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► **To cite this version:**

Maya Hickmann, Stéphane Robert. Introduction: Space, language, and cognition: Some new Challenges. *Space in Languages Linguistic Systems and Cognitive Categories*, 66, John Benjamins Publishing Company, pp.1 - 15, 2006, *Typological Studies in Language*, 9789027229786. 10.1075/tsl.66.01hic . halshs-04368743

HAL Id: halshs-04368743

<https://shs.hal.science/halshs-04368743>

Submitted on 1 Jan 2024

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In: M. Hickmann, S. Robert (Eds.) *Space in languages : Linguistic systems and cognitive categories*. 2006. Typological Studies in Language 66. Amsterdam : J. Benjamins, 1-15. doi.org/10.1075/tsl.66.01hic

Space, language, and cognition: Some new challenges

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1. Why space?

As illustrated by the Kantian tradition and by a number of more recent theories, space is often viewed as a universal cognitive primitive, an “a priori form of intuition”, that conditions all of our experience. From this point of view, it is of particular interest to study the linguistic expression of space, since languages seem to capture and to make explicit the constraints of experience on the construction of spatial reference. At the same time, language confers to spatial representations the property of referential “detachability”, that distinguishes these representations from those that are produced by our perceptual experience of space. This fundamental property allows speakers to dissociate and to choose among different components of spatial reference, as well as to use spatial morphemes to express other and/or more abstract meanings, such as temporal, causal, or argumentative relations.

Some questions then arise concerning the primitive nature of the category of space in language. To what extent does space, as it is linguistically encoded, reflect forms of perceptual experience and which aspects of this experience do different languages encode? Does space constitute a pure and primitive category from which other linguistic meanings are then derived? These questions are recurrently addressed by cognitive grammars. They are particularly central to metaphor theory, as well as highly relevant in the light of numerous derivations that have been observed in the history of languages, often indicating that a given term evolves from a “concrete” spatial meaning to an “abstract” discourse meaning. What are the cognitive mechanisms that allow such transitions?

In contrast, some recent linguistic analyses argue that spatial values are neither basic nor even purely spatial, but rather that spatial terms intrinsically carry many other values, for example meanings related to the functional properties of objects, their force or resistance, or the goals towards which speakers construct spatial relations in their utterances. According to this conception, space in language is therefore not a primitive

category, but already the result of some construction that is based on our experience and that is part of the actions we carry out in interaction with the world. What evidence can be brought to bear on these different conceptions?

Finally, in the last twenty years, many studies in linguistics, psycholinguistics, and cultural anthropology have revealed wide variations in spatial systems across languages and cultures. These variations concern, for example, the nature of the linguistic devices expressing spatial information (e.g., verb roots, affixes, classifiers, particles), the particular distinctions they encode and highlight the most (e.g., manner of motion, location, posture, shape and other dimensions of spatial entities), and the reference systems that are used by speakers (absolute, egocentric, relative). In addition, various studies show that linguistic and cultural systems determine - at least partially - the nature and cognitive accessibility of the information that is selected by speakers. This evidence has cast some doubts on the supposedly universal properties of spatial categories. It therefore raises questions concerning the impact of linguistic categorization on perception, as well as the existence of a single (amodal) spatial system or of two distinct (linguistic, perceptual/motor) systems of spatial representations.

2. General overview of book contents

The study of space is framed in this volume within an interdisciplinary perspective in which varied contributions stem from different scientific traditions, each bringing its own concerns and methodologies: descriptive, typological and diachronic linguistics, cognitive anthropology, the philosophy of language, cognitive psychology, developmental psychology, psycholinguistics, neurosciences and the study of various pathologies. The book is organized into three main parts, each focusing on a major set of questions: *Universals, variability, and change* (Part I); *The nature and uses of space in experience and in discourse* (Part II); *Space, language, and cognition* (Part III). As shown below, these issues are interrelated throughout the volume.

