et al. 1996). The same area was also active during the observation of meaningful pantomimes (Decety, Grèzes et al. 1997). The observation/execution matching system ("mirror neurones") identified both in monkeys and in man, can thus be considered as a putative system specialised both for the encoding and the production of actions, and may form the basis of the recognition of meaningful motor events. Additionally, Perani, Cappa et al. (1995) found that, while animal picture recognition activated the inferior temporo-occipital areas, bilaterally, artefact recognition (tools) engaged a predominantly left hemispheric network, involving also the left dorsolateral frontal cortex. The network of neural structures activated by artefact recognition was lateralised to the left hemisphere and involved the prefrontal cortex, in particular the inferior frontal gyrus. This pattern of activation might be related to the functional knowledge or to cognitive strategy related to object manipulation. All these findings are compatible with the hypothesis

that the link between prefrontal cortex and verb processing is at least in part due to the activation of action representations.

There is however considerable evidence that other factors, besides semantic content may result in verb-specific neural representations. In the area of clinical studies, there are patients showing modality-specific grammatical class effects, i.e. only in written or in oral production (Caramazza & Hillis 1991; Hillis & Caramazza 1995; Rapp & Caramazza 1998). These observations cannot be easily explained in term of a semantic difference between nouns and verbs, and indicate that, at least in some patients, the defective performance is due to grammatical differences. Similarly, the observation reported by Shapiro, Shelton et al. (2000), of two patients with selective impairment in morphological processing of nonwords in, respectively, a nominal and a verbal context, indicates that a noun/verb dissociation can be observed on a purely grammatical basis.

Also in the case of imaging studies, the observed differences in the pattern of brain activation may be attributed to other factors, besides semantics. Phonological and morphological factors should be taken into account: for example, the presence of verb-specific suffixes in the Italian language may be hypothesised to play a role in the experiment of Perani, Cappa et al. (1999). It is however noteworthy that the verb-specific area observed in the latter investigation is localised in a part of Broca's area which has been found to be activated by the detection of syntactic anomalies, suggesting that the difference may actually be due to syntactic factors. In addition, the results of Shapiro, Pascual-Leone et al. (2001) with pseudoverbs can be hardly accounted by semantic factors.

The neurological model recently proposed by Caramazza & Finocchiaro (in press) may be able accommodate this complex pattern of neurological correlations. These authors postulate the existence of two separate processing pathways specialised for noun and verb processing: a fronto-temporal and a fronto-parietal route. Specific subcomponents of Broca's area are supposed to be involved in verbal and nominal morphology. An anterior-superior region, with prevalent connections to the parietal lobe, is responsible for verb processing, while an inferior region, connected to the temporal region, is specialised for nouns. Damage to selective components of these networks may result in cases of noun/verb dissociation which can be attributed to different mechanisms of linguistic impairment. Imaging studies can test the details of this model directly, with the final aim to tease apart the contribution of conceptual, lexical and grammatical factors to the anatomical and functional specificity for nouns and verbs.

Address of the Author:

Stefano F. Cappa, M.D., Dept of Psychology, Vita Salute San Raffaele, S. Raffaele University, DIBIT, Via Olgettina 58, 20132 Milano <cappa.stefano@hsr.it>
Daniela Perani, Dept of Psychology, Vita Salute San Raffaele, S. Raffaele University, DIBIT, Via Olgettina 58, 20132 Milano.

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Dominanza di verbi vs. nomi nel discorso di madri italiane: ruolo del contesto e dell'età del bambino

Emiddia Longobardi & Luigia Camaioni

This study examines naturalistic speech produced by 15 Italian middle-class mothers to determine which specific patterns of noun and verb use characterize linguistic input to children in their second year of life. The aim is to verify if maternal use of nouns and verbs changes as a function of context ("toy play" and "meal") and child's age (16 and 20 months). Since Italian is a PRO-DROP language, we expect that mother-to-child speech will show a bias towards a more salient semantic and morphological significance of verbs relative to nouns. Moreover, we expect that verbs will more likely occupy the sentence-initial position, and have more morphological inflections relative to nouns. Mother-to-child speech was coded for type and token frequency, utterance position, and morphological variation of nouns and verbs. The results confirm our predictions since the verb emphasis pattern was found in both contexts and at each age considered. Namely, Italian-speaking mothers produced verb types and tokens more frequently than noun types and tokens, they placed verbs more frequently than nouns in initial position, they placed nouns more frequently than verbs in final position, and they morphologically marked verb stems more than noun stems.

1. Introduzione

Negli anni '80 vi è stato un generale consenso tra gli studiosi sul fatto che i bambini tendono a imparare più nomi che verbi o altri tipi di predicati nel loro primo vocabolario, e alcuni ricercatori si sono spinti fino a sostenere che questa tendenza potrebbe essere universale (Gentner 1982). Diverse ricerche, basate per lo più sull'utilizzo di questionari o diari compilati dalle madri, hanno verificato che i nomi sono dominanti ('noun bias') nell'acquisizione di lingue come l'inglese (Goldfield 1993), l'italiano (Caselli *et al*. 1995, 1999) e l'israeliano (Dromi 1987). Più recentemente si è cominciato a dubitare che il 'noun bias' rappresenti una tendenza universale, valida per tutte le lingue. Ricerche condotte su bambini che imparano il cinese (Tardif 1996, Tardif *et al*. 1997), il coreano (Choi & Gopnik, 1995) e il tzotzil, una lingua Maya del Messico meridionale (de Leon 1999), hanno evidenziato come questi bambini utilizzino più verbi che nomi nella loro

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produzione spontanea. Per quanto riguarda l'acquisizione dell'italiano, uno studio di Camaioni & Longobardi (1995), volto a indagare la presenza di differenze nello stile di acquisizione, non ha trovato conferma alla prevalenza di uno stile 'referenziale' caratterizzato da una elevata produzione di nomi, laddove diverse ricerche hanno documentato che questo stile prevale nei bambini che imparano l'inglese (Nelson 1973, Bates *et al*. 1988).

Alcune peculiarità della lingua italiana la accomunano alle lingue cinese e coreana piuttosto che all'inglese, soprattutto quelle caratteristiche che determinano l'enfasi sui verbi. In italiano il soggetto della frase (per lo più un nome o un pronome) spesso è opzionale e viene omesso. Viceversa il verbo viene raramente omesso, anzi occupa frequentemente la posizione iniziale nell'enunciato in conseguenza dell'omissione del soggetto. Questo duplice fenomeno – frequente omissione del soggetto e infrequente omissione del verbo – potrebbe determinare una maggiore proporzione di verbi piuttosto che di nomi e una maggiore proporzione di verbi in posizione iniziale nell'enunciato. Altre caratteristiche differenziano l'italiano dal cinese e dal coreano, in particolare la presenza nella lingua italiana, ma non nelle altre due, di una ricca morfologia sia nominale che verbale, e una maggiore complessità e variabilità delle forme verbali rispetto ai nomi. Questa caratteristica, che possiamo definire di 'semplicità morfologica', dovrebbe facilitare l'apprendimento dei nomi piuttosto che dei verbi nei bambini che imparano la lingua italiana.

Iverson *et al*. (1994) hanno documentato nella produzione spontanea di bambini italiani una predominanza dei nomi sui predicati, anche se quest'ultima categoria viene intesa in modo ampio così da includere non soltanto i verbi ma anche gli aggettivi e gli avverbi. Uno studio basato sulla parallela somministrazione di un questionario compilato dai genitori a consistenti campioni di bambini italiani e americani tra 18 e 30 mesi di età, ha trovato curve di sviluppo simili per i nomi e i predicati nei due campioni a parità di livello di vocabolario. Questo risultato riguarda non soltanto la fase iniziale del lessico ma anche le fasi successive (con ampiezza di vocabolario compresa tra 100 e 600 parole), fino alla transizione alla grammatica (Caselli *et al*. 1999). Un altro studio ha trovato che i predicati aumentano significativamente di più rispetto ai nomi quando il lessico infantile, valutato tramite la somministrazione di un questionario ai genitori, si espande dalle 100 alle 200 parole (D'Odorico *et al*. 2001).

Alla luce dei dati finora disponibili sulla dominanza di nomi vs. verbi nel lessico dei bambini italiani, l'analisi dell'input diventa particolarmente importante in quanto può consentire di verificare la

relazione tra caratteristiche strutturali della lingua italiana e apprendimento di particolari categorie lessicali.

Tardif *et al*. (1997) hanno confrontato l'uso di nomi e verbi da parte di madri americane, italiane e cinesi quando parlano ai loro bambini tra 22 e 24 mesi di età. Hanno trovato che le madri americane utilizzano in eguale misura i nomi e i verbi, collocano i nomi in posizione finale nelle frasi e presentano una maggiore variabilità delle forme verbali rispetto a quelle nominali. Le madri cinesi producono più verbi, che vengono prevalentemente collocati in posizione finale negli enunciati e mostrano una variabilità nominale maggiore di quella verbale. Le madri italiane adoperano più nomi che verbi, ma in misura non significativa, collocano i nomi prevalentemente in posizione finale e mostrano una morfologia verbale più ricca di quella nominale. Le autrici riportano anche i dati relativi all'uso di nomi e verbi da parte dei bambini trovando che i bambini inglesi producono significativamente più nomi che verbi, i bambini cinesi significativamente più verbi che nomi e i bambini italiani più nomi che verbi ma in misura non significativa. Mentre i dati relativi ai bambini inglesi e cinesi appaiono congruenti con l'input che ricevono, i dati relativi all'acquisizione dell'italiano non evidenziano una chiara associazione tra caratteristiche del discorso materno ed esiti nel lessico infantile.

In uno studio recente (Camaioni & Longobardi 2001) abbiamo analizzato l'utilizzo di nomi e verbi da parte di quindici madri di lingua italiana che si rivolgono ai propri bambini di 16 e 20 mesi di età rispettivamente in un contesto di gioco. Abbiamo trovato che le madri utilizzano prevalentemente verbi piuttosto che nomi, sia come tipi che come frequenze e collocano più frequentemente i verbi in posizione percettivamente 'saliente' nella frase, dove saliente include sia la posizione iniziale che quella finale. Tuttavia, considerando le due posizioni distintamente, i verbi occupano soprattutto la posizione iniziale e i nomi la posizione finale. Relativamente alla morfologia i verbi presentano una maggiore variabilità rispetto ai nomi. Un input così caratterizzato pone una più chiara enfasi sui verbi piuttosto che sui nomi e sembra adatto a favorire l'apprendimento dei verbi piuttosto che dei nomi. Tuttavia i dati sulla variazione morfologica indicano che per il bambino potrebbe essere più facile apprendere i nomi in virtù della loro maggiore 'semplicità' morfologica rispetto ai verbi.

Un ulteriore fattore che influenza l'utilizzo di nomi e di verbi è il contesto di interazione. Gopnik *et al*. (1996) hanno esaminato il linguaggio di madri di lingua inglese e coreana in due diversi contesti di interazione con i bambini, la lettura di un libro figurato e il gioco con oggetti, ipotizzando che la struttura grammaticale dell'inglese e del

coreano porti ad enfatizzare l'uso dei nomi o dei verbi nelle due lingue rispettivamente. In linea con le previsioni, le madri coreane tendono a produrre più verbi delle madri americane, le quali centrano il loro discorso sugli oggetti e adoperano più nomi. Analizzando separatamente i due contesti di gioco, la lettura del libro favorisce la produzione di un maggior numero di nomi in ambedue i gruppi di madri, mentre il gioco con oggetti favorisce l'uso di verbi. Le madri coreane prediligono comunque un discorso che enfatizza il ruolo delle azioni e delle routine sociali piuttosto che la denominazione, che caratterizza viceversa le madri americane (Kim *et al*. 2000). Anche Tardif *et al*. (1999), confrontando un gruppo di madri americane e cinesi nei medesimi contesti, hanno rilevato che durante la lettura di un libro prevale l'uso di nomi e nel gioco con oggetti l'uso di verbi per entrambi i gruppi di madri. Inoltre, Goldfield (2000) analizzando gli aspetti pragmatici del discorso materno, ha evidenziato come le madri americane sollecitino frequentemente la produzione di nomi chiedendo una risposta verbale da parte dei bambini. Al contrario, quando utilizzano i verbi, tendono soprattutto a sollecitare l'esecuzione di una azione, ovvero una risposta non verbale. Questa differenza implica che l'acquisizione dei verbi nel linguaggio infantile potrebbe essere sottostimata qualora si prenda in considerazione soltanto la produzione verbale e non anche la comprensione verbale dei bambini.

In definitiva, i dati finora disponibili per l'inglese, il cinese e il coreano evidenziano come diversi fattori, di tipo sia strutturale che pragmatico, influenzano la dominanza di nomi o di verbi nel linguaggio materno rivolto ai bambini che imparano a parlare. Per quanto riguarda l'italiano sono necessari ulteriori studi per verificare il ruolo dei fattori di tipo sia strutturale che pragmatico nel determinare la dominanza di forme linguistiche diverse nel discorso materno.

La presente ricerca si propone di analizzare l'utilizzo di nomi e verbi da parte delle madri italiane in diversi contesti di interazione con il proprio bambino a 16 e a 20 mesi di età rispettivamente. A tal fine sono stati presi in considerazione due contesti, uno di gioco e uno di routine (il pasto). La scelta dei contesti è stata guidata dall'esigenza di tener conto di situazioni che tipicamente caratterizzano l'interazione madre-bambino nella vita familiare, includendo sia l'attività ludica sia una routine in cui prevale l'aspetto di accudimento del bambino. Considerando le caratteristiche strutturali dell'italiano, come la frequente omissione del soggetto e l'infrequente omissione del verbo nonché la 'semplicità' morfologica dei nomi, ci si aspetta di rilevare che i verbi prevalgano sui nomi, che i verbi occu-

pino più frequentemente la posizione iniziale nell'enunciato e presentino una maggiore variabilità morfologica rispetto ai nomi. L'obiettivo è quello di analizzare se e come varia l'utilizzo di nomi e verbi da parte delle madri in funzione dell'età del bambino e del contesto di interazione.

2. Metodo

2.1. Soggetti

Sono state selezionate quindici coppie madre-bambino di livello socio-culturale medio-alto definito in base alla scolarità materna (diploma superiore o laurea) e il lavoro paterno (impiegato, libero professionista, insegnante, dirigente). Tutte le famiglie erano di madre lingua italiana e residenti a Roma; i bambini (7 bambini e 8 bambine, 10 primogeniti e 5 secondogeniti) presentavano uno sviluppo psico-fisico normale fin dalla nascita. Dieci madri svolgevano una attività lavorativa, prevalentemente a tempo parziale, durante il periodo di rilevazione dei dati.

