calls "the Aristotle problem," to which a simple solution will be proposed.

It will be useful to separate two senses of *predicate:* (1) in its modern, logical sense, a predicate (henceforth, predicate$_L$) is a function from a singular term to a sentence expressing a proposition about the object to which the singular term refers; and (2) in its traditional, grammatical sense, the predicate (henceforth, predicate$_G$) is that which is affirmed or denied of the other term, the subject. I believe that the solution to the problem at hand lies in a dual interpretation of the subject term. In his conception of terms, Aristotle took the intensional or the extensional point of view, depending on the domain explored (putting greater emphasis on the former in his theory of the proposition and near exclusive emphasis on the latter in his theory of the syllogism). I suggest that the Aristotelian subject should be treated (by theorists) and can be processed (by speakers) from both points of view. With an intensional reading, the subject functions as a predicate$_L$ (which trivially licenses the occupation of the subject slot and the predicate$_G$ slot by the same term). But with an extensional reading, the subject functions as a class providing generic *individual* terms, which licenses the occupation of the subject place to play the role of an argument in association with the predicate$_L$. In brief, the traditional A-sentence superficially expresses a higher-order predication, but its generic subject term is of the same logical type as the other arguments to which the predicate$_G$ may apply (*qua* predicate$_L$): Predication in the A-sentence is understandable on the same grounds as the basic predication, from which it does not differ in nature.

From the inception of categorization, the A-sentence predication could start to develop, taking *generic* individual objects as its subject: "*x* is a predator" (with temporal anteriority) and "*x* is yellow" are conflated into "the predator is yellow." Indeed, it would be uneconomical to formulate, for example, *the x is S and P* when the first predication is temporally or cognitively already established; hence the shorter formulation *the S is P.* Now, in remarking that "FOPL is more distanced from the surface of natural languages" (sect. 6.3, last para.), Hurford makes an understatement: FOPL, at least with standard quantification, fails to capture what the A-sentence captures by using the generic term of the subject class, namely, the anteriority of the first predication (Sx) with regard to the second (Px). For example, in the rendering of *some cat is black,* $(\exists x)(Cx \,\&\, Bx)$, C and B are treated on a par, except if one remedies this by using restricted quantification, $(\exists x\!: Cx)(Bx)$, which captures well the prior predication.

There is indirect evidence that for Aristotle the deep structure of sentences like *some S are P* coincides with their expression in FOPL. This is suggested by one of his methods to solve syllogisms, namely *ecthesis.* Consider his proof for Darapti: *all M are P; all M are S; therefore some P are S.* First, extract an individual *x;* now, because both *P* and *S* are predicated of this individual, it follows that one of the two is predicated of the other: *some S are P.* In other words, *some S are P* is proved by the fact that there is an individual that has both properties *P* and *S.* This turns out to be a paraphrase of the FOPL formula $(\exists x)(Sx \,\&\, Px)$. But notice that in this syllogism, *S* and *P* play parallel roles (except in the conclusion where the end term labeled *S* is, by convention, allocated to the subject place), so that none of the terms *S* and *P* takes precedence over the other; this leads to another psychologically acceptable conclusion *some P are S.*

If, as I have argued, the nature of the predication in the A-sentence does not differ from the basic predication in which (in agreement with Hurford's claim) the object attended to (the subject) and the property attributed to it have a different status, it follows that people should be sensitive to this difference in status. Of course, this meets speakers' intuitions of a contrast between subject and predicate$_G$; but also this ought to have testable consequences: People should be reluctant to exchange the role of the subject and of the predicate$_G$. This is precisely one of the most robust and remarkable findings in the psychological study of syllogistic reasoning. There are two related phenomena. One is called the *figural effect* (Johnson-Laird & Steedman 1978). Irrespective of the logical status of the syllogisms, people have a tendency to produce a conclusion whose terms (subject and predicate$_G$) reproduce the role which they have in the premises. Take, for example, the syllogism *some M are P; all S are P,* from which most people fail to recognize that nothing follows; instead, they provide *some* conclusions, most of which are *some S are P,* and only very few *some P are S.* The other phenomenon concerns valid syllogisms. The four most difficult syllogisms to solve (for which the success rate is typically below 15 percent) coincide with the only ones in which both end terms change grammatical role from premise to conclusion (e.g., *no P are M; all M are S; therefore some S are not P*).