Part I proposes typological and diachronic analyses of spatial systems. Particular attention is placed on universal and variable aspects of these systems, as well as on historical changes and factors determining these changes over time. The chapters in this part examine major typological differences across linguistic systems (Creissels, Grinevald, Slobin) and propose diachronic analyses of how some of these systems have evolved through the emergence, reorganization, or disappearance of categories or through some more general structural changes (Kopecka, Marchello-Nizia, Peyraube). Some of these papers also address questions that are at the center of subsequent parts. For example, analyses of deixis in language (Marchello-Nizia) directly touch on issues related to the pragmatics of discourse (Part II), while discussions of the notion of “salience” across spatial systems directly touch on issues related to spatial cognition (Part III).

Part II concerns the nature and uses of spatial language in discourse and in relation to our experience of space. The papers in this section examine how spatial reference is constructed from experience at the discourse level and show how this construction process might bear on the very nature of space in language. They discuss how semantic information is distributed across clauses, how linguistic categories interact, and how informational components may be explicit vs. implicit and inferred from context. Some papers also address questions concerning cognition (Part III) by asking whether “spatial” values in language inherently require taking into account other values (Vandeloise, Robert, Cadiot et al.) or by comparing spoken and signed languages (Sallandre, Talmy) along some of the typological issues discussed at length elsewhere in the volume (Part I).

Part III touches on fundamental issues concerning the relation between spatial language and spatial cognition. It examines the impact of linguistic variation on how spatial information is expressed, perceived, and categorized by adults and children, as well as how spatial representations may break down in pathology. Some question the assumption that linguistic variation affects speakers’ perception (Dokic and Pacherie). Others examine how pathology might inform us about the existence of one vs. several representational systems for space within the same speaker (Landau and Lakusta; Denis, Ricalens, Baudouin, and Nespoulous). Yet others (Hickmann) examine how children acquire spatial systems across languages that present typological differences (discussed in Part I), suggesting the potential role of language in structuring spatial cognition. As shown below, some of these papers also touch on issues concerning Part II, by examining the organization of spatial information in discourse (Hickmann, Denis et al.).

The more detailed overview of the volume below shows how each chapter centrally addresses one or the other set of questions at the heart of each part in the volume. It also indicates how different contributions substantially address other questions, pointing to interrelations among questions and to recurrent links across the entire volume.

3. Part I: Universals, variability, and change

The first set of questions in this volume concerns the variability of spatial systems across languages: What components of space do linguistic systems encode and how? What is the extent of linguistic variation and what are its limits? How do spatial systems evolve over time, sometimes shifting from one type to another, and what are the causes of these changes? How can the study of sign language bear on these questions from a typological point of view?

Linguistic typology studies the types and limits of linguistic diversity. For example, comparing what could be logically expressed with what languages actually express allows us to classify languages according to the types of distinctions they make. Spatial systems include different means of

expressing location (Creissels, Grinevald, Vandeloise) and motion (Slobin, Kopecka, Peyraube; also see Hickmann in Part III), as well as different frames of reference used to locate entities in space (see Marchello-Nizia; also see Robert for linguistic insights in Part II and Dokic and Pacherie for epistemological questions in Part III).

Because languages use a limited number of means to express meanings, they differ in the distinctions they systematically express. As shown by Grinevald in relation to location (responses to the question “Where is X?”), languages vary first in the nature of the spatial information they encode. Each language selects some information components towards which it directs speakers’ attention, leaving other components more or less implicit and to be inferred. In this respect, languages differ widely in their degree of semantic “granularity”. Thus, languages may vary in the number of spatial prepositions they provide. Some even provide a unique semantically vacuous preposition, but express locations indirectly through constructions that indicate the position of entities (‘the pot is [standing vertical] by the fire’). Again, languages may distinguish only a few positions (‘lying’, ‘standing’, ‘sitting’, ‘hanging’) or a great number of positions (up to fifty positions, for example, ‘sitting on bottom’, ‘sitting on one’s haunches’, ‘sitting huddled’....).