2.2. Procedura

Le coppie madre-bambino sono state audio-videoregistrate nell'ambiente familiare una prima volta a 16 mesi di età del bambino (età media: 1;4.4 mesi, min-max: 1;3.29-1;4.8) e una seconda volta a 20 mesi (età media:1;8.3, min-max: 1;7.28-1;8.7). Ciascuna seduta di osservazione ha incluso due diversi contesti, della durata di 15 minuti ciascuno, e precisamente: il 'gioco con oggetti familiari' e il 'pasto'. Per il 'gioco con oggetti familiari' si chiedeva alla madre di svolgere con il bambino le consuete attività ludiche; la routine del pasto ha incluso il pranzo, la cena o la merenda tenendo conto degli abituali orari del bambino.

La lunghezza media degli enunciati (LMEp) dei bambini a 16 mesi era 1.07 (d.s. = 0.1), a 20 mesi 1.26 (d.s. = 0.26).

2.3. Misure

Il linguaggio prodotto dalle madri nel corso delle audio-videoregistrazioni è stato integralmente trascritto su appositi protocolli. A ciascuna età del bambino e per ciascun contesto sono stati selezionati 100 enunciati materni di almeno due parole, prodotti consecutiva-

mente. La scelta di includere nell'analisi soltanto gli enunciati di almeno due parole deriva dalla necessità di ottenere una misura consistente relativamente alla posizione iniziale e/o finale dei nomi/verbi. Pertanto sono stati analizzati complessivamente 400 enunciati materni suddivisi equamenti nei due contesti interattivi (gioco e pasto), a 16 e a 20 mesi di età del bambino. Gli enunciati materni sono stati codificati utilizzando le seguenti misure: a) tipi e frequenze dei nomi; b) tipi e frequenze dei verbi; c) enunciati che contengono nomi in posizione iniziale e finale; d) enunciati che contengono verbi in posizione iniziale e finale; d) variazioni morfologiche nei nomi; e) variazioni morfologiche nei verbi.

Nella codifica dei nomi e dei verbi sono stati utilizzati due criteri, che chiameremo 'ristretto' e 'allargato'. Per quanto riguarda i nomi, il criterio 'ristretto' include soltanto i nomi concreti e astratti, il criterio 'allargato' include anche i nomi propri. Rispetto ai verbi, il criterio 'ristretto' include soltanto i verbi principali, il criterio 'allargato' include anche i verbi ausiliari, modali e le copule (cfr. Tardif *et al*. 1997). L'analisi riportata nel presente studio si riferisce alla codifica dei nomi e dei verbi effettuata in base al criterio ristretto. I nomi e i verbi sono stati considerati come tipi diversi di parola ogni volta che si presentavano nelle diverse forme morfologiche previste dal loro lemma (ad es. singolare/plurale, genere, tempo, modo). Ad esempio bambino/bambina, fai/facciamo/fare sono stati considerati come tipi diversi di nomi e verbi. Nel calcolare la variazione morfologica, il numero di variazioni morfologiche rilevato per ogni nome e verbo è stato diviso per il rispettivo lemma (cfr. Camaioni & Longobardi 2001).

Sul 20% degli enunciati materni selezionati è stato calcolato l'accordo tra due codificatori indipendenti, opportunamente addestrati ad utilizzare le misure linguistiche prese in esame. I pochi casi di disaccordo sono stati discussi con un terzo codificatore in modo da pervenire al 100% di accordo sulle misure prese in esame.

3. Risultati

3.1. Tipi e frequenze di nomi e verbi

È stata condotta preliminarmente una Analisi della Varianza per misure ripetute (2x2) sul numero di parole prodotte nei 400 enunciati materni selezionati (n° medio di parole nel gioco a 16 mesi: 334.07, a 20 mesi: 340.40; nel pasto a 16 mesi: 340.60, a 20 mesi:

350.13). L'analisi ha verificato la stabilità di questa misura linguistica globale, non evidenziando nessun effetto significativo dei fattori presi in esame (età del bambino e contesto interattivo).

La Tabella 1 riporta l'uso di nomi e di verbi da parte delle madri, in termini sia di tipi che di frequenze, alle due età del bambino e nei due contesti.

Tabella 1. Nomi e verbi nel discorso materno in funzione del contesto e dell'età del bambino

	Gioco		Pasto	
	16 mesi			
Misure	Tipi	Frequenze	Tipi	Frequenze
	Media d.s.	Media d.s.	Media d.s.	Media d.s.
Nomi comuni	21.20 (7.23)	38.47 (8.93)	21.87 (5.77)	39.47 (10.91)
Verbi principali	41.13 (6.16)	77.07 (10.24)	42.40 (9.20)	76.40 (15.32)
	20 mesi			
Nomi comuni	24.57 (5.46)	45.20 (10.84)	23.87 (5.05)	43.93 (10.24)
Verbi principali	43.67 (5.55)	73.27 (6.89)	44.27 (7.93)	70.47 (8.43)

Al fine di verificare una eventuale variazione nell'uso di nomi e di verbi da parte delle madri in funzione dell'età del bambino e del contesto interattivo sono state calcolate diverse Analisi della Varianza per misure ripetute (2x2x2) considerando i seguenti fattori: categoria linguistica (nomi e verbi), età del bambino (16 e 20 mesi) e contesto interattivo (gioco e pasto). Le Analisi della Varianza per misure ripetute sono state calcolate separatamente per ciascuna delle variabili dipendenti prese in esame e precisamente: tipi e frequenze di nomi e verbi, variazione morfologica dei nomi e dei verbi, posizione iniziale e finale dei nomi e dei verbi nell'enunciato.

Per quanto riguarda la variabile tipi, l'Analisi della Varianza ha evidenziato un effetto significativo della categoria lessicale ($F(1,14) = 272.14$, $p = 0.0001$) e dell'età del bambino ($F(1,14) = 6.25$, $p = 0.02$). In particolare, i verbi risultano significativamente più utilizzati rispetto ai nomi sia nel contesto di gioco a 16 ($t(14) = -8.96$, $p = 0.0001$) e a 20 mesi di età del bambino ($t(14) = -9.02$, $p = 0.0001$), sia nel contesto del pasto a 16 mesi ($t(14) = -11.89$, $p = 0.0001$) e a 20 mesi ($t(14) = -8.39$, $p = 0.0001$). Inoltre, nel contesto di gioco si registra un aumento significativo nell'utilizzo materno dei nomi dai 16 ai 20 mesi di età del bambino ($t(14) = -2.06$, $p = 0.05$).

Per quanto riguarda la frequenza d'uso di nomi e di verbi l'Analisi della Varianza ha evidenziato un effetto significativo della categoria lessicale ($F(1,14) = 267.84$, $p = 0.0001$) e un'interazione tra il fattore categoria lessicale e l'età del bambino ($F(1,14) = 6.73$, $p = 0.02$). Anche in questo caso le madri utilizzano significativamente più verbi che nomi sia nel contesto di gioco a 16 ($t(14) = -11.16$, $p = 0.0001$) e a 20 mesi ($t(14) = -8.91$, $p = 0.0001$) che nel contesto del pasto ad ambedue le età del bambino (16 mesi: $t(14) = -10.57$, $p = 0.0001$; 20 mesi: $t(14) = -6.39$, $p = 0.0001$). Inoltre la frequenza dei nomi aumenta significativamente tra i 16 e i 20 mesi nel contesto di gioco ($t(14) = -2.39$, $p = 0.03$).

I risultati ottenuti evidenziano in sintesi, una chiara prevalenza dei verbi rispetto ai nomi nel discorso materno rivolto ai bambini per entrambi i contesti esaminati, in termini sia di tipi che di frequenze. L'età del bambino influenza l'andamento di queste due categorie lessicali limitatamente all'utilizzo dei nomi nel contesto di gioco, sia come tipi che come frequenze. Questo risultato relativo al contesto di gioco può indicare un cambiamento nella costruzione degli enunciati materni; mentre la quantità dei verbi rimane stabile nel passaggio dai 16 ai 20 mesi di età del bambino, aumenta il numero di argomenti nominali che accompagnano il verbo. Ad esempio a 16 mesi è più frequente che la madre utilizzi enunciati del tipo "prendi la palla" o "mettiamo il coperchio"; a 20 mesi si rilevano piuttosto enunciati come "dammi la bambola con il grembiule", "l'orso mangia con il cucchiaio", "costruiamo la torre con i cubi".

3.2. Variazione morfologica

La Tabella 2 riporta i lemmi e la variazione morfologica di nomi e verbi prodotti dalle madri nei contesti presi in esame.

Tabella 2. Lemmi e variazione morfologica di nomi e verbi nel discorso materno in funzione del contesto e dell'età del bambino

	Gioco				Pasto			
Misure	16 mesi		20 mesi		16 mesi		20 mesi	
	Media	d.s.	Media	d.s.	Media	d.s.	Media	d.s.
Lemmi								
Nomi comuni	19.13	(6.67)	22.40	(5.82)	20.27	(5.09)	21.80	(4.79)
Verbi Principali	24.73	(3.51)	24.20	(3.63)	26.53	(6.19)	26.93	(4.80)
Variazione morfologica								
Nomi comuni	1.12	(0.08)	1.11	(0.10)	1.07	(0.02)	1.10	(0.03)
Verbi principali	1.68	(0.23)	1.82	(0.22)	1.61	(0.20)	1.66	(0.18)

Relativamente al numero dei lemmi di nomi e verbi, l'Analisi della Varianza per misure ripetute ha evidenziato un effetto significativo della categoria lessicale ($F(1, 14) = 25.97$, $p=0.0001$). I lemmi relativi ai verbi prevalgono significativamente rispetto ai nomi nel contesto di gioco a 16 mesi di età del bambino ($t(14) = -4.59$, $p = 0.004$) e nel contesto del pasto a 16 mesi ($t(14) = -4.37$, $p = 0.001$) e a 20 mesi ($t = (14) = -3.31$, $p = 0.005$). L'Analisi della Varianza condotta sulla variazione morfologica di nomi e di verbi ha evidenziato un effetto significativo dei fattori categoria lessicale ($F(1, 14) = 389.71$, $p = 0.0001$) e contesto interattivo ($F(1, 14) = 8.63$, $p = 0.01$). La variazione morfologica dei verbi è significativamente maggiore rispetto a quella dei nomi nel contesto del gioco a 16 ($t(14) = -9.81$, $p = 0.0001$) e a 20 mesi ($t(14) = -14.81$, $p = 0.0001$) di età del bambino, come pure nel contesto del pasto (16 mesi: $t(14) = -9.79$, $p = 0.0001$; 20 mesi: $t(14) = -11.35$, $p=0.0001$). Inoltre, la variazione morfologica dei verbi è significativamente maggiore nel contesto di gioco rispetto al pasto a 20 mesi di età del bambino ($t(14) = 2.67$, $p = 0.02$).

I nostri risultati da un lato confermano i risultati di studi precedenti sul linguaggio di madri italiane in cui la complessità morfologica dei verbi risultava significativamente maggiore di quella dei nomi (Tardif *et al*. 1997, Camaioni & Longobardi 2001), dall'altro documentano come tale caratteristica strutturale della lingua italiana rimane stabile nei due contesti interattivi presi in esame. L'effetto del contesto sulla variazione morfologica dei verbi è limitato all'età di 20 mesi e può essere interpretato nel senso che nel contesto di gioco rispetto al pasto l'input materno si diversifica maggiormente fornendo al bambino un ulteriore elemento di ricchezza ma anche di complessità.

3.3. Posizione saliente di nomi e verbi

Le Figure 1 e 2 mostrano la frequenza con cui le madri collocano i nomi e i verbi in posizione percettivamente saliente (iniziale e finale) all'interno dell'enunciato.

Sono state condotte due Analisi della Varianza per misure ripetute per ciascuna posizione (iniziale e finale) occupata dai nomi e dai verbi all'interno degli enunciati analizzati. Relativamente alla posizione iniziale, l'Analisi della Varianza ha evidenziato un effetto significativo della categoria lessicale ($F(1, 14) = 185.55$, $p = 0.0001$) e dell'età del bambino ($F(1, 14) = 6.07$, $p = 0.03$), e un'interazione tra questi due fattori ($F(1, 14) = 7.667$, $p = 0.01$). I verbi occupano in misura significativamente più frequente dei nomi la posizione

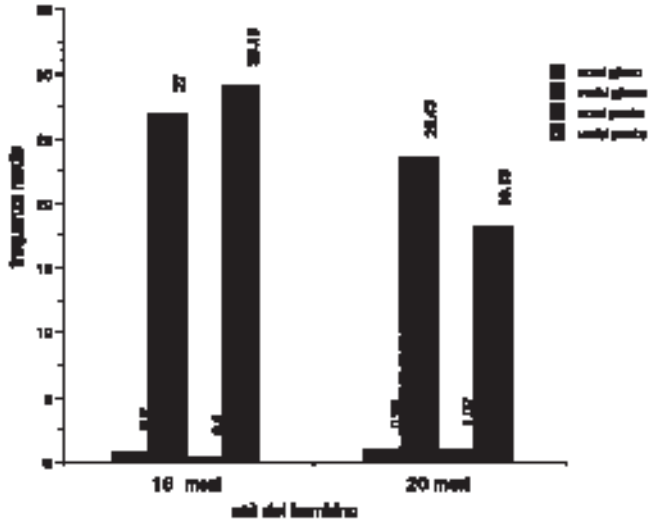

Figura 1. Posizione iniziale di nomi e verbi negli enunciati materni in funzione del contesto e dell'età del bambino.