Ventral versus dorsal pathway: The source of the semantic object/event and the syntactic noun/verb distinction?

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Abstract: Experimental data suggest that the division between the visual ventral and dorsal pathways may indeed indicate that static and dynamical information is processed separately. Contrary to Hurford, it is suggested that the ventral pathway primarily generates representations of objects, whereas the dorsal pathway produces representations of events. The semantic object/event distinction may relate to the morpho-syntactic noun/verb distinction.

By presuming that expressions of language exhibit certain logical forms and by mapping these forms onto regions of cortex, Hurford tries to reduce conceptual structures to neural events. Although I agree to this two-step method, I recently presented a methodologically similar approach (Werning 2001; 2003a) that arrives at different conclusions with regard to the cortical realization of object and property concepts: (1) A property concept is identified with the column(s) of neurons that code for the property in question. The application to the ventral/dorsal division leads to the conjecture that property concepts are located both in the ventral and the dorsal stream. However, the ventral stream may predominantly host representations for properties of *objects* expressed by objectual predicates (e.g., by adjectives like *red, vertical,* or, in more complex cases, by nouns like *square, circle*), whereas columns in the dorsal stream may predominantly represent properties of *events,* for example, the direction or speed of motion. These are expressed by eventual predicates (e.g., by adverbs like *downward, quickly,* or, if complex, by verbs like *to fall, to move*). (2) Individual (object and event) concepts are identified with synchronous oscillations. (3) One or more property concepts $F_1, \ldots, F_n$ are predicated of an individual concept *x*, that is, $F_1(x) \,\&\, \ldots \,\&\, F_n(x)$, just in case neurons of the columns that code for the properties represented by $F_1, \ldots, F_n$ fire in synchrony, that is, with the same oscillation function. On the basis of these assumptions it was possible to show how cortical structure semantically realizes a predicate language (Werning 2003b).

To highlight the differences to Hurford's proposal, let me first turn to what I call his *object-by-position hypothesis* (OP): An object concept amounts to the representation of the object's position in space. OP expresses a fairly rich notion of what object representations are, because falling under an object concept would be equivalent to having all the positional properties the object concept represents. In other words, being object *x* requires the possession of certain *essential* properties, if only positional ones. My view, in contrast, is less demanding and follows Quine's (1961) dictum: "To be [an individual] is to be the value of a [bound] variable." Accordingly, an individual concept would be the neural event that binds together neural representations of properties. Following Singer and Grey's (1995) theory of binding by synchrony, individual concepts should be identified with synchronous oscillations.

Hurford conjoins OP with what I call his *position-through-dorsal hypothesis* (PD): The dorsal stream (plus superior colliculus and pulvinar) is predominantly engaged in the processing of positional information, and particularly not in the processing of property information. A rival view holds that the dorsal stream primarily processes motional information (Wurtz & Kandel 2000). According to Merigan and Maunsell (1993), the dorsal stream – involving, inter alia, the thick stripes, the middle temporal (MT), medial superior temporal, lateral parietal and ventral parietal areas, and area 7a – receives input predominantly from the magno pathway via lateral geniculate nucleus. Recall that magno cells have excellent dynamic (temporal) resolution, whereas the parvo cells contributing mainly to the ventral stream have much better static (spatial) resolution. Furthermore, MT of the dorsal stream seems to be paradigmatically involved in motion processing. The dorsal pathway can thus be regarded as carrying mainly dynamic, that is, eventual information (prototypically motion), whereas the ventral stream seems to be preoccupied with static, that is, objectual information (prototypically, color and form). It thus remains an empirically unsettled issue whether the ventral/dorsal division corresponds to a distinction between property ("what") information and positional ("where") information, or to one between objectual and eventual information. Wurtz and Kandel (2000) review a large amount of data from lesions in humans and monkeys that support the second option.

Even if one were to accept OP and PD, it would be rash to conclude that object concepts are delivered exclusively by the dorsal stream. For, if property concepts are processed by the ventral stream, what then is the mechanism of predication, that is, the mechanism of binding an object concept to a property concept? Hurford gives no answer. Theorists who identify individual (object and event) concepts with oscillation functions, in contrast, have shown in detail how the neurons of one column can be modeled as oscillators so that the Gestalt principles are honored, according to which neighboring elements with similar properties are likely to belong to one and the same individual (Maye 2002; Schillen & König 1994; Werning 2003b). According to this view, an individual concept is generated within hyper-columns by synchronizing and desynchronizing connections. Because columns serve as property concepts, there is no anatomical separation between the processing of property and individual concepts.