Languages also differ in the density of the information they convey through the phenomenon of “conflation”. Different types of information may be expressed in a unique form, for example posture can conflate with verticality, dimensionality (whether the object is 1D, 2D, or 3D), texture, permanence, animacy, number (e.g., “a horizontal flat object is somewhere on its back in relation to another entity”, “something is crouching immobile”). Some distinctions may not be expressed at all. For example, Creissels shows that some languages use distinct morphemes to express location (‘to be at a place’), the source of a motion (‘to come from a place’), and direction (‘to go to a place’), but two or three distinctions may conflate into a unique morpheme, without further detail. Furthermore, spatial information may be distributed across various devices and subtle combinations thereof (verbs, prepositions, postpositions, affixes, particles, nominal classifiers...) (see papers by Grinevald, by Kopecka, and by Creissels).

However, as pointed out by Talmy, whereas the spatial lexicon can be quite rich (particularly because of conflation phenomena), grammatical forms relevant to space come in a relatively closed set of categories. Speakers must therefore select among these pre-packaged schemata when depicting spatial scenes. Furthermore, the universal inventory of fundamental spatial elements that combine to form whole schemata is relatively limited. Expressing a spatial scene requires a process of “schematization”, that is the selection of some characteristics, that relies on some among a relatively limited set of elements in each relevant category.

For example, the category of “number” pertains to individual components of spatial scenes. In closed-class items (i.e. classes with a closed inventory such as grammatical forms), this category may only include four members in relation to space (one, two, several, many): the ground may consist of just one object (*near*), of two objects (*between*), of several objects (*among*), and of numerous objects (*amidst*). According to Talmy, this property is a special characteristic of spoken language as compared to other cognitive systems. Furthermore, Talmy and Vandeloise both note that classical geometric tools do not accurately account for the distribution of linguistic spatial components such as prepositions. In this respect, it is worth noticing that language is neutral with respect to particular dimensions of Euclidean geometry. This neutrality makes languages flexible and allows them to make maximal use of a limited number of components. For example, with respect to the dimension of “magnitude”, the preposition *across* can apply to a situation of any size and the preposition *near* can describe the distance between planets in the solar system or between two houses within a relatively small region.

Thus, languages vary noticeably in the spatial distinctions they explicitly make, but they also vary in other respects. Interestingly, comparing the types of distinctions that are found across languages to the set of all logical possibilities shows three points. First, all types seem to exist most of the time, but a few patterns are predominant and some are very rare. Second, existing types often correspond to a common linguistic area or linguistic family, but this rule is by no means absolute. Different types of languages can coexist in the same linguistic area. Third, different patterns may be found within one language, so that it might be best to talk of “strategies” used by languages rather than of language types.

The same conclusions hold for location and for motion. As Peyraube reminds us, the expression of a basic motion event in natural languages involves several semantic components: a figure (or target), that is the entity in motion and/or to be located; a ground (or landmark), that is the entity in relation to which the figure is located; the path of motion; the manner in which motion is carried out; and the cause of motion. Three of these components are central across languages: manner (e.g., English *to run*, *to walk*, *to fly*), path (*to run in*, *out*, *up/down*, *across*), and ground (*to run into the room*, *to run into the garden*). Languages differ in how they encode path and manner, but also in the attention they pay to manner. In his pioneer work, Talmy (1985, 1991, 2000) suggests that languages can be divided into two groups in terms of the ways in which they encode the core feature of a motion event, namely its path. Verb-framed languages (such as Romance or Semitic languages) typically convey path information by lexicalizing it in the main verb (e.g., French *entrer*, *sortir*, *monter*, *traverser*). In contrast, satellite-framed languages (such as Germanic and Slavic languages) encode path in satellites, such as particles, prefixes, or prepositions associated to the main verb (English *to walk into*, *to climb up*, *to run across*). The use of

satellites to encode path allows the main verb of the clause in S-languages to be available to encode other dimensions of motion events, for instance manner (*to walk into, to climb up, to run across*).