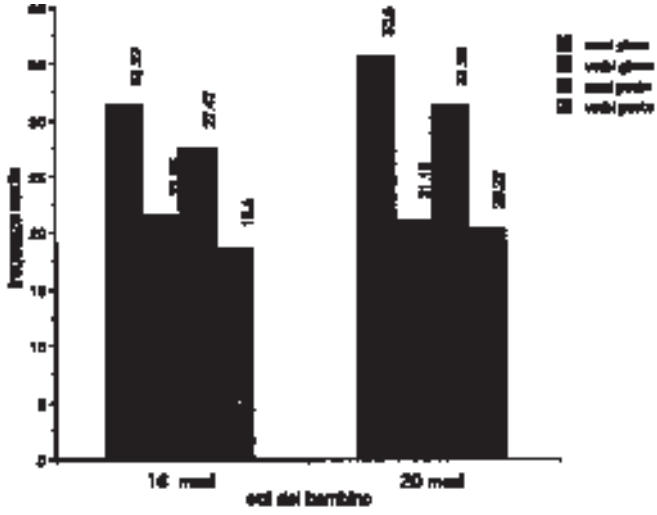

Figura 2. Posizione finale di nomi e verbi negli enunciati materni in funzione del contesto e dell'età del bambino.

iniziale sia nel gioco (16 mesi: $t(14) = -14.84$, $p = 0.001$; 20 mesi: $t(14) = -10.56$, $p = 0.0001$) che nel pasto (16 mesi: $t(14) = -6.01$, $p = 0.0001$; 20 mesi: $t(14) = -8.51$, $p = 0.0001$) ad ambedue le età del bambino. Nel

contesto del pasto le madri collocano più frequentemente e in misura significativa i nomi nella posizione iniziale a 20 rispetto a 16 mesi ($t(14) = -2.47$, $p = 0.03$), e collocano meno frequentemente e in misura significativa i verbi nella posizione iniziale a 20 rispetto a 16 mesi ($t(14) = 2.29$, $p = 0.04$). Inoltre, a 20 mesi di età del bambino le madri collocano in misura significativamente maggiore i verbi in posizione iniziale nel gioco rispetto al pasto ($t(14) = 3.11$, $p = 0.008$).

Relativamente alla posizione finale l'Analisi della Varianza ha evidenziato un effetto significativo della categoria lessicale ($F(1, 14) = 37.33$, $p = 0.0001$), dell'età del bambino ($F(1, 14) = 6.61$, $p = 0.02$) e del contesto interattivo ($F(1, 14) = 10.36$, $p=0.006$). Più specificamente, i nomi occupano più frequentemente dei verbi e in misura significativa la posizione finale all'interno degli enunciati materni sia nel gioco (16 mesi: $t(14) = 3.99$, $p = 0.001$; 20 mesi: $t(14) = 5.17$, $p = 0.0001$) che nel pasto (16 mesi: $t(14) = 3.99$, $p = 0.001$; 20 mesi: $t(14) = 3.43$, $p = 0.004$), ad ambedue l'età del bambino. Rispetto all'età del bambino, nel contesto di gioco le madri collocano maggiormente i nomi in posizione finale a 20 piuttosto che a 16 mesi ($t(14) = -2.09$, $p = 0.05$). Riguardo al contesto interattivo, le madri a 16 mesi di età del bambino collocano maggiormente i verbi in posizione finale nel gioco rispetto al pasto ($t(14) = 2.10$, $p = 0.05$). Si registra infine una differenza tra i contesti tendenzialmente significativa ($t(14) = 1.97$, $p = 0.07$) relativamente ai nomi. Le madri infatti collocano i nomi in posizione finale più frequentemente nel gioco rispetto al pasto a 20 mesi di età del bambino.

Nel complesso i risultati mostrano che la posizione (iniziale e finale) occupata dai nomi e dai verbi negli enunciati materni rispecchia le previsione formulate in base alle caratteristiche strutturali dell'italiano, e cioè che i verbi occupino più frequentemente la posizione iniziale e i nomi quella finale; ciò accade ad ambedue i livelli di età del bambino e nei due contesti interattivi presi in esame. Il parametro della posizione è apparso moderatamente sensibile ai fattori presi in esame, l'età del bambino e il contesto. L'influenza del contesto sulla posizione di nomi e verbi nell'enunciato merita di essere ulteriormente approfondita attraverso un'analisi delle strategie comunicative materne e delle corrispondenti funzioni pragmatiche veicolate dagli enunciati.

4. Discussione

I risultati ottenuti nel presente studio confermano le previsioni formulate circa la prevalenza di verbi nel discorso materno rivolto ai

bambini che imparano a parlare. Tale dominanza era già stata documentata in uno studio precedente, che aveva preso in esame un solo contesto di interazione, quello di gioco (Camaioni & Longobardi 2001). I nuovi risultati qui presentati sottolineano la stabilità di questo pattern di dominanza in relazione ai fattori presi in esame, cioè l'età del bambino e il contesto interattivo.

I due contesti gioco e pasto rappresentano situazioni tipiche della vita quotidiana del bambino piccolo e inoltre, ben differenziate lungo la dimensione gioco/accudimento. Il non aver rilevato differenze tra questi due contesti nel pattern di dominanza verbi vs. nomi apparentemente contrasta con le differenze rilevate da alcuni studi precedenti. Tuttavia le differenze contestuali riscontrate nel discorso delle madri di lingua inglese e coreana (Gopnik *et al*. (1996), come pure in quello delle madri cinesi (Tardif *et al*. 1999), riguardavano due specifici 'formati' di attività congiunta tra madre e bambino, cioè 'la lettura del libro' e il 'gioco con oggetti'. Si ritiene che tali 'formati' sollecitino un uso diversificato di nomi o di verbi da parte delle madri a seconda che prevalga un'attività centrata sulla denominazione o sull'esecuzione di azioni con gli oggetti.

Globalmente è stata confermata la salienza dei verbi rispetto ai nomi nel discorso delle madri italiane, le quali forniscono un input che dovrebbe favorire l'apprendimento dei verbi piuttosto che dei nomi da parte dei bambini. Tuttavia, il fatto che i verbi presentino una maggiore variabilità morfologica potrebbe rappresentare un elemento di difficoltà per l'apprendimento dei verbi a favore dei nomi, che godono di una maggiore semplicità morfologica nell'input.

Studi futuri dovrebbero verificare se i bambini che imparano l'italiano presentano una dominanza dei verbi rispetto ai nomi o piuttosto una presenza bilanciata di queste categorie lessicali nel loro primo vocabolario. Sappiamo ormai con sufficiente certezza che l'input che i bambini italiani ricevono enfatizza i verbi piuttosto che i nomi (cfr. Tardif et al. 1997, Camaioni & Longobardi 2001) e il presente lavoro rafforza tale risultato mostrando la stabilità di questo pattern di dominanza in contesti diversi e a diverse età del bambino. Sarebbe importante, a nostro parere, che gli studi sulla dominanza di verbi vs. nomi nell'acquisizione della lingua italiana, si basassero sulla produzione spontanea del bambino piuttosto che su questionari compilati dalle madri e controllassero il contesto di attività nell'interazione madre-bambino.

Address of the Authors:

E. Longobardi, Dipartimento di Psicologia Dinamica e Clinica, via dei Marsi 78, 00185, Roma, Italia. Tel. 0039 06 49917561, fax: 0039 06 49917652 <emiddia.longobardi@uniroma1.it>
L. Camaioni, *idem* <luigia.camaioni@uniroma1.it>

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Verbs, nouns, and simulated language games

Domenico Parisi, Angelo Cangelosi & Ilaria Falcetta

The paper describes some simple computer simulations that implement Wittgenstein's notion of a language game, where the meaning of a linguistic signal for an individual is the role played by the linguistic signal in the individual's interactions with the nonlinguistic and linguistic environment. In the simulations an artificial organism interacts at the sensory-motor level with an environment and its behavior is influenced by the linguistic signals the individual receives from the environment (conspecifics). Using this approach we try to capture the distinction between (proto)verbs and (proto)nouns, where (proto)verbs are linguistic signals that tend to co-vary with the action with which the organism responds to the sensory input whereas (proto)nouns are linguistic signals that tend to co-vary with the particular sensory input to which the organism responds with its actions. Some extensions of the approach to the analysis of other parts of speech ((proto)adjectives, (proto)sentences, etc.) are also described. The paper ends up with some open questions and suggestions on how to deal with them.[1]

1. Simulated language games

The meaning of a linguistic signal is the manner in which the linguistic signal is used in the everyday interactions of speakers/hearers with the world and the role the linguistic signal plays in their overall behavior. This Wittgensteinian definition of meaning, while probably correct, poses a serious problem for the study of language in that, although linguistic signals as sounds or visual (written) forms are easily identified, observed, and described, the way in which linguistic signals are used by actual speakers/hearers in real life situations is very difficult to observe and describe with any precision, reliability, and completeness. Therefore, linguists, psycholinguists, and philosophers tend to replace meanings with such poor "proxies" as verbal definitions, translations (when studying linguistic signals in other languages), or the limited and very artificial uses of linguistic signals in

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laboratory experiments (e.g., the naming of pictures or the decision if a sequence of letters is a word or a nonword).

An alternative to such practices is to adopt Wittgenstein's strategy of studying "language games", i.e., simplified models of the very complex and diverse roles that linguistic signals play in our complicated everyday life which may be closer to the "games by means of which children learn their native language" (Wittgenstein 1953, 5e) and to languages "more primitive than ours" (Wittgenstin 1953, 3e). In this paper we adopt this Wittgensteinian strategy but with a significant change: our language games are simulated in a computer. We create artificial organisms which live in artificial worlds and which may receive and produce linguistic signals in such a way that these linguistic signals become incorporated in their overall behavior and in their interactions with the world. Simulated language games have two advantages when they are compared with the philosopher's language games. First, since simulated language games are "objectified" in the computer (the organisms' behavior can be actually seen on the computer screen) and they do not only exist in the philosopher's mind or in his/her verbal expressions and discussions with colleagues, they offer more degrees of freedom and more objectivity when one tries to describe, analyze, measure, and manipulate experimentally the meaning of linguistic signals conceived as their role in the overall behavior of the artificial organisms. Second, given the great memory and computing resources of the computer, which greatly exeeced those of the human mind, one can progressively add new components to an initially very simple simulation in such a way that the language games may become more and more similar to actual languages.

Recently, computer models have been used to simulate the evolutionary emergence of language in populations of interacting organisms (Cangelosi & Parisi 2002; Knight et al. 2000; Steels 1997). Various simulation methodologies have been employed, such as communication between rule-based agents (Kirby 1999), recurrent neural networks (Batali 1994; Ellefson & Christiansen 2000), robotics (Kaplan 2000; Steels & Vogt 1997), and internet agents (Steels & Kaplan 1999). Among these, artificial life neural networks (ALNNs: Parisi 1997) provide a useful modelling approach for studying language (Cangelosi & Parisi 1998; Cangelosi & Harnad in press; Parisi & Cangelosi 2002). ALNNs are neural networks that control the behaviour of organisms that live in an environment and are members of evolving populations of organisms. They provide a unifying methodological and theoretical framework for cognitive modelling

because of the use of both evolutionary and connectionist techniques and the interaction of the organisms with a simulated ecology. All behavioral abilities (e.g., sensorimotor skills, perception, categorization, language) are controlled by the same neural network. This permits the investigation of the interaction between language and other cognitive and sensorimotor abilities.

2. Verbs and nouns

For linguistic signals such as words one can distinguish among different classes of words based on some general properties of the use of these different classes of words (Brown & Miller 1999). The purpose of this article is to explore what neural network models can contribute to a better understanding of the nature of verbs and nouns and, possibly, other parts of speech. The distinction between verbs and nouns is perhaps the most basic and universal distinction among different classes of words in human languages and a neural network treatment of verbs and nouns, if successful, can then be extended to other parts of speech. Verbs and nouns may be distinguished on semantic or syntactic grounds. Semantically, verbs and nouns can be distinguished in terms of the different types of entities to which they refer. Verbs are said to refer to actions or processes while nouns refer to objects or static entities (cf., e.g., Langacker 1987). Syntactically, verbs and nouns are distinguished in terms of the different roles they play, or the different contexts in which they appear, in phrases and sentences. Given our simplified language games, in which almost no multi-component signals are used such as phrases and sentences, the work to be reported here tries to illuminate the semantics rather than the syntax of verbs and nouns.

We hypothesize that in the early stages of language acquisition in children, and perhaps also in the early stages of linguistic evolution in the lineage of Homo sapiens, words begin to differentiate into verbs and nouns with verbs referring to actions and nouns to objects. But what does it mean to refer to actions or to objects and, more generally, what it is for a word to refer? Heard sounds acquire meaning or reference (we use the two terms interchangeably) for an organism and therefore become linguistic signals for the organism when they influence the way in which the organism responds to the input from the environment. We imagine a basic situation in which the organism is exposed to visual input from the environment and the organism responds to this visual input with some motor action. Heard sounds

are additional inputs to the organism which are physically produced by the phono-articulatory behavior of some nearby conspecific. If this additional input systematically influences how the organism responds to the visual input, with specific sounds having specific influences on the organism's behavior, we say that the sounds have become linguistic signals which have meaning or reference.

Our organisms see objects in the environment and they respond by moving their (single) arm in order to execute some action with respect to the objects. An organism's behavior is controlled by the organism's nervous system which is modeled using an artificial neural network. The neural network has two distinct sets of input units (sensory receptors). One set of input units encodes the content of the organism's retina (visual input). The other set of input units encodes the current position of the organism's arm (proprioceptive input). The network's output units encode muscle movements which result in changes in the arm's position. Intermediate between the input and the output units there are one or more layers of hidden units. All the network's units encode information in terms of the quantitative state of activation of the units. The neural network functions as a succession of input/output cycles of activity. In each cycle the pattern of activation of the input units is transformed into the patterns of activation of the successive layers of hidden units by the connection weights linking one unit to the next one until an output pattern of activation is generated which results in a micro-movement of the arm. A succession of micro-movements is an action of the organism with respect to the visually perceived objects. The organism may see a single object at a time or two objects at the same time and it may respond by moving its arm to reach an object or to push the object away from itself or to pull it toward itself.

Now we add language. Imagine that the organism's neural network includes a third set of input units which may encode various sounds (auditory input). These heard sounds tend to influence the way in which the organism responds to the visual input. When the organism hears one particular sound it responds to the visual input with some particular action which may be different (although it need not be) from the action with which the organism would have responded to that input in the absence of the sound (including no action at all). When a different sound is heard by the organism, the organism may respond with a different action.

We will describe a number of simple situations in which linguistic signals acquire their meaning in that they become part of the organism's total experience in its environment.

Imagine the following language game (Cangelosi & Parisi 2001; Parisi & Cangelosi 2002). The life of the organism is divided up into episodes which are composed of a number of successive input/output cycles. In each episode the organism sees one of two objects, O1 and O2, which vary in their shape. Together with this visual input the organism receives an auditory input, a heard sound presumably pronounced by some conspecific located nearby in the organism's environment. There are only two possible sounds, S1 and S2, but in any given episode the organism hears only one of these two sounds. At the beginning of each episode the endpoint of the organism's arm (the hand) is already positioned on the object. If we observe the organism's behavior, we see that the organism responds to the visually perceived object by pushing the object away from itself if it hears the sound S1 and by pulling the object toward itself if it hears the sound S2. This happens independently from whether the object is O1 or O2. In these circumstances, we say that the two sounds which are heard by the organism are (proto)verbs. (In fact they have a meaning which is equivalent to the meaning of the English verbs "push" and "pull".) S1 and S2 co-vary with the action with which the organism responds to the visual input but they are indifferent to the content of the visual input, i.e., to whether the object which is seen and which is pushed or pulled is O1 or O2.