Summing up the critical arguments, one may contrast Hurford's view with an alternative hypothesis: Property concepts and individual concepts alike are processed in the ventral and dorsal stream. However, the dorsal stream is predominantly occupied with the representation of events, which are dynamic in nature. It hosts concepts of eventual properties and generates individual event concepts. The ventral stream, on the other hand, tends to produce representations of objects. It hosts objectual property concepts, which are static in nature, and generates individual object concepts. This ontological division of objects and events reflects a structure that is well known from the logical analysis of language and thought (Varzi & Pianesi 2000). A sentence of the form, "A red circle is slumping," has to be analyzed by quantification over an object (the red circle) and an event (the slumping): $(\exists x \exists e)$(RED(x) & CIRCLE(x) & SLUMPING(e) & AGENT_OF(x,e)). Hence, the mental representation expressed by the sentence consists of two objectual property concepts (RED and CIRCLE), one individual object concept (x), one eventual property concept (SLUMPING) and one individual event concept (e). According to the alternative hypothesis, the neural realization of RED and CIRCLE should be columns of neurons in the ventral stream (e.g., V4). There should be an oscillation among them that corresponds to the object concept x. Furthermore, the property concept SLUMPING is expected to be realized by columns of neurons in the dorsal stream (e.g., MT), and those neurons are predicted to oscillate synchronously in a way described by the oscillation function that corresponds to e.

The alternative theory would, moreover, allow us to aim at a neurobiologically founded explanation of the origin of the morpho-syntactic noun/verb dichotomy. Although its universality has been disputed, there seems to be rich evidence that it holds (Croft 2000; Mithun 2000). Nouns and their modifiers – adjectives – prototypically denote objects and their properties, whereas verbs and their modifiers – adverbs – prototypically refer to events and their properties. Because the alternative hypothesis suggests that the semantic object/event distinction correlates with the ventral/dorsal division, one might conjecture that this division, at least in evolutionary terms, is the origin of the noun/verb distinction.

The neural representation of spatial predicate-argument structures in sign language

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Abstract: Evidence from studies of the processing of topographic and classifier constructions in sign language sentences provides a model of how a mental scene description can be represented linguistically, but it also raises questions about how this can be related to spatial linguistic descriptions in spoken languages and their processing. This in turn provides insights into models of the evolution of language.

Hurford's target article proposes a "wormhole" between formal logic and empirical neuroscience, identifying *PREDICATE(x)* as a schematic representation of the brain's integration of the location of an arbitrary referent object, mapped in parietal cortex, with the analysis of the properties of that referent by other systems. A single point will be raised here for consideration in relation to this proposal. With this model, it might be expected that the parietal lobes would be involved in linguistic comprehension tasks, especially those that demand spatial representational resources. In nonlinguistic contexts, a very wide range of spatial functions is associated with parietal lobe function (see Culham & Kanwisher 2001 for a review). However, even when space is referred to in spoken language, there is little evidence that these parietal systems, specialised for spatial processing, are specifically activated.

Although parietal regions may be involved in tasks such as solving spatial syllogisms (Carpenter et al. 1999) or generation of spatial prepositions in response to visual images (Damasio et al. 2001), this does not appear to be mandatory (Goel et al. 1998; Reichle et al. 2000). Indeed, there is evidence that the parietal involvement in the Damasio et al. study may arise from the processing of the visual image and not from the linguistic task itself. Because the claim is made by Hurford that mapping of "scenes" by the parietal cortices underlies the subsequent creation of linguistic structures, the absence of any parietal involvement in language processing needs to be explained.

In relation to this point, data from sign language research is of interest. Although the sign languages of contemporary deaf communities do not provide direct evidence relating to the evolution of human language, because they have arisen in humans with "language-ready" brains, they do provide insight into what an earlier "wormhole" might have looked like.

In sign languages, space serves several functions. All signing occurs in "sign space," an area in front of the signer. This space may be regarded in different ways: From a phonological perspective, it serves simply as a region for the execution of signs. At a higher level, entirely abstract sentence meanings can be represented spatially. In the BSL (British Sign Language) translation of the sentence, "Knowledge influences belief," one location in the space in front of the signer is assigned to "knowledge," a second location to