As pointed out by Slobin, languages differ considerably in their lexical and morphological means of expressing manner, thereby attributing different degrees of salience to this dimension. For example, various common manner verbs in English (*to walk, creep, trample, stomp, stumble... on the plants*) can hardly be translated into French. Manner is expressed with more limited means in V-languages, frequently in subordinate manner verbs, that are merely optional (*entrer en courant, en rampant...*), and it is most frequently not expressed at all. Slobin proposes a third language type, namely “equipollently-framed” languages, in which path and manner are expressed by equivalent grammatical forms (also see Slobin 2003, but see a critique by Peyraube in relation to Chinese). These forms may be serial-verbs, bipartite verbs (a complex of two verbs, one expressing manner, the other path) or generic verbs combined with coverbs encoding path and manner. As we will see (Part II), the nature of these morphological means has important consequences for the degree to which manner is salient in discourse.

Now let us turn to frames of reference. Levinson’s major work has shown the existence of different frames of reference across languages (e.g., Levinson 2003). As summarized in this volume (see Robert in Part II and Dokic and Pacherie in Part III), three kinds of frames of reference can serve to locate entities: (1) an *intrinsic* frame of reference, in which coordinates are determined by the inherent features of the ground object (*He’s in front of the house*: the house has an intrinsic orientation defining its front part); (2) a *relative* or anthropocentric frame of reference, where the coordinate system is based on an external viewer or point of view (*He’s to the left of the house*: the left of the house is defined relative to the speaker’s position); (3) an *absolute* frame of reference using fixed bearings such as cardinal points (*He’s north of the house*). When the point of view used as the frame of reference is the speaker, the relative frame of reference is also called “egocentric” or more commonly “deictic”. Several authors in this volume also point out the crucial role of the speaker’s deictic space for language, that is the space in which the speaker is taken as reference point (Marchello-Nizia in relation to French, Robert in relation to an African language, and Vandeloise more generally).

Three chapters add a diachronic perspective to the description of spatial linguistic systems, providing interesting examples of how systems evolve through time. These papers illustrate a semantic change in the values of French demonstratives (Marchello-Nizia), as well as structural changes in the expression of motion events in French (Kopecka) and in Chinese (Peyraube). In all three cases, changes were not abrupt, but unfolded in several stages that took place over centuries. In addition, all three cases illustrate the existence of some “hybridization” within given languages at

given points in time and show that this observed language-internal variability corresponds to the more general variability that can be observed across languages. That is, during the course of its history, a given language evolves from one type of system into a different type that is found in other languages.

For example, spatial systems may undergo structural changes that reflect typological shifts. With respect to the expression of motion events, Peyraube shows that Chinese evolved some ten centuries ago from a verb-framed language encoding path information in the main verb of the clause to a satellite-framed language encoding path in satellites, namely in directional complements. Inversely, Kopecka shows that French evolved since about the 14th century onwards from a satellite-frame language encoding path in verbal prefixes to a predominantly verb-framed language where path is lexicalized in the verb. Nonetheless, French has retained a secondary satellite-framed system, which is a less productive remnant of its previous state (e.g., verbs such as *écrémer* ‘to take off cream’, *empoter* ‘to pot’, *emprisonner* ‘to imprison’, *atterrir* ‘to land on the earth’).

French demonstratives evolved from a personal value (in Latin) to a spatial semantic value (in Modern French) through a stage during which they referred to the speaker’s sphere (anything that is linked to the speaker, whether spatial or not). This change went smoothly through several stages before reaching its present state. These stages can be summarized as follows. First, an ambiguous construction plays a pivotal role that allows the change to occur. Second, at some point the former and the new constructions (or values) coexist. Third, the frequency of ambiguous constructions is probably a crucial factor explaining why they are reanalyzed into a new type. In the case of French demonstratives, the subjective-pragmatic meaning played the role of the pivotal construction. The change from a strictly subjective value (referring to the “speaker’s sphere”) to a more abstract value (any element or object activated in the speaker’s mind or standing out because it is present in the speech situation) was facilitated by the frequent use of elements being altogether part of the speaker’s sphere (in a very broad sense) and present at the time and moment of speech. The frequent combination of these two features in discourse allowed the semantic reanalysis.