Imagine now another language game (Falcetta 2001). The organism sees both objects, O1 and O2, at the same time. The two objects are located one in the left half and one in the right half of the organism's visual field. Together with this visual input the organism hears one of two sounds, S3 and S4. At the beginning of each episode the organism's arm is in a randomly selected position but always away from the objects. (Notice that the organism does not see its arm. It is informed by the proprioceptive input about the arm's current position but it only sees the objects.) When the organism hears S3 it moves its arm and reaches object O1 whereas when it hears S4 it reaches object O2. In these circumstances, we say that the two sounds S3 and S4 are (proto)nouns.

Notice that, like S1 and S2, S3 and S4 influence the action produced by the organism. Assuming that in a given episode the object O1 is in the left hemifield and the object O2 in the right hemifield, if the organism hears S3 it moves its arm toward the left portion of the visual field and reaches the object which is there (O1) whereas if it hears S4 it moves the arm toward the right portion of the visual field and reaches O2. However, in this second language game the linguistic input has a different role in the overall experience of the organ-

ism. While in the first language game the two linguistic signals, S1 and S2, had the role of determining the particular action executed by the organism, pushing or pulling, independently from whether the object was O1 or O2, in this new language game there is a single action, reaching an object, and the two linguistic signals, S3 and S4, have the role of directing the action of the organism toward one particular object rather than toward the other.

Therefore, we characterize verbs as linguistic signals that co-vary with the actions of the organism whereas nouns are linguistic signals that co-vary with the particular objects which are involved in these actions.

Since in the second language game the organism is capable of only one action, i.e., reaching an object with its arm, there is no need for the language to specify which action to choose - which is the role of verbs. The organism has only to know which one of the currently perceived objects must be reached, and providing this information is the role of nouns. But consider a third, somewhat more complex, language game in which the organism is both capable of two distinct actions, pushing and pulling objects (as in our first language game) and it sees two different objects at the same time (as in our second language game). In the new language game the organism will need to hear two linguistic signals, one verb and one noun, in order to know what to do. The auditory input units will encode one of the two verbs S1 and S2 at time T0 and then one of the two nouns S3 and S4 at time T1, or viceversa. (In this language game the temporal order of the two words in each sequence is irrelevant but, whatever the temporal order, to be able to appropriately process this simple (proto)sentence the neural network will need a working memory which keeps a trace of the first word while hearing the second word). In general, to have a (proto)sentence, one portion of the heard sounds must co-vary with the action to be executed and the other portion with the object on which the action is to be executed. Since actions can be executed on more than a single object (e.g., the action of giving involves two objects: the object given and the person receiving the object), (proto)sentences may include more than a single noun. (For the emergence of subjects or agents, cf. the last section. For the evolutionary emergence of compositionality, cf. Cangelosi 2001.)

We have defined nouns in terms of their role in directing the organism's action toward particular objects. Consider, however, that the organism's action can also consist in what is called "overt attention", i.e., movements of the organism's eyes or head that allow the organism to visually access some particular object - the object which

is specified by the noun. Normally organisms see many different objects at the same time and by hearing a noun they select one particular object as the object which is to be involved in the organism's action while ignoring the other objects. However, in other cases the organism hears some particular noun without seeing the object which is indicated by the noun. In these circumstances the noun causes the organism to move its entire body (locomoting) or particular parts of its body (turning the head or the eyes) until it finds an object with the required properties and it can execute the expected action on the object.

To illustrate this role of nouns let us consider a fourth language game. The organism's visual field is divided into three parts: a central portion with better seeing capabilities (fovea) and two peripheral portions, on the left and on the right of the central portion, with less good vision. The neural network which controls the organism's behavior has two sets of output (motor) units, not just a single set as in the preceding language games. One set of motor units controls the organism's arm, as in our previous simulations, while the second set of motor units controls the movements of the organism's (single) eye. At the beginning of each episode the organism looks straight ahead but it can move its eye either to the right or to the left. In every episode the organism's visual field contains three objects with different shapes, O3, O4, and O5, which are randomly distributed one in the visual field's central portion and each of the other two in one of the two peripheral portions. Notice, however, that the organism can recognize the shape of an object if the object is located in the central fovea but not if it is located in the peripheral portions of the visual field.

The organism is capable of only one action using its arm: reaching an object. Hence, we don't need verbs in this language game. In each episode the organism hears one of three linguistic signals (nouns): S3, S4, and S5. If the organism hears the linguistic signal S3 and the object O3 is in the fovea, the organism directly reaches the object with its arm. However, if O3 is not in the fovea the organism rotates its eye either to the left or to the right. The organism continues to rotate its eye until the object O3 is in the fovea, and at this point it reaches the object. The same is true for the other two objects, O4 and O5, and the other two linguistic signals, S4 and S5. The new language game makes it clear in what sense nouns control the movements of the organism's eye, head, or entire body that allow the organism to obtain visual access to some particular object contained in its environment so that the organism can execute some further

action with respect to the appropriate object, i.e., the object specified by the noun.

In the language games we have described we can distinguish between verbs and nouns in that some particular linguistic signal co-varies *either* with the organism's action *or* with the particular object which is involved in the organism's action. In the former case we say that the linguistic signal is a verb whereas in the latter case it is a noun. But consider a fifth language game in which the organism lives in an environment which contains both edible and poisonous mushrooms (Cangelosi & Parisi 1998). To survive and reproduce the organism must be able to approach (and eat) the edible mushrooms and to avoid the poisonous ones. Notice that each individual mushroom is perceptually different from all other mushrooms, including those belonging to the same category. Therefore, when it encounters a mushroom the organism must be able to both recognize (classify) the mushroom as either edible or poisonous and respond with the appropriate action to the mushroom (approaching and eating the edible mushrooms and avoiding the poisonous ones). When it encounters a mushroom the organism can hear one of two linguistic signals, S6 and S7, presumably produced by some nearby conspecific which wants to help our organism. Of these two linguistic signals, S6 co-varies with (all) edible mushooms and S7 co-varies with (all) poisonous mushrooms. Are S6 and S7 verbs or nouns? We think that the distinction cannot be made in this language game. S6 co-varies both with one type of action (approaching and eating the mushroom) and with one type of objects (edible mushrooms), and S7 co-varies with both the other type of action (avoiding the mushroom) and the other type of objects (poisonous mushrooms). Therefore, although S6 and S7 are linguistic signals since they influence the organism's behavior (for example they make the behavior more efficient), there is no ground for saying that they are either verbs or nouns because they co-vary simultaneously with both the action on the part of the organism and the type of objects to which the action is addressed. It might be that this type of language game, in which it is still impossible to distinguish between verbs and nouns, reflects a very primitive stage of language such as the language of our earliest language-using ancestors and the language of children between, say, 1 year and 1 year and a half of age.

In our model nouns co-vary with objects and verbs with actions. However, there are two types of objects, natural objects (e.g., trees) and artificial objects (e.g., knives). Organisms respond to natural objects with a variety of different actions depending on the circum-

stances but there is generally no particular action associated with each natural object. An organism may respond to a tree by cutting the tree, picking up fruits from the tree, recovering under the tree for shadow, etc. In contrast, organisms tend to respond to artificial objects with one particular action which is specific for each of them. A knife is normally used to cut, although a knife can also be bought, cleaned, put into a drawer, etc. Therefore, in a sense artificial objects are more associated with the specific actions than natural objects and, from this point of view, they resemble verbs. However, linguistic signals that co-vary with artificial objects are nouns in the same way as linguistic signals that co-vary with natural objects. In both cases the linguistic signal is used to direct the attention/action of the organism to some particular object in the environment.

3. Adjectives and, more generally, noun modifiers

Consider now a sixth, somewhat more complex, language game. In the preceding language games the different objects differed only in their shape. In the organisms' environment there was only one object for each shape, and therefore there were only two (or three, in the fourth language game) objects in all. In the new language game the organism's environment contains four objects. Two objects have one shape and the other two objects have a different shape. However, the two objects with the same shape differ in their color: one is blue and the other one is red.

In each episode the organism sees two objects and the two objects have the same shape but different color. Hence, providing the organism with the noun that refers to objects of a given shape (our second language game) is useless. The organism would not know which object to reach with its arm. However, we now introduce two new linguistic signals, S8 and S9. When the organism hears the sound S8 it reaches the blue object and when it hears the sound S9 it reaches the red object. In these circumstances S8 and S9 are (proto)adjectives. Notice that if the organism sees all four objects at the same time, it will need both a noun and an adjective in sequence (a (proto)noun phrase) to be able to identify the particular object which it is supposed to reach.

Adjectives have the same general role of nouns in the behavior of our organisms: they direct the attention of the organism to particular objects and guide the organism's action toward those objects. So what distinguishes nouns from adjectives? In our simulations nouns co-

vary with (in common parlance, refer to) objects having particular shapes whereas adjectives co-vary with other properties of objects such as their color. In fact, shape appears to be more important for distinguishing among different nouns than other properties of objects. In psycholinguistic experiments both children and adults generalize invented words syntactically identified as nouns to other objects having the same color, size, or texture of an initial object more often than to objects with a different shape (Landau et al. 1988), although words syntactically identified as count nouns show this tendency more than words syntactically identified as mass nouns (Landau et al. 1992). Therefore, we hypothesize that, while both nouns and adjectives have the same general role of directing the attention/action of organisms to particular objects in the environment, nouns differ from adjectives because nouns direct the organisms' attention/action to objects with a given shape and adjectives to objects with a given color or size or some other property.

Of course, there is nothing special or metaphysical about shape as contrasted with color or size in object identification except that objects which differ in shape are more likely to require different actions on the part of organisms than objects differing in color or size. (This may explain why other properties of objects such as those that identify an object as an animal, e.g., texture, may also be important for nouns (Jones et al. 1991; 1998). Animals generally require different types of actions directed toward them in contrast to non-animals.) Shape rather than color or size tends to be unique to classes of objects that require specific types of actions. Trees tend to have a unique shape whereas they do not have a unique color or size. Only trees have the shape of trees but not only trees are green. All the objects which co-vary with (i.e. are designated by) a given noun share a particular shape which is not shared by other objects whereas even if they are all of the same color, like strawberries, this color is shared also by other objects not called "strawberries".

Now consider another language game. The organism sees two objects at the same time. The two objects can be either the same object (same shape) or two different objects (different shapes) but in any case they are located in different portions of the visual field. For example, an object can be located in the left portion and one in the right portion of the visual field. The organisms hears one of two sounds, S8 and S9. When it hears S8, the organisms reaches the object located in the left portion of the visual field whereas when it hears S9 it reaches the object located in the right portion of the visual field. Notice the difference between this language game and the

second language game described above. In that language game the organism was also directed by language to go to the left portion or the right portion of the visual field. However, when the organism heard, for example, S3 it went to the left portion of the visual field if the object O1 was there but it went to the right portion of the visual field if the object O1 was in the right hemifield. In other words, the organism's behavior was guided by the shape of the objects and therefore S3 and S4 were classified as nouns. In this new language game, on the contrary, the organism reaches the object located in the left hemifield whethere the object is O1 or O2, i.e., independently from the shape of the object. Therefore the new linguistic signals, S8 and S9, cannot be nouns. Are they adjectives?

We introduce a new class of words called non-adjective noun modifiers. Both adjectives and non-adjective noun modifiers are noun modifiers but, while adjectives tend to co-vary with more or less permament properties of objects such as their color or size, non-adjective noun modifiers co-vary with more temporary properties of objects such as the object being located in the left or right portion of the organism's visual field. An object can be more or less permanently red or small but it is only temporarily placed, say, in the left portion of the organism's visual field. Hence, S8 and S9 are non-adjective noun modifiers. (Notice that non-adjective noun modifiers tend to be sequences of more than one word (phrases) whereas adjectives are single words. For example, the meaning of S8 is roughly equivalent to the meaning of the English phrase "on the left".)

To summarize, we have distinguished two large categories of linguistic signals: verbs and what we can call noun phrases. Verbs co-vary with the action with which the organism responds to the visual input largely independently from the content of the visual input. Noun phrases, on the other hand, direct the attention/action of the organism to particular visually perceived objects in the environment. Noun phrases can be simply nouns or they can be sequences of linguistic signals which almost always include a noun accompanied by a noun modifier, which can be either an adjective or a non-adjective noun modifier (itself a phrase in many cases). Noun modifiers have the same role of nouns in directing the attention/action of the organism to the particular object which is to be involved in the organism's action but they refer to different properties of objects. Nouns refer to the shape of objects or to other properties of objects that tend to be more highly correlated with the actions of the organism with respect to the objects. Adjectives refer to more or less permanent properties of objects which, however, are less highly correlated with the actions

of the organism with respect to the objects. Non-adjective noun modifiers refer to more temporary or extrinsic properties of objects such as their current position in the organism's visual field or, more generally, in space (e.g., "on the desk").

Verbs also may be accompanied by verb modifiers which are similar to noun modifiers. These verb modifiers can be adverbs (single word) or adverbial phrases (sequence of words). Verb modifiers ask the organism to execute an action in the particular way which is indicated by the adverb or adverbial phrase. Consider this last language game. The language game is identical to our first language game in which the organism can either push or pull an object. What is new is that the organism can push or pull the object either slowly or quickly. The organism can hear two new signals, S10 and S11, together with the verbs S1 (pull) and S2 (push). When the organism hears S10, it pushes or pulls the object slowly whereas when it hears the S11 it pushes or pulls the object more quickly. S10 and S11 are (proto)adverbs.

4. Many open questions

We have described a number of simple simulated language games that are aimed at clarifying how heard sounds become linguistic signals and how different classes of sounds which play different roles in the organism's experience and interaction with the environment become different parts of speech. These language games are simulated in the sense that we can construct artificial organisms that behave in the ways we have described. Neural networks respond to the input, i.e., they behave, in particular ways because they have particular connection weights. In our simulations we use a genetic algorithm to find the appropriate connection weights which result in the desired behaviors. A genetic algorithm is a learning procedure which is inspired by evolution (Holland 1975). However, there is no assumption that the linguistic abilities (responding appropriately to linguistic signals) of our organisms are either entirely genetically inherited (which of course cannot be since different humans speak different languages) or entirely learned during life with no important genetically inherited basis (which cannot be since only humans have language). Simply, we have not addressed the problem of the origin of the linguistic abilities exhibited by our artificial organisms.

Of course, we have just scratched the surface of the problem of accounting for the differences among the parts of speech. Let us men-

tion a list of open questions, with in some cases some hints as to how to address these questions in the present framework.

(1) We have simulated (some aspects of) the ability to understand language, i.e., to respond appropriately to heard sounds which are linguistic signals, but we haven't said anything about the ability to produce language, i.e., to execute the phono-articulatory motor behaviors which result in the physical production of the appropriate sounds/linguistic signals. To simulate the ability to speak it is necessary to add a further set of output units to the neural network of our organisms which will encode phono-articulatory movements resulting in the physical production of sounds. Aside from that, we believe that the basic categories of words remain the same: produced sounds are verbs if they co-vary with the actions of the speaker or of the hearer; they are nouns if they co-vary with the objects (mainly identified on the basis of their shape) involved in the actions of the speaker or of the hearer; they are adjectives if they co-vary with other properties of objects; and so on.

(2) We have simulated verbal commands but language has many other pragmatic uses and is involved in different types of speech acts: acts of information, questions, expressions of intentions or desires, etc. To account for these other uses of language we will need more complicated language games and more complex social interactions among our simulated organisms.

(3) Many verbs to do not refer to actions and many nouns do not refer to concrete, perceptually accessible objects. Verbs sometimes co-vary with (i.e., refer to) processes rather than with actions (Langacker 1987). Actions are processes but many processes are not actions of organisms (e.g., the process of snowing). Verbs referring to processes which are not actions require that our artificial organisms possess an ability to abstract "change of state" (or even "lack of change of state" for verbs referring to states such as sleeping) in a succession of inputs even if the succession of input does not reveal an action. Furthermore, verbs and nouns may not all possess verbness and nounness to the same degree. There might be a continuum of verbness/nounness.

(4) Language is often used in situations in which the organism is not responding to external (in our case, visual) input with external motor behavior (in our case, the movements of the arm). The organism can respond to heard sounds without producing any external behavior, it can produce linguistic signals with no current input from the external environment, and it can even use language

purely internally with no external input or external output of any kind (thinking). These uses of language all involve the self-generation of input by a neural network, both linguistic (imagined sounds) and nonlinguistic (imagined actions and their effects in the environment) input. The ability to self-generate input is what defines mental life as distinct from behavior.

(5) Nouns and verbs, and of course the other parts of speech, have properties which are syntactic in nature, rather than semantic. These syntactic properties derive from their use in sequences of words which have sequential constraints (for example, in English verb objects follow verbs, do not precede them) and internal structure (cf. Cangelosi & Parisi 2002; Turner & Cangelosi 2002).

(6) Nouns can be morphologically "derived" from verbs and verbs from nouns.

(7) The kind of simple verb-noun sequences we have considered in one of our language games represent verb-object (proto)sentences. How verb subjects emerge in languages? Probably the emergence of subjects in action sentences (agents) is linked with the ability to recognize the same action as made by me and as made by other individuals (cf. the "mirror neurons" of Rizzolatti & Arbib 1998). In these circumstances one has to specify not only the object(s) on which the action is executed (the verb complement(s)) but also the author of the action, i.e., the agent (the verb's subject).

Address of the Authors:

Domenico Parisi, Institute of Cognitive Sciences and Technologies, National Research Council <parisi@ip.rm.cnr.it>
Angelo Cangelosi, Centre for Neural and Adaptive Systems, School of Computing, University of Plymouth <acangelosi@soc.plym.ac.uk>
Ilaria Falcetta, University of Rome La Sapienza <ilariafalcetta@libero.it

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Verbs and nouns from a cross-linguistic perspective

Jan Rijkhoff

It has often been claimed that all languages have major, distinct classes of verbs and nouns (see e.g. Robins 1967: 211; Schachter 1985: 6-7; Whaley 1997: 59). There is, however, growing evidence to suggest that the verb-noun distinction is scalar rather than discrete (Ross 1972, 1973), and that in some languages this distinction is perhaps even altogether absent (e.g. Kinkade 1983; Gil 1994, 2000; Broschart 1997; Hengeveld 1992a, 1992b). For a recent typological overview of 'scales between nouniness and verbiness' I refer to Sasse (2001).

This contribution is mostly concerned with languages in which the verb-noun distinction is believed to be weak, perhaps even non-existent, as well as languages in which verbs or nouns only constitute a minor word class (sections 1-4). Regarding languages that are deemed to have a solid verb-noun distinction, I will argue that verbs and nouns (as well as noun phrases and clauses) can be analyzed in a similar fashion (section 5).[1]

1. Preliminary remarks

Statements concerning the occurrence of certain word classes (and how they can be distinguished from other word classes) crucially depend on the way the various parts-of-speech are defined and it is safe to say that there is still no general consensus among typologists on what constitutes a verb or a noun. This is mostly due to the fact that it has turned out to be rather difficult to define word classes in a language independent fashion. For example, to say that a noun is a word that is inflected for number is quite irrelevant for all those languages across the globe in which number marking is absent (cf. Anward & Moravcsik & Stassen (1997) and Croft (2001) for discussion). In this contribution I will use Hengeveld's definitions, not only because Hengeveld stays close to the cross-linguistic facts (as will be shown in section 4 below, the parts-of-speech systems he recognizes closely reflect statements and data provided in the actual grammars), but also because he offers a TYPOLOGY (rather than just a classification) of parts-of-speech systems in that it appears to be possible to predict certain semantic or morpho-syntactic features of a language once one knows what kind of parts-of-speech system that language employs (section 4).

In defining the four major lexical word classes (verb, noun,

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adjective, adverb) Hengeveld takes as his starting point the function of a content word ('predicate') in a linguistic expression. In the present context only two functions are relevant: head of the clause (verbal function) and head of the term or NP (nominal function). He uses the following definitions (1992b: 58):

A verbal predicate is a predicate which, without further measures being taken, has a predicative use ONLY.
A nominal predicate is a predicate which, without further measures being taken, can be used as the head of a term (NP).

Thus, Dutch *lezen* 'to read' is a verb, because (apart from the usual inflections for person, number, tense) no 'further measures' are necessary to let it function as the main predicate of the clause ('predicatively'):

Dutch

(1)	Ik	lees	elke	morgen	de	krant
	I	read:1SG.PRES	every	morning	the	newspaper

'Every morning I read the newspaper'

If we want to use the predicate *lezen* as the head of an NP, we first have to nominalize it (e.g. *het gelezene* 'the (thing) read', *het lezen* 'the reading'), in which case it also receives a gender (*het* is the neuter form of the definite singular article). In other words, *lezen* 'to read' can only be used predicatively, as the head of clause, and if we want to use it in another function (e.g. as the head of an NP), we first need to take extra measures.

A predicate such as Dutch *leraar* 'teacher', on the other hand, can immediately be used as the head of an NP (ignoring inflectional modifications that are typical for that function, such as number marking):

Dutch

(2)	De	leraar	vergat	zijn	boek-en	mee	te	nemen
	the	teacher	forget:3SG.PAST	his	book-PL	with	to	take

'The student forgot to take his books along'

As it happens, in Dutch a requires the presence of a copula (i.e. an extra measure) when it functions predicatively, as the main predicate of the clause:

Dutch

(3)	Hij	is	leraar
	He	be:3SG.PRES	teacher
	'He is a teacher'		

This is not the case in many other languages; hence Hengeveld's definition of a noun (nominal predicate) leaves open the possibility that it can also be used predicatively without further measures being taken - as in Tagalog:

Tagalog (Schachter 1985: 7)

(4)	Mga	guro	sila
	PL	teacher	they
	'They are teachers'		

I will return to Hengeveld's approach to parts-of-speech systems below. First I will present data from languages in which the verb or nouns cannot be distinguished, or in which verbs or nouns constitute a smallish, minor word class.

2. Verbs

It is not the case that verbs constitute a distinct, open word class in all languages. There are languages in which verbs cannot be distinguished from nouns (or other lexical word classes for that matter, such as adjectives and adverbs) as well as languages in which verbs only form a small, closed class of predicates. In this section we will see some examples of either type.

2.1. Languages without a distinct class of verbs (and nouns)

Various Austronesian languages are characterized by the fact that they employ predicates that display great functional flexibility (Himmelmann 1991; Gil 1994; Broschart 1991, 1997). Consider, for example, what Mosel and Hovdhaugen (1992: 73, 74, 77) write about predicates ('roots') in Samoan:[2]

> Many, perhaps the majority of, roots can be found in the function of verb phrase and NP nuclei and are, accordingly, classified as nouns and as verbs. This does not mean that a noun can be used as a verb or a verb as a noun or that we have two homophonous words, one being a noun and the other being a verb. Rather, it means that in

> Samoan the categorization of full words is not given a priori in the lexicon. It is only their actual occurrence in a particular environment which gives them the status of a verb or a noun. [...] What is given in the lexicon, is not a particular word class assignment, but the potential to be used in certain syntactic environments as a noun or a verb.[3]
> Although certain full words seem to be used more as verb or more as an NP nucleus for semantic reasons, there are no lexical or grammatical constraints on why a particular word cannot be used in the one or the other function.

Here are some examples of roots with their verbal and nominal translations in English:

Samoan (Mosel and Hovdhaugen 1992: 73f., 82f.)

			noun phrase nucleus	*verb phrase nucleus*
(5)	a.	*teine*	'girl'	'be a girl'
	b.	*tusi*	'book, letter'	'write'
	c.	*salu*	'broom'	'sweep'
	d.	*ma'i*	'patient, sickness'	'be sick'
	e.	*la*	'sun'	'be sunny'
	f.	*fana*	'gun'	'shoot'
	g.	*lama*	'torch'	'fish by torch light'

It is basically the presence of non-lexical elements that indicates what particular function such predicates fulfil. If a flexible predicate serves as the head of the clause, it will typically combine with tense-aspect-mood particles; if it serves as the head of a noun phrase it will appear with an article or a preposition.

Tongan is another example of a language with multifunctional predicates. This is shown in the following examples where the word *si'i* '(to be) small, smallness' is used as a verb in (6) and as a noun in (7).[4]

Tongan (Tchekhoff 1981: 4)

(6)	Na'e	si'i	'ae	akó
	PAST	small	ABS	school:DEF
	'The school was small'			

(7)	i'	'ene	si'í
	in	POS.3SG	childhood:DEF
	'in his/her childhood'		

Although the title of this section is 'Languages without a distinct

class of verb', it will be clear that languages like Samoan and Tongan also lack a distinct class of nouns. Section 3.1 below is concerned with languages that have a distinct class of verbs, but in which nouns cannot be distinguished from other parts-of-speech.

2.2. Languages with a minor class of verbs

In addition to languages in which verbs and nouns do not constitute clearly DISTINCT parts-of-speech, there are also languages that only have a minor, closed class of verbs. This phenomenon is typically attested in languages spoken in Northern Australia (Dixon 1980; Schultze-Berndt 2001; McGregor 2002) and in the Papuan languages of New Guinea (Foley 1986: 113-28).

Thus, Walmatjari (Australian) is deemed to have only about forty verbs, Gurindji no more than thirty, whereas some languages in the Kimberleys and the Daly River area only have around a dozen verbs (Dixon 1980: 280). As to the Papuan languages of New Guinea, Kalam has under 100 verb stems, only about twenty-five of which are commonly used. According to Foley (1986: 115), using material from Pawley (e.g. Pawley 1966, 1980):

> Almost every action, process or state is categorized to one of these twenty-five verbs, which Pawley calls 'generic verbs'. In comparison to English, these generic verbs have a very general meaning, and would need to be translated by a number of more specific English verbs, according to the context. For example, the Kalam verb *pag-* roughly means 'cause to become in an unstable condition', and would be translated by the English verbs: break, collapse, shatter, chip, dent, crease, fold, ripple, be sprung (of a trap), have a hollow, pour (liquid).

In normal Kalam discourse, these generic verbs are either combined or appear with more specific verbs or nouns to describe actual events more precisely. Here are some examples:

Kalam (Foley 1986: 116-18; original examples in Pawley 1966, 1980):
- verb combinations with *ag-* 'sound'

(8) a. ag ñ-
sound transfer
'tell'

b. ag tk-
sound sever
'interrupt'

c. yn ag-
burn sound
'ignite (engine)'

d. ag ay-
sound stabilize
'confine'

- nominals combining with *nŋ-* 'perceive'

(9)	a.	*wdn nŋ-*	eye perceive	'see'
	b.	*tmwd nŋ-*	ear perceive	'hear'
	c.	*gos nŋ-*	thought perceive	'think'
	d.	*gos konay nŋ-*	thought many perceive	'worry'
	e.	*wsn nŋ-*	sleep perceive	'dream'
	f.	*gos tep nŋ-*	though good perceive	'like'
	g.	*mapn nŋ-*	liver perceive	'be sorry'
	h.	*nn pag nŋ-*	arm break perceive	'count'
	i.	*mnm nŋ*	speech perceive	'know a language'
	j.	*bwk nŋ-*	book perceive	'read'

- complex constructions with multiple verbs.

(10)	a.	ap	yap	pk-
		come	descend	hit
		'tumble'		
	b.	pwŋy	md	ay-
		poke	stay	put
		'fix (by insertion)'		

2.3. Conclusion: verbs as a cross-linguistic category

From a cross-linguistic perspective one could say that all languages have a group of predicates with a verbal function in that these predicates can all immediately be used as the main predicate of the clause. However, in some languages (such as Samoan) the same group of predicates may also appear in nominal function 'without extra measures being taken' (see Hengeveld's definition above), and vice versa. This indicates that verbs and nouns are not distinct parts-of-speech in all languages (section 2.1). In other languages (such as Kalam) verbs constitute a distinct, but smallish group of predicates, which indicates we are only dealing with a minor class of verbs (section 2.2).

3. Nouns

The current section focuses on languages in which nouns are distinguished from verbs but do not constitute a distinct or major word class.