Interestingly, the spatial value of French demonstratives (which is very common cross-linguistically) is not primary, but rather appears to be the result of a long evolution that took place during more than twelve centuries. Marchello-Nizia argues that the evolution from Latin to Modern French, far from starting with a spatial meaning and gradually moving further away from it, seems to have gone through a “cyclic” change, as do some other morphemes: it moved from spatial to personal meanings (Latin), then to subjective-pragmatic meanings (Old French), before returning to spatial meanings (Modern French).

Finally, Talmy compares how spoken and signed languages represent space. Signed languages are of particular interest because, in comparison to spoken languages that are linear, they are spatialized and multidimensional systems, that use a gestural subsystem of face, head, torso representations, a gradient subsystem of “bodily dynamics”, and an associated somatic subsystem including facial expressions. However, according to Talmy, spoken and signed languages share the property of containing two subsystems, one “open-class” or lexical subsystem (typically the roots of nouns, verbs, and adjectives) and one “closed-class” or grammatical subsystem, consisting of relatively few forms that are difficult to augment. These two subsystems basically perform two different functions when they combine in the sentence: open-class forms largely contribute conceptual content, while closed-class forms determine the conceptual structure of the scene to be construed by language. Spoken and signed languages can therefore be considered as two language modalities.

As shown by Talmy, a crucial property that is specific to how signed language represents space appears to be the structural characteristics of scene parsing in visual perception. Thus, in comparison to spoken language, signed language can mark finer spatial distinctions with its larger inventory of structural elements, of categories, and of elements per category. It can represent many more of these distinctions in any particular expression. It also represents these distinctions independently in the expression, not bundled together into pre-packaged schemata. In addition, its spatial representations are largely iconic with visible spatial characteristics; with respect to this last point, Sallandre also shows the central role of *highly iconic structures* in discourse. She further demonstrates that signers may use a variety of different handshapes (*proforms*), which are all available in French Sign Language, to denote a given referent, depending on the particular properties on which they choose to focus, given their relative relevance in discourse. As further discussed below, these properties have consequences for how the brain might organize cognitive functions related to space in different systems (an issue that is at the center of Part III). However, because both systems represent spatial situations schematically and structurally, they nonetheless share properties that are central for language use at the discourse level (at issue in Part II).

4. Part II: The nature and uses of space in experience and in discourse

This volume addresses a second set of questions concerning space in language: How are linguistic systems used to construct spatial reference at the discourse level? Is it possible to determine “spatial” values in language autonomously, without taking into account other values that are relevant to our experience of space and that are necessary to characterize our use of language in discourse or, more generally, any action we might perform.

As shown above, spatial information is distributed in different parts of the sentence and this distribution varies across languages within a certain range

of possibilities. Grinevald amply illustrates how spatial information can be distributed across different sentence components. She shows that the distribution of spatial information can be overt or covert, redundant or underspecified, and even entirely absent in extreme cases where the location of an entity must be inferred from its posture or shape. Indeed, discourse analysis reveals that the semantics of space, as well as meaning in general, is compositional and distributed, because language inherently involves linearization and sequencing. In contrast to vision, which is a holistic and multidimensional process, verbalization imposes the need to break down information into discreet and successive pre-constructed units.

However, as a counterpart to this constraint, another property of language gives it a special kind of power, because different sentence elements interact with each other, thereby creating new meanings. As shown by Vandeloise, particular ways of combining spatial prepositions with different verbs and constructions may confer new meanings to the sentence and to the units within sentences themselves. For example, French *contre* ('against') cannot be used with intransitive motion verbs (**L'enfant va contre le mur* '*the child goes against the wall'), because voluntary motion verbs describe the *will* of the mover, who is assumed not to move deliberately into an obstacle, unless s/he is mad (*Le forcené court contre le mur* 'The madman runs up against the wall'). The sentence construction itself contributes to spatial meaning. Transitive motion verbs are used when there is a dynamic exchange between the agent and the patient (*John breaks the wood*), while intransitive motion verbs are used when there is no such dynamic exchange between the subject and the complement (*The bird is above the tree*).