3.1. Languages without a distinct class of nouns

In section 2.1 I have discussed languages in which nouns cannot

be distinguished from verbs. This section is concerned with languages in which verbs constitute a word class by themselves, but in which nouns cannot be clearly distinguished from adjectives (and manner adverbs; see section 4 below). One such language is Quechua (actually Quechua covers a large group of closely related languages and dialects). Whereas Samoan has a single class of lexemes whose members combine the prototypical functions of verb and noun (also those of adjectives and manner adverbs; see section 4 below), Quechua is said to have two major lexical word classes: a distinct class of verbs and a large class of words which "includes what in other languages would be distinguished as nouns and adjectives. These are regarded as a single class [...] because there is insufficient evidence of a strictly morpho-syntactic nature for distinguishing them (as lexical categories)" (Weber 1989: 35). Examples (11)-(14) show that the Quechua counterparts of the English noun 'mayor' *alkalde* and the English adjective 'big' *hatun* can serve as a noun, as in (11) and (13), and as an adjective, as in (12) and (14). Compare:

Quechua (Schachter 1985: 17)

(11) Rikaška: alkalde-ta
see:PAST.1SG mayor-ACC
'I saw the mayor'

(12) chay alkalde runa
DEM mayor man
'that man who is mayor'

(13) Rikaška: hatun-ta
see:PAST.1SG big-ACC
'I saw the big one'

(14) chay hatun runa
DEM big man
'that big man'

Similarly, the Australian language Ngiyambaa is deemded to have a distinct class of verbs and a class of so-called 'nominals' (Donaldson 1980: 68). The class of nominals includes nouns as well as lexemes that would be translated as adjectives in English. Although there is a morphological difference in that only a subclass of lexemes of the noun/adjective type permit reduplication, this is attributed to ontological rather than linguistic factors (Donaldson 1980: 70-71):

> Semantically, nominals are divided into two groups; those which are not subject to productive reduplication and those which are. When rejecting a reduplicated version of a nominal which cannot be reduplicated, Eliza Kennedy [a native speaker informant - JR] would explain: "Either it is that, or it isn't." It was therefore nonsensical to reduplicate, which is equivalent to prefacing the form with 'more-or-less' or 'somewhat'. Thus **miri-miri* was rejected, because one cannot have a 'more-or-less dog', while *gi:dja-gi:djan* 'more-or-less green, greenish' is an acceptable form.
> Nominals which do not reduplicate are normally translated by English nouns, and those which do undergo reduplication are normally translated by adjectives. The possibility of productive reduplication could be advanced as a formal criterion for similarly dividing Ngiyambaa nominals into two sub-classes, noun and adjective. But in Ngiyambaa there are no known further differences, morphological or syntactic, as between non-reduplicating and reduplicating nominals. Syntactically, for instance, any nominal which can be a constituent of part of an NP can also be the sole representative of an NP [..] *gi:djan* may translates either 'green' or '(a/the) green one'. To introduce the term 'noun' and 'adjective' as synonyms for 'non-reduplicating' and 'reduplicating' would serve no descriptive purpose elsewhere in the grammar.

Other examples of languages with a distinct category of verbs and a flexible noun/adjective class include many languages of the Turkic family (see, for example, Lewis (1967: 53f.) and contributions in Deny et al. 1959).

3.2. Languages with a minor class of nouns

There is some controversy over the question whether there really are languages without nouns, but experts seem to agree that in some Northern Iroquoian languages nouns are at best a minor word class. For example, Sasse (1993: 206) has argued that Cayuga has two kinds of 'roots' (German: *Wurzeln*): R1 and R2 roots. R1 roots normally only appear with one pronominal prefix (usually the third person singular non-human form) and a stative aspect suffix. They are largely used to refer to discrete physical objects, e.g.: *ka-nhóh-a'* 'it is a door' (*/-nhoh-/* '[be a] door'), *ka-nyó:t-a'* 'it is a spoon' (*/-nyot-/* '[be a] spoon'). R2 roots, on the other hand, can occur with all pronominal, tense, aspect, and mood affixes as well as with other kinds of affixes, e.g. *ha-hyatǫ-ha'* 'he writes it (down)' (*/-hyatǫ-/* 'write'), *o-yá:nr-e'* 'it is good' (*/-yanr-/* 'be good'). Although a few R2 roots tend to occur in

more or less lexicalized forms, they can still be used as the head of the clause, e.g. *kaǫtanéhkwih* 'it pulls logs, horse', *tęká:tęh* 'it habitually goes up, airplane'; *ǫtwęnǫtáhkhwa'* 'one habitually puts one's voice in it, telephone'.

In Sasse's view speakers of Cayuga commonly refer to an object by means of a phrase whose nucleus consists of a R1 root, which is basically a verbal predicate (Sasse 1993: 209) and he concludes that Cayuga does not have a lexical category that can be characterized as nouns (Sasse 1993: 203; also 1988: 186ff.).

> Im Cayuga sind alle in aktuellen Äußerungen erscheinenden Inhaltswortformen syntaktisch prädikativ, d.h. ohne weitere Hilfsmittel geeignet zum Ausdruck einer eigenständigen, vollständigen Proposition. Sie repräsentieren damit eine Äußerung, die in europäischen Sprachen Satzcharakter hätte.
> [In Cayuga all content words that appear in actual utterances are syntactically predicative, i.e. no further measures are required to express an independent, complete proposition. Thus they represent an expression that would constitute a sentence in European languages.]

In an early analysis of noun phrases in Tuscarora, another Iroquoian language, Mithun Williams (1976: 31) seems to propose essentially the same idea when she writes: "The fact that many noun phrases are actually realized as surface verbs, while they function just as common nouns, provides additional support for the analysis of nouns as semantic propositions."

Tuscarora (Mithun Williams 1976: 30)
(15) rò:rá:thv:
r-o-rathv-"
M-OBJ-climb-PERF
'he climbs' ('black snake')

In a more recent publication, however, she argues that despite certain "intriguing similarities" between nouns and verbs, they do constitute distinct word classes in all Iroquoian languages. At the same time she admits that matters are not always as straightforward as one would like to have it (Mithun 2000: 419):

> What may be graded is the degree of lexicalization of specialized forms. Some morphological verbs have been so fully lexicalised as nominals that speakers no longer use them as predicates and may

even be unaware of their literal verbal meanings. Others are never used as nominals. Still others have two uses, one as a referential nominal, one as a predicate.

Hengeveld (1992b: 58) already pointed out that word class distinctions should be stated in terms of tendencies rather than in absolute terms. One of the reasons why Mithun and Sasse have come up with different proposals as regards the verb-noun distinction in the Iroquoian languages is, apparently, that the former puts more emphasis on the differences whereas the latter is more impressed by the similarities. Whoever is right, it seems that we can at best speak of a minor class of true nouns here.

3.3. Conclusion: nouns as a cross-linguistic category

From a cross-linguistic perspective one could say that all languages have a group of predicates with a nominal function in that these predicates serve (without extra measures being taken) as the head of the term or noun phrase. However, in some languages, such as Samoan, these predicates cannot be distinguished from verbs (and other lexical word classes: adjectives and adverbs). When verbs do constitute a distinct word class we find that there are languages such as Ngiyambaa, which make no distinction between nouns and adjectives. Both in the case of Samoan and Ngiyambaa, then, we are dealing with languages in which nouns do not form a distinct word class (section 3.1). Finally we saw that there are languages such as Cayuga in which nouns are probably only a minor word class (section 3.2).

4. Parts-of-speech systems

We need a rather sophisticated approach to lexical word classes if we want to take into consideration the facts presented above. Such an approach has been proposed by Hengeveld (1992a, 1992b), who argues that lexical word classes (verbs, nouns, adjectives, adverbs) can be captured in a typology of parts-of-speech systems that distinguishes between distinct (or 'rigid') and flexible predicates. He uses the following definitions (Hengeveld 1992b: 58):

A verbal predicate is a predicate which, without further measures being taken, has a predicative use ONLY.

A nominal predicate is a predicate which, without further measures being taken, can be used as the head of a term (NP).
An adjectival predicate is a predicate which, without further measures being taken, can be used as a modifier of a nominal head.
An adverbial predicate is a predicate which, without further measures being taken, can be used as a modifier of a non-nominal head.

Thus, four major functions are distinguished: [1] head of the clause (verbal function), [2] modifier of the head of the clause (adverbial function; note that Hengeveld only refers to manner adverbs), [3] head of the term or NP (nominal function), and [4] modifier of the head of the term (adjectival function). In certain languages these functions are clearly distributed over distinct, non-overlapping groups of predicates (specialized or rigid predicates; types 4–7); in other languages some or all of these functions can be performed by the same group of predicates (flexible predicates; types 1-3).[5]

Table 1. Parts-of-speech systems (based on Hengeveld 1992b: 58)

Flexible	Type 1	V/N/A/adv			
	Type 2	V	N/A/adv		
	Type 3	V	N	A/adv	
Rigid	Type 4	V	N	A	adv
	Type 5	V	N	A	—
	Type 6	V	N	—	—
	Type 7	V	—	—	—

Recall that Hengeveld takes a scalar view on parts-of-speech systems and that the seven types he recognizes should be regarded as points on a continuum, since he explicitly states that "languages at best show a strong tendency towards one of the types". This means, among other things, that there is also room for languages with minor word classes, such as Cayuga (which would then be classified as intermediate type 6/7). Languages of type 1 (Samoan), 2 (Quechua, Ngiyambaa), and 7 (or rather type 6/7: Cayuga) have already been discussed in previous sections, so I will only give examples of types 3, 4, 5 and 6 here.

Ngiti, which belongs the Sudanic branch of the Nilo-Saharan

family, is a good example of a language of Type 3 (Kutsch Lojenga 1994: 336):

> There is no morphological nor a clear syntactic distinction between a class of adjectives and a class of adverbs in Ngiti. The functional term modifiers is therefore used [..] to cover a fairly large grammatical class of words, containing about 150 items, which are neither nouns nor verbs and which all have a modifying function in relation to different constituents.

In the following examples, *ɨsɔ́* is first used adjectivally (to modify a noun) meaning 'light (of weight)', and then as a manner adverb meaning 'easily, without effort'.

Ngiti (Kutsch Lojenga 1992: 338)

(16)	ngbángba	nítdù	ɨsɔ́	ànɔ̀
	ngba!ngba	nɨ́-ítdù	ɨsɔ́	ànɔ̀
	child	RSM-carry:PERF.PRES	light	load
	'the child carried a light load'			

(17)	ɨsɔ́	ngbángba	nítdù	ànɔ̀
	ɨsɔ́	ngbángba	nɨ́-ítdù	ànɔ̀
	light	child	RSM-carry:PERF.PRES	load
	'the child carried a load easily'			

The Australian language Ngalakan belongs to Type 4, because it has adjectives as well as a separate group of lexemes specifying 'manner' that can immediately be used to modify the verb, such as *yukaji*ʔ 'thoroughly, forcefully, altogether, for good', *ŋuča* 'quickly', *mapuy*ʔ 'slowly', *gamakun* 'properly' (Merlan 1983: 123).

Wambon, a Papuan language from Irian Jaya, is a language that, apart from one or two exceptions, has no flexible or distinct class of adverbs (Type 5). Instead Wambon employs medial verb constructions (de Vries 1989: 49):

> The category of manner adverbs can be so marginal because Wambon prefers to use medial verbs as modifiers of other verbs in serial verb constructions in which the modifying verb immediately precedes the modified verb. [..] Very often the medial verbs specifying manner, are verbs which are derived from adjectives by *–mo* [..].

For example, in the next example the verb *matetmo* 'be good' is derived from the adjective *matet* 'good'

Wambon (de Vries 1989: 49)

(18)	Jakhov-e	matet-mo	ka-lembo?
	they-CN	good-SUPP.SS	go-3PL.PAST
	'Did they travel well?'		

Finally, Galela, another Papuan language, is a clear example of Type 6: a language without a distinct class of adjectives or adverbs. For example, if we take the Galela equivalent of the English adjective 'big' *lamo* and let it function as a modifier of the noun, we must also add a third person pronoun. This is because in Galela '(be) big' is expressed through a verbal predicate whose sole argument must be explicitly expressed in the form of a pronominal element. Furthermore, if used attributively, the first syllable of the verbal predicate in question is reduplicated, yielding the participial form.

Galela (van Baarda 1908: 35)

(19)	awi	ɗòhu	i	lalamo
	his	foot	it	big:PRT
	'his big foot'			

One of the interesting features of Hengeveld's approach is that it is possible to predict certain semantic or morpho-syntactic features of a language once one knows what kind of parts-of-speech system that language employs (cf. Hengeveld et al. 1997; Rijkhoff 2000, 2002). For example, one does not expect flexible 'nouns' of either type (Type 1 = V/N/A/adv and Type 2 = N/A/adv) to be specified for such noun specific categories as number and gender, i.e. flexible 'nouns' are transnumeral and are not divided into different genders or noun classes (Hengeveld & Valstar forthcoming).

5. Parallels between verbs and nouns

In sections 2 and 3 I have discussed languages without a clear verb-noun distinction as well as languages with only a minor class of verbs or nouns. In this section I will argue that, for those languages that do seem to have a clear verb-noun distinction (types 3-4-5-6 in Table 1), verbs and nouns can be analyzed in similar fashion.

5.1. Verb semantics

Properties and relations in the temporal dimension, which are typically designated by verbal predicates ('sit', 'walk', 'read', etc.), can

all be characterized in terms of two temporal features: BEGINNING and ENDING. Depending on the way these distinctions are coded they belong to different fields in verb semantics. When they are expressed by inflectional morphology, they are usually called verbal aspects, but when these aspectual distinctions are part of the lexical meaning of a verb, i.e. when they are morphologically invisible, they are usually studied under the heading of AKTIONSARTEN (the German term literally means "modes of action", but is often translated as "event types" or "types of State-of-Affairs"; cf. Comrie 1976: 6-7; Dik 1997: 105-26). Thus, the perfective (more precisely, momentaneous) character of a verb like 'to hit' ('*The arrow hit the target*') belongs to the study of Aktionsart and not verbal aspect (see Sasse 2002 for a recent discussion of Aktionsart and verbal aspect).

5.1.1. Verbal aspect

Using the two temporal features Beginning and Ending, we can define four verbal aspects: imperfective aspect, ingressive aspect, egressive aspect, perfective aspect. Further subdivisions can be made within the two major aspects perfective and imperfective. For example, imperfective aspect can be divided into continuative and progressive aspect and it depends on the time span between the beginning and the endpoint whether the perfective aspect can be further characterized as momentaneous or durative. Cross-linguistically imperfective and perfective aspect are grammaticalized much more often than ingressive or egressive aspect (note, furthermore, that perfective aspect often subsumes ingressive and egressive aspectual meaning).

Table 2. Verbal aspects

TIME	-BEGINNING	+BEGINNING
–ENDING	imperfective	ingressive
+ENDING	egressive	perfective

For illustrative purposes, I will use paraphrases to explain the aspectual differences in Table 2. Let us take as an example the verb 'to sleep'. If the speaker uses the verb in the perfective form, he emphasizes the temporal boundedness of the sleeping event. With *sleep* in the egressive form he stresses the ending ('to stop sleeping' = 'to wake up'), whereas 'sleep' + ingressive aspect underlines the

beginning of the sleeping event (i.e. 'to fall asleep'). Finally, with 'sleep' in the imperfective form the speaker does not want to draw attention to the beginning or the ending but to the occurrence of the event as such. In many languages imperfective aspect is used to provide a background for a more central event, as in e.g. "While she was sleeping, somebody knocked on her door." In other words, the same property ('sleep') can be represented in at least four different ways in terms of the features Beginning and Ending.

The following examples of inflectional aspect marking are from Mokilese (Micronesian). The first sentence, with the verb in the imperfective, characterizes the situation as a open-ended event (the chase has not stopped) whereas the sentence with the verb in the perfective describes the situation as a bounded event, i.e. the chase has come to an end:

Mokilese (Chung & Timberlake 1985: 237)

(20)	Ngoah	kauj-ki	ih	awahioaw
	I	chase:IMPF-DUR	him	hour
	'I chased him for an hour'			

(21)	Ngoah	kauj-kih-di	ih	awahioaw
	I	chase-DUR-PERF	him	hour
	'I chased him down in an hour'			

Thus, the time adverb has a different sense in these sentences (Chung & Timberlake 1985: 237): "With an imperfective the time expression measures the duration of an open event, while with a perfective it specifies the duration of a closed event". The choice between perfective and imperfective is often a matter of pragmatics in that it is determined by what the speaker wishes to emphasize. For instance, the English sentence 'I stood there for an hour' can be translated in Russian as *ja stojal tam cas* (with the verb in the imperfective form) or as *ja postojal tam cas*, i.e. with the verb in the perfective form. The last sentence (with *postajal*) implies that the waiting was not experienced as lasting long whereas the first sentence (with *stojal*) is neutral in this respect (Comrie 1976: 4, 16-17). Thus we see that the same event in the physical world can be represented in different ways aspectually. These examples also show that we do not refer to events in the real world, but rather to mental constructs of events (which may or may not have a correlate in the external world).

5.1.2. Aktionsart

I mentioned earlier that Aktionsart is concerned with the lexical

(rather than inflectional) encoding of aspectual features in the verb. So far I have restricted myself to the parameter of BOUNDEDNESS (±Beginning, ±Ending), which is relevant for both verbal aspect and Aktionsart. Apart from Boundedness, however, the semantic subcategorization of verbs in terms of Aktionsarten also involves semantic categories such as Change and Duration, as is shown in the classification of event types in Table 3 (based on Kearns 2000: 204; cf. also e.g. Vendler 1967; Mourelatos 1981).

Table 3. Aspectual verb/event classes (*Aktionsarten*)

	Change	Duration	Bound
State	–	+	–
Achievement	+	–	+
Activity	+	+	–
Accomplishment	+	+	+

(22) State: *Mary liked Fred*

(23) Achievement: *He realized that it was too late*

(24) Activity: *Bill pushed the stroller*

(25) Accomplishment: *John ran a mile*

Thus the predicate 'like' describes a static, durative, unbounded event (–Change, +Duration, –Bound), whereas an achievement verb like 'realize' defines a dynamic, nondurative, bounded event (+Change, –Durative, +Bound). There are various criteria that can be used to distinguish between the various kinds of events. For example, 'for' adverb(ial)s measure the duration of unbounded events; hence they only combine with state and activity verbs:

(26) *Mary liked Fred for half an hour*

(27) * *He realized that it was too late for half an hour*

(28) *Bill pushed the stroller for half an hour*

(29) * *John ran a mile for an hour*

Note that the boundedness of an event may be co-determined by the non-verbal material in the clause. For example, 'painting a portrait' is normally a bounded event, whereas 'painting portraits' can go on indefinitely (cf. Verkuyl 1972; Dik 1997: 108-9).

5.2. Noun semantics: Seinsart and nominal aspect

In section 5.1 I have discussed the distinction between verbal aspect and Aktionsarten; in this section I will make a similar distinction in the area of noun semantics. Whereas verbs can be characterized in terms of the temporal features Beginning and Ending, nouns can be characterized in terms of the spatial features SHAPE and HOMOGENEITY (I will restrict myself here to nouns that are used to refer to spatial entities, thus ignoring abstract and higher order nouns such as 'wedding', promise', 'love' etc.). To the extent that the aspectual features 'Shape' and 'Homogeneity' are part of the lexical meaning of the noun they could be studied in the context of *Seinsart* ('mode of being'), and when these features are overtly expressed by inflectional morphology we could speak of *nominal aspect*. Thus, Seinsart deals with the covert (lexical) coding of the way a nominal property is represented in the spatial dimension in terms of the features Shape and Homogeneity and nominal aspect is reserved for the overt inflectional expression of Shape and Homogeneity.

It is perhaps useful to emphasize at this point that referents of NPs are not objects in the real world, but rather mental constructs that are created, stored, and retrieved in the minds of the speech participants (see also my remarks about events in section 5.1.1 above). It is important to keep this in mind, since this distinction allows for possible discrepancies between (linguistic) properties of discourse referents and (ontological) properties of their real-world counterparts or 'Sein-correlates' (if they exist). This holds especially true with respect to the features Shape and Homogeneity.

5.2.1. Seinsart

It appears that cross-linguistically six major noun types are used to refer to spatial entities and they can be defined as follows in terms of the features SHAPE and HOMOGENEITY (Rijkhoff 2002: 54; cf. Friedrich (1970) on the importance of the notion SHAPE in grammar):

If the property designated by a noun is coded as having shape (+Shape), this means that the property is characterized as having a definite outline in the spatial dimension; hence set nouns, singular object nouns, and collective nouns can all be in a direct construction with a cardinal numeral (only discrete entities can be counted direct-

Table 4. Aspectual noun classes (SEINSARTEN)

SPACE	-HOMOGENEITY	+HOMOGENEITY
–SHAPE	general noun	
	sort noun	mass noun
+SHAPE	set noun	
	singular object noun	collective noun

ly). If the property designated by a noun is coded as being homogeneous (+Homogeneity), this means that the space for which this property holds is characterized as being cumulative (or agglomerative) and dissective. In other words, the referent of an NP headed by a noun that is coded as being homogeneous consists of portions (of a mass) or members (of a collective). General nouns and set nouns are neutral with respect to the feature Homogeneity.

For example, the Dutch noun *fiets* 'bicycle' is a singular object noun in that the unmarked form can only be used to refer to a singular object. If reference is made to more than one bicycle, the plural form *fiets-en* [bicycle-PL] 'bicycles' must be used.

The Dutch noun *familie* 'family' is an example of a collective noun: it designates a property of a single group of entities of a kind (family members). It also describes a homogeneous entity: when a child is born (or when a relative dies), this changes the size of the family but not the number of families.

The Oromo noun *gaala* 'camel(s)' differs from both singular object nouns and collective nouns in that it is transnumeral. That is to say, it may be used to refer to one camel or to a group of camels (Stroomer 1987: 76-77). Since a set may contain any number of individuals (including 'one', in which case we speak of a singleton set), I have labeled nouns of this type set noun. Set nouns can be in a direct construction with a numeral, just like singular object nouns and collective nouns (Dutch *twee fietsen* 'two bikes', *twee families* 'two families'), but since set nouns are transnumeral they do not occur with a plural marker when they are modified by a cardinal numeral:

Oromo (Stroomer 1987: 107):

(30) a. gaala
camel(s)
'camel, camels'

b. gaala lamaani
camel(s) two
'two camels'

Mass nouns, sort nouns, and general nouns all have in common that they are transnumeral and that a modifying cardinal numeral appears with another constituent, a so called 'classifier' of some kind (see Aikhenvald 2000 for a recent overview of classifiers). In this context three kinds of classifiers are relevant: mensural classifiers, sortal (or: numeral) classifiers, and general classifiers. Mensural classifiers typically co-occur with quantified mass nouns and indicate size, volume, or weight, e.g.

Mensural classifiers in English:

(31) a 'a LITER of wine'
b. 'two BAGS of flour'
c. 'three POUNDS of cheese'
d. 'four CUPS of tea'

Mensural classifiers in Thai (Hundius & Kölver 1983: 168, 170):

(32) dinnĭaw săam kɔ̆ɔn
clay three lump
'three lumps of clay'

(33) náamtaan săam thûaj
sugar three cup
'three cups of sugar'

Mass nouns such as English 'water' and Thai *náamtaan* 'sugar' define [+Homogeneous] entities because they have cumulative and dissective properties, just like collective nouns (cf. the example with 'family' above). If we add some milk to a liter of milk we still refer to it as 'milk' (cumulative); after we drink some of the milk that is contained in a glass, the remaining substance in the glass will still be called 'milk' (dissective).

In addition to mensural classifiers, many (particularly Southeast Asian) languages employ sortal classifiers with nouns that would be translated as count nouns, or rather individual object nouns, in languages such as English or Italian. I have labeled the nouns that occur with sortal classifiers sort nouns in Table 4 above. Sortal classifiers do not indicate the volume, size or weight, but involve other kinds of notions (notably 'shape'). Compare:[6]

Sortal classifiers in Thai (Gandour et al. 1984: 466, 455):

(34) thian sìi lêm
candle two CLF:long, pointed object
'two candles'

(35)	pèt	hâa	tua
	duck	five	CLF:body
	'five ducks'		

The reason why mass nouns and Thai nouns such as *thian* 'candle' and *pèt* 'duck' require the occurrence of a classifier is that the meaning definitions of these nouns do not include the notion of spatial boundedness or discreteness (Hundius & Kölver 1983). Since only discrete entities (+Shape) can be numerated directly, it is assumed that in languages such as Thai the numeral must combine with a special constituent, a sortal classifier, which functions as a kind of individualizer (cf. Lyons 1977: 462).[7]

Thai (Hundius and Kölver 1983: 166):

> [Thai nouns] purely denote concepts and, for this reason, are incompatible with direct quantification.

Finally, there are languages such as Yucatec Maya (Mexico). This language also has transnumeral nouns that require a classifier when modified by a numeral, but Yucatec Maya differs from Thai in that it does not distinguish between mensural and sortal classifiers (Lucy 1992: 83, 76):

> Interpretatively, in Yucatec all nouns [..] are neutral with respect to logical unit or shape.
>
> Outside of the restriction on compatibility with other classifiers, little in the grammar of Yucatec appears to hinge on, or correlate with, this "sortal" [...] versus "mensural" distinction [...].

I have called such nouns 'general nouns' in Table 4 above, and the classifiers that are used with these nouns 'general classifiers'.

Yucatec Maya (Lucy 1992: 74; 2000: 329):[8]

	a/one-CLF	banana	
(36)	a. *'un-tz'íit*	*há'as*	'one/a 1-dimensional banana (i.e. the fruit)'
	b. *'un-wáal*	*há'as*	'one/a 2-dimensional banana (i.e. the leaf)'
	c.*'un-kúul*	*há'as*	'one/a planted banana (i.e. the plant/tree)'
	d. *'un-kúuch*	*há'as*	'one/a load banana (i.e. the bunch)'
	e. *'um-p'íit*	*há'as*	'one bit banana (i.e. a bit of the fruit)'

It is important to point out here that languages do not so much differ in the kind of nominal properties they predicate of entities, but

rather in the way the meaning definition of the noun specifies how the property is represented in the spatial dimension in terms of the features Shape and Homogeneity. Just as languages can make different choices as to the way they represent verbal properties in the temporal dimension (Aktionsart, verbal aspect), languages can also make different choices as to the way they represent nominal properties in the spatial dimension (Seinsart, nominal aspect). For instance, we can refer to the same entity as: 'fifty grapes' (as when the grapes are going to be distributed individually), 'a pound of grapes', or 'a bunch of grapes'. In other words, in the act of referring different spatial features of the property 'grapeness' can be emphasized. It can be referred to as a number of distinct individual objects, as a mass, or as a collective entity (cf. Adams 1989: 3).

5.2.2. Nominal aspect

We can define 'aspect' as an inflectional category that specifies the way in which a property or relation designated by a predicate is represented in some dimension. Depending on the type of predicate involved, two kinds of aspect can be distinguished: verbal and nominal aspect. Verbal aspect is concerned with representations in the temporal dimension, and nominal aspect with representations in the spatial dimension (Rijkhoff 1991; 2002: 105-22).

Verbal aspect is an established grammatical category, but nominal aspect (in the sense used here) has only been introduced recently (Rijkhoff 1988, 1991). One of the reasons why nominal aspect has not been recognized earlier as a grammatical category in its own right is probably that nominal aspect markers were simply treated as some deviant kind of number marking. To make clear what distinguishes number marking from nominal aspect marking, I will briefly discuss the differences between number marking in Dutch (which typically employs singular object nouns for reference to discrete physical objects) and so-called number marking in Oromo (which uses set nouns).

It have already mentioned above that in Dutch the plural marker is obligatory whenever reference is made to more than one individual, both with and without the presence of an adnominal numeral in the NP.

Dutch

(37)	a.	de/een	fiets
		'the/a	bicycle'

b. (de) fiets-en
(the) bicycle-PL
'the bicycles'

The plural marker is also compulsory when the noun is modified by a numeral with a value of 'two' or higher:

Dutch
(38) a. (de) twee fiets-en
(the) two bicycle-PL
'(the) two bicycles'

b.* (de) twee fiets
(the) two bicycle

Since the unmarked noun designates a property of a single object I have called such nouns singular object nouns.

In Oromo (Afro-Asiatic), on the other hand, the so-called number marker is optional, but it must be absent when the noun is modified by a numeral (Stroomer 1987: 76):

> In general, nouns with plural suffixes refer to a counted or countable group of items, whereas the possible plural meaning of nouns unspecified for plural is more general and vague. If a noun is counted by means of a numeral, then there is no plural suffix.

Recall that Oromo nouns are transnumeral in that the unmarked form may be used to refer to one or more entities.

Oromo (Stroomer 1987: 76-77)

(39) a. *farda*	'horse/horses'	vs. *fardoollee*	'horses'
b. *saree*	'dog/dogs'	vs. *sareellee*	'dogs'

Because nouns such as *farda* 'horse/horses' and *saree* 'dog/dogs' designate a property of one or more individuals and because a set may consist of any number of individuals (including 'one'), I have called these nouns 'set nouns' (section 5.2.1). Some nouns may also occur with a singulative suffix, so there are actually two ways to disambiguate the transnumeral character of nouns in Oromo (Stroomer 1987: 83, 87; BOW = the three Oromo dialects Boraana, Orma and Waata):

> BOW nouns denoting animate beings, in particular ethnonyms, can take the singulative suffixes *-ca* (masculine), and *-ttii* (feminine);

these suffixes are preceded by the epithetic vowel *i*; *t* is sometimes inserted between the noun root and the singulative suffix. In BOW ethnonyms these suffixes are productive.

In BOW these [singulative] suffixes basically have the meaning of indicating an individual out of a group ...