It is worth noticing that despite some important differences across systems, spoken and signed language share common properties at the discourse level. As pointed out by Talmy, both have basic elements that combine in order to structurally schematize scenes. Both group their basic elements within some categories that themselves represent particular categories of spatial structure. Both follow some conditions on the combination of basic elements and categories into a full structural schematization. Both also follow conditions on the co-occurrence and sequencing of such schemata within a larger spatial expression. Both allow speakers to amplify some semantic elements or parts of a schema by means of open-class lexical forms outside the schema. And in both subsystems a spatial situation can often be conceptualized in more than one way, so that it is amenable to alternative schemata.

Talmy's analysis, then, shows the extendability of linguistic prototypes and the existence of processes that deform schemata. In line with this insight, Vandeloise's analysis of spatial prepositions in discourse reveals first that their values vary according to the terms with which they are used. It also points out that the semantics of spatial terms involve notions that are related to our *experience*, rather than to a conception of space in terms of Cartesian axes. Such notions include, for example, the transmission of energy and

forces, the cause of motion, control, intentionality, will, and even the agent's satisfaction. More generally, some important asymmetries found in the uses of prepositions (*The bird is in front of the house*, but **The house is behind the bird*) result from the fact that spatial prepositions are not devoted to a purposeless description of space, but rather serve as *instructions* in order to help locate a specific target. In order to guide the addressee, the speaker uses the most conspicuous landmark possible and a bird is not a good landmark to locate a house.

We saw above that the semantics of spatial terms often combine spatial values with other components because of the phenomenon of conflation. Another characteristic of language is that spatial terms always have non-spatial uses. This property is not specific to spatial language, but results from the more general polysemous nature of linguistic units. This point is alluded to by Vandeloise's provocative title "Are there spatial prepositions?". His final answer to this question is positive, but as long as one conceives of space in language as a component of human concrete external experience, rather than as a geometric tool. According to this conception, spatial uses of prepositions play a central role in providing the necessary "impulsion" that determines how these devices are distributed overall in languages.

Non-spatial uses of spatial markers are also discussed by Robert in the particular case of deictic space (also see by Marchello-Nizia in Part I). If deictic elements are used to refer to the space of the speaker, they always have at least an extended use to refer to the space of discourse, particularly to designate a term that is close or far away in previous speech. This special discursive use of spatial terms illustrates another property of language, namely its reflexiveness, that is the property whereby language can be used to "talk about" language. In the case of Wolof studied by Robert, the use of deixis goes far beyond the spatial location of an entity, pervading the entire language (noun determination, predication, subordination) and playing a special role in the construction of various relationships of syntactic dependency. Through a special suffix indicating the absence of localization in the speech situation, Wolof also provides a striking example of how "deixis in absentia" plays a central role for linguistic construals.

Finally, as demonstrated by several papers, discourse analysis reveals another important point concerning linguistic variation. Although different ways of expressing space may coexist in a given language system, some may be scarcely used in discourse, while others, on the contrary, may be obligatory and even overexploited. This variation results from the fact that languages choose particular strategies about which elements they consider to be most *salient* for the description of situations. These choices can be purely conventionalized or induced by the morphosyntactic constraints of each system.

Grinevald (in Part I) illustrates this point with two groups of Amerindian languages that make extensive use of the same morphological devices, but

that do so in totally different ways. Tzeltalan languages make pervasive use of positional roots in locative predicates, but also in a very productive derivational system (such as numeral classifiers and verbs, intransitive and transitive constructions). Such frequent positional roots therefore systematically direct attention to spatial and other physical characteristics of entities, such as the figure of a basic locative construction. In Jakaltek-Popti' directionals are also massively used. However, because they have evolved to express an *abstract notion of trajectory* in space, they can be used in the absence of any motion on the part of spatial entities, as shown by their use with verbs of perception or with verbs of saying ('He saw her [up] [away]' or 'He said hello [up] [towards] to her'). In these cases directionals serve to perspectivize scenes, indicating the reference point from which the scene is to be conceived, somewhat like a camera which takes different points of view.

Slobin's analysis of an extensive corpus of texts (in Part I) concludes that lexicalization and morphosyntactic patterns constrain information focus in discourse. In contrast to speakers of satellite-framed languages, speakers of verb-framed languages virtually never mention manner, focusing on emergence, appearance, or changes of state and showing a strong preference for marking state changes in the verb root. Although V-languages provide means of expressing manner, speakers seldom do so in spontaneous discourse, because such constructions unnecessarily *foreground* manner, given that their language selects state changes as the main information focus and provides no compact construction that allows joint attention to state changes and to manner. Hickmann's study (in Part III) provides developmental evidence for this claim, showing that adults and children frequently express both path and manner in English, but only path in French. As a result of verb- vs. satellite-framing, speakers also organize their discourse in very different ways, compactly expressing information within utterances in English, but distributing it across several utterances in French, particularly at young ages. Finally, in addition to these strong cross-linguistic differences, particular discourse factors (such as presuppositions, contrastive contexts, world knowledge of particular event properties) influence discourse organization in both languages by inviting speakers to express or to ignore the manner of motion.

As will be discussed at length below (in relation to Part III), it is at this point worth noting a general problem that concerns the precise nature of language effects on cognition and the ways in which such effects can be demonstrated. For example, when speakers' internal representations are inferred on the basis of their productions, it is somewhat circular to argue - in the absence of any independent evidence - that these behaviours reflect different modes of cognitive organization. In this respect, some recent views propose that linguistic mediation should be particularly efficient in situations that require organizing the flow of information in discourse for communicative purposes. Depending on the authors, this organizational

process is said to be universal or to vary (partially or even substantially) as a function of language-specific properties from the youngest age onwards, despite developmental progressions that can be observed in all languages. It is also shown to remain intact or to break down in various pathologies, in addition to other deficits that may be otherwise observed.

Finally, in sharp contrast with all of these views, Cadiot et al. argue that the various theoretical frameworks that underlie such analyses are insufficient to account for the ways in which language intertwines spatial and other values that arise from our experience during the construction of meaning. In particular, they argue against the predominant view in cognitive linguistics that space should be reduced to topological properties and provide the basis from which all other values should be derived. In order to illustrate the problems that arise in such a framework, they argue against the validity of the typological distinction between verb- and satellite-framing by analyzing a number of French path-verbs (*partir* ‘to leave’, *sortir* ‘to exit’, *monter* ‘to go up’). This analysis shows the numerous dimensions that are involved in contextualized verbal uses, such as mechanicity and correct functioning in the case of *marcher* ‘to walk’ (cf. 1), or surprise and non-control in the case of *tomber* ‘to fall’ (cf. 2), as illustrated in examples such as: (1) *Le moteur marche* (‘The engine is running’), *Ca marche bien, ton affaire ?* (‘Is your business going well?’), *Il nous a fait marcher !* (‘He put us on!’); (2) *tomber dans les pommes* (‘to pass out’), *tomber amoureux* (‘to fall in love’). Such uses, they argue, cannot be accounted for in the currently available frameworks of cognitive linguistics, except by postulating secondary processes of deriving “metaphorical” meanings in various artificial and counter-productive ways, that do not capture the very nature of language and of experience in context. In contrast, Cadiot *et al.* defend a holistic view of semantics and of perceptive experience. In line with phenomenology and *Gestalt* theory, they claim that perception is a dynamic field of experience involving not only spatial perception but also dimensions pertaining to action (such as manner, gesture or attitude) and qualitative evaluation (such as surprise, telicity, intentionality, anticipation). These “praxeologic” and subjective dimensions of perception are also present in the core semantics of motion verbs but activated to different degrees as a function of the situation and discourse context, as is also the case for the spatial value of these terms.

5. Part III: Space, language, and cognition

The systematic cross-linguistic study of space raises central questions concerning the relation between language and cognition. Although this fundamental question is not specific to space (see similar issues in other domains, for example in Gentner and Goldin-Meadow 2003; Gumperz and Levinson 1996; Lucy 1992; Nuyts and Pederson 1997), it has been particularly debated in relation to this domain across all disciplines among the cognitive sciences. As we saw, much research in linguistics and anthropology has been devoted to uncovering and interpreting universal and

language-specific properties of spatial language, the implications of which have led to a renewed attention for the relation between language and cognition. Recent research in neurosciences has been also concerned with determining the neural substrate underlying spatial behaviour, leading some to postulate the existence of two distinct anatomical systems in the brain (*what/where*-systems) devoted to cognitive functions centered on the recognition of objects or on their localization in space (see Jackendoff 1996; Landau and Jackendoff 1993). Finally, space has always been at the center of much research in developmental psychology, constituting even one of the building blocks for cognitive development in Piagetian theory (Piaget and Inhelder 1947). From this point of view, cognition emerges from early sensori-motor schemata during ontogenesis (e.g., displacements in space, object manipulation), following a sequence of general and universal stages.

The special status of space in this respect may reside in the fact that it is one of the most basic domains of behaviour, which is essential for survival in all species, but also a domain that displays considerable and striking variations across spatial systems in human languages. In the face of such linguistic diversity, a number of major questions must be addressed on the basis of empirical evidence. As we saw, linguistic representations result from particular spatial systems that display very different types of internal organization. However, general perceptual or cognitive processes contributing to how we construct spatial representations have been traditionally assumed to be universal and independent of language. How autonomous or intimately related are our linguistic and non-linguistic representations of space? Do these two forms of representation necessarily interact in everyday processing? Does one derive from the other ontogenetically and, if so, through what developmental processes?

Different answers to these questions have been proposed. In particular, a major debate opposes two contrasted views, although variants of each position and intermediate views between these two extremes are also available. The first position assumes that linguistic and non linguistic representations are entirely independent from one another and that they do not interact in any substantial way. In this view, the fact that these two types of representations may have similar structures would merely result from functional requirements of spatial behaviour. In sharp contrast, it has also been proposed that spatial language and other forms of spatial cognition are intimately related and that they fully interact with one another. A further variant of this position, which is thoroughly discussed in this volume, postulates that our linguistic spatial representations partially structure our non linguistic representations and that they do so in variable ways across systems.

More generally, developmental research shows the existence of some universal perceptual and cognitive constraints, as well as the impact of general and language-specific properties on the development of human cognition. With respect to cognitive constraints, a growing number of

results shows that infants display numerous capacities from a few days or months onwards in a variety of knowledge domains. However, the relation between this precocious knowledge and subsequent development after the emergence of language still remains entirely mysterious. Depending on the theoretical framework that is adopted, the child's "initial state" at birth comprises some innate "core" knowledge (Spelke 2003) and/or a strong propensity to discover perceptual invariants (Mandler 1998), either of which (or both) might constitute the first universal foundation of cognition. In either case, it is assumed that the child's task is to match his/her initial representations (or at least some of them) with the ones that are provided by language. In turn, language implies a new representational format that allows abstraction and/or interconnections among knowledge components during later development.

A very different approach puts forth the idea that language structures cognition itself. One version of this approach is best represented by Vygotsky's writings during the twentieth century (Vygotsky 1962; also see revivals in Hickmann 1987; Wertsch 1991), but also by more recent developmental research addressing related issues in a new light (for example, Gentner 2003). It proposes that human language provides a semiotic medium that has a major implications for ontogenetic and phylogenetic development. Thus, during ontogenesis language invites the child to construct new forms of cognitive organization, though some of its general properties, such as its multifunctionality, the propositional and temporal constraints it imposes on information processing, its meta-semiotic or self-reflexive capacity, and the potential it offers the child to extract invariants and to construct concepts through particular forms of reasoning.

A second version, most known through the writings of Whorf (