Oromo (Stroomer 1987: 84-85)

(40)	a. *nama*	'man/men'	vs. *namica*	'a/the man'
	b. *nad'eeni*	'woman/women'	vs. *nad'ittii*	'a/the woman'

Why do these numbers markers behave so differently in Dutch and Oromo? The answer I have proposed (Rijkhoff 1991, 2000, 2002) is that the Oromo affixes are not number markers at all but grammatical elements indicating that the noun designates a property of a set which consists of one individual (singleton set) or multiple individual entities which together form a collective (collective set). This analysis is supported by the fact that in the grammars of languages with set nouns it is often explicitly stated that the so-called plural marker has a collective meaning (Rijkhoff 2002: 104). Since strictly speaking these elements do not indicate number but rather specify the way the nominal property is represented in the spatial dimension (i.e. they relate to inherent or qualitative properties of the referent) I have called these so-called number markers on set nouns *singulative* and *collective aspect markers*, or more generally *nominal aspect markers* (see also notes 7 and 8). Thus, apart from the difference in meaning, nominal aspect markers are usually optional and only appear on set nouns, i.e. transnumeral nouns that can be directly modified by a numeral (note, incidentally, that not every language with set nouns necessarily has nominal aspect markers; they may also simply be absent). By contrast, number markers are obligatory and only appear on singular object and collective nouns.

Another difference between Dutch and Oromo that supports the view that we are dealing with different aspectual noun classes (SEINSARTEN) and inflectional categories is that cases of systematic "number discord" (Rijkhoff 2002: 106–7) between verb and argument only involve set nouns, not singular object nouns. This can be explained if we accept that the verb may agree with the set (singular verb agreement) or with the individual(s) in the set (singular or plural verb agreement). For instance, in the case of Oromo, but also in other languages with set nouns such as Georgian (Kartvelian) and Lango (Nilo-Saharan), verb agreement is always with the (single) set:

Oromo (Stroomer 1987: 107)

(41)	gaala	lamaani	sookoo	d'ak'-e
	camel	two	market	go-3SG.MPAST
	'Two camels went to the market'			

Georgian (Harris 1981: 22)

(42)	sami	ḳnuṭi	goravs
	three	kitten	roll:3SG
	'Three kittens are rolling'		

Lango (Noonan 1992: 168)

(43)	gúlú	àdɛ̂k	òtɔ̀ɔ̀
	pot	three	3SG:die:PERF
	'Three pots broke'		

5.3. From nouns and verbs to noun phrases and clauses

The similarities between verbs and nouns discussed in the previous sections (Aktionsart and Seinsart, verbal aspect and nominal aspect) also permit us to draw parallels between clauses and noun phrases (NPs). I have shown elsewhere (most recently in Rijkhoff 2002) that the underlying semantic structure of both the noun phrase and the clause consist of three hierarchically ordered layers, which specify different descriptive properties of the referent of the clause (an event) or the NP (an object): (1) a Location Layer, which specifies locative properties of the referent, (2) a Quantity Layer, which specifies quantitative properties of the referent, and (3) a Quality Layer, which specifies qualitative (inherent, characteristic) properties of the referent (Figure 1).

The Quality Layer is the innermost layer of modification, which contains the nucleus (verb or noun) and which accommodates modifier categories that only relate to the lexical nucleus. In the case of a noun we find nominal aspect markers as the grammatical and (typically) adjectives as the lexical expression of the notion Quality.[9] The counterpart of the grammatical modifier category 'nominal aspect' in the clause is of course verbal aspect, and lexical modifiers at this level in the underlying structure of the clause are certain adverbs or adverbials (e.g. of manner, speed; cf. Dik 1997: 225-232).

The Quality Layer is contained in the Quantity Layer, which in the NP accommodates grammatical and lexical modifier categories having to do with number distinctions (singular, plural) and cardinality (one, two, etc.). Notice that in many languages the expression of cardinality in the NP involves lexical categories (i.e. cardinality is

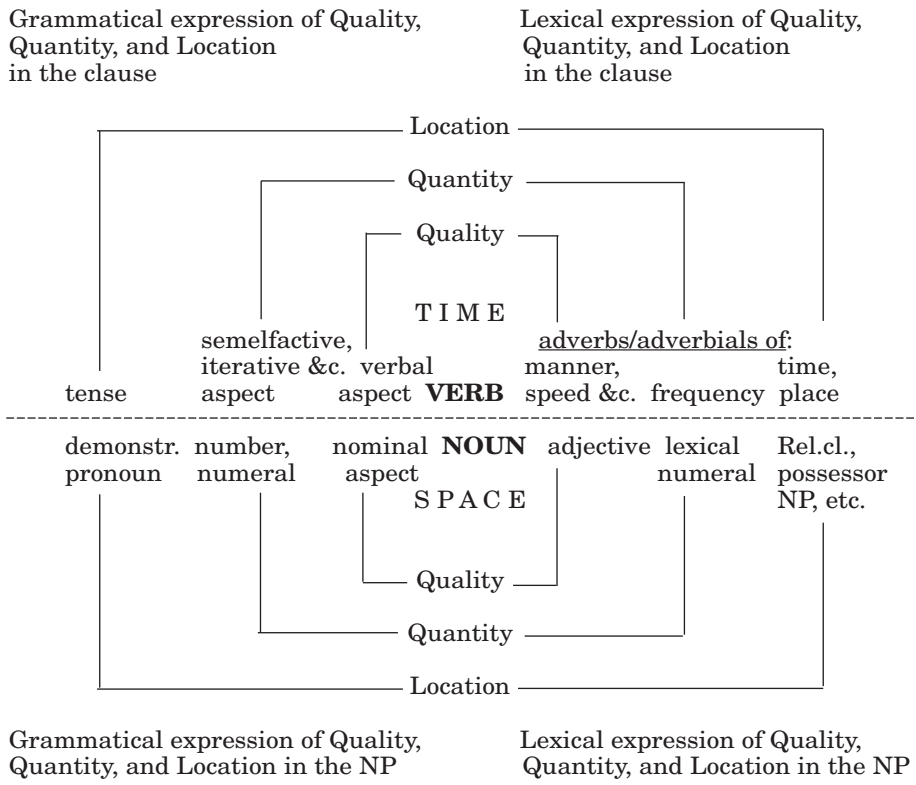

Figure 1. Symmetry in the underlying structure of clauses and NPs

expressed in a construction containing numeral verbs or nouns). For example, the Babungo (Niger-Congo) equivalents of 'digit(s)', 'ten(s)', 'hundred(s)', 'thousand(s)', and 'million(s)' are categorized as nouns: they all belong to a certain gender or noun class (CL), just like any other noun. Thus, in the Babungo example below the noun *ŋgá* 'antelope' belongs to noun class 1/2, class 2 (CL2) being the plural of class 1 (traditionally Bantu noun classes are defined as including number distinctions); the numeral *-bɔ̀ɔ* 'two' agrees in class with the noun *ǹjɔ̀-* 'digit', which belongs to noun class 9/10 (class 10 is the plural of class 9). This is the class for animals and many other things, such as abstracts.

Babungo (Schaub 1985: 187)

(44)	və̀-ŋgá	njɔ̀-sə́	sə̀-bɔ̀ɔ	múu-mbɔ̀ɔ
	CL2-antelope	digit-CL10	CL10-two	ten:PL-two

'twenty-two antelopes'

We find similar quantitative distinctions in modifier categories at the level of the clause. Semelfactive and iterative (or: repetitive, frequentative) aspect are grammatical (inflectional) expressions of number in the clause; adverb(ial)s such as 'every day', 'repeatedly' and 'sometimes' are lexical expressions of the notion Quantity in the clause.

In its turn the Quantity Layer is contained in the Location Layer, which accommodates modifier categories specifying properties concerning the location of the referent. In the NP such modifiers include, for example, demonstratives (grammatical expression of Location) and adnominal possessive NPs and relative clauses (lexical expressions of the notion Location; on the localizing/identifying function of relative clauses and possessive constructions, see e.g. Lehmann (1984: 402); on the relationship between possession and location, see e.g. Clark (1978: 3) and Claudi & Heine (1986: 316). Localizing adnominal NPs can be specified for other semantic functions besides 'possessor', the most obvious semantic function being 'location' (e.g. 'on the table' in 'the flowers *on the table*$_{\text{Location}}$ need some fresh water'). In the clause the localizing function is expressed through grammatical means by tense markers; time and place adverb(ial)s are typical examples of the lexical expression of the notion Location ('*Last week*$_{\text{Time}}$ he met her *in Paris*'$_{\text{Place}}$).

In sum, qualifying modifiers only have the nucleus (verb, noun) in their scope; the Qualifying Layer (including the nucleus) is inside the scope of quantifying modifiers; and localizing modifiers have the widest scope, containing both the Quantity and the Quality Layer. Thus, in an NP like 'those two black dogs on the carpet' it is only the dogs that are black ('black' is a lexical, qualifying modifier), not the quantity or the location. And the quantifying modifier *two* specifies the number of black dog entities, not the number of locations. Finally, both the grammatical localizing modifier *those* and the lexical localizing modifier *(on) that old blanket* specify the location of dog entities with all their qualitative and quantitative properties.

As a matter of fact, both in the NP and in the clause these three descriptive layers of modification (Quality, Quantity, Location) are contained in a Referential or Discourse Layer, which accommodates grammatical and lexical modifier categories that provide the

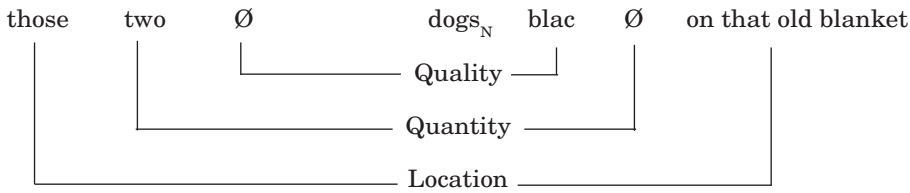

Figure 2. Layered representation of 'those two black dogs on that old blanket'

addressee with information about the referent of the NP or clause as a discourse entity. In the NP, for instance, the grammatical category (In)definiteness specifies whether or not the speaker believes the referent of the NP to be an identifiable entity in the world of discourse for the addressee (for example, because it has been mentioned earlier). In the clause a similar function is served by the grammatical category of (Ir)realis (±Actual). The grammatical notions Definite and Realis (Actual) have a similar function in that they signal that the entities they refer to (already) exist in the world of discourse (or that their existence is presupposed). By contrast, their negative counterparts Indefinite and Irrealis (Non-Actual) have in common that the entities they refer to do not exist (or do not exist yet) in the world of discourse as identifiable or actual ('grounded') entities. For an elaborate discussion of the parallels between the underlying, semantic structure of clauses and NPs I refer to Rijkhoff 2002 (chapter 7).

6. Conclusion

The assumption that all languages contain at least two major word classes, nouns and verbs, seems to be due to a Eurocentric rather than a global perspective on word classes. Recent typological research indicates that the distinction between verbs and nouns is often scalar rather than rigid and that in many languages this distinction is absent or at best weak. Furthermore there are languages in which verbs or nouns do not constitute a major word classes. Finally I argued that in languages that do have a more or less rigid distinction between verbs and nouns, members of both word classes can be analyzed in a similar fashion semantically. Ultimately this analysis makes it possible to argue that clauses and NPs have similar underlying semantic structures.

Address of the Author:

Jan Rijkhoff, Department of Linguistics, University of Aarhus, Nobelparken, Jens Chr. Skous Vej 7, DK-8000 Aarhus C, Denmark, <linjr@hum.au.dk>

Notes

[1] Abbreviations: 1 = first person, 2 = second person, 3 = third person, ABS = absolutive case, ACC = accusative case, CL = noun class, CLF = classifier, CN = connector, DEF = definite, DEM = demonstrative pronoun, DUR = durative, IMPF = imperfective aspect, M = masculine, OBJ = object, PAST = past tense, PERF = perfective aspect, PL = plural, POS = possessive, PRES = present tense, PRT = participle, RSM = resumptive marker, SG = singular, SS = same subject, SUPP = support verb.

[2] On Samoan word classes, see also Churchward (1951: 126; as cited in Vonen 1994: 155): "Almost any part of speech can be used as any other part of speech."

[3] The text continues as follows: "Not all roots occur with the same frequency as verbs and nouns. Some roots predominantly function as verbs, whereas others are more likely to be found in the function of nouns. Until now we have not, for instance, found *alu* 'go' in a nominal function or *mea* 'thing' in a verbal function [...]. But we hesitate to say that *alu* is inherently a verb and *mea* inherently a noun for two reasons. Firstly, we cannot find any functional explanation why *alu* should not be used as a noun and *mea* as a verb, whereas, for instance, *gaoi* 'thief, to steal' and *tagata* 'person, to be a person' are bi-functional. And, secondly, previous experience taught us to be careful with classifications. The more texts we analyzed, and included in our corpus, the more items were unexpectedly found in nominal or verbal function."

[4] Cf. also Churchward (1953: 16) on Tongan: "In Tongan [..] there is much interchange of functions between the various parts of speech. This applies particularly to nouns, verbs, adjectives, and adverbs." Cf. also Broschart (1991, 1997).

[5] In 1724, Lafitau (as quoted in Sasse 2001a: 503) already wrote about Iroquoian as only having verbs, and almost a century ago Hoffmann (1903: xvi ff.) reported on the extreme flexibility of lexical elements in Mundari (Austroasiatic, Munda family).

[6] See Hundius and Kölver (1983: 167f.) for differences between sortal and mensural classifiers in Thai (cf. also Adams 1989: 2-10); see e.g. Bisang (1996; 1999) on semantic indeterminateness of nouns (and verbs) in southeast Asian languages.

[7] To the extent that classifiers are grammatical elements that affect the Seinsart of a nominal predicate they can be regarded as nominal aspect markers (section 5.2.2; see Rijkhoff (1988: 6-7; 2002: 340); cf. also Dik (1997: 165) and note 8).

[8] Lucy also recognized the relationship between classifiers and aspectuality (Lucy 1992: 74): "From an interpretative point of view the classifiers resemble the inflectional category of aspect in the verb phrase which gives the logical or temporal perspective being applied to or presupposed of the predicate. [...] classifiers clarify the logical or spatial perspective being applied to, or presupposed of, the noun phrase complement. In this way Yucatec speakers achieve by means of a single grammatical formation what English speakers achieve by a combination of lexical alternation, determiners, and quantitative modifiers."

[9] Note that, particularly in the case of lexical modifiers, there is no one-to-one relation between form and function. Especially relative clauses and adverb(ial)s are very versatile in that they are employed as Qualifying, Quantifying, and Localizing Modifiers (for more details, see Rijkhoff 2002).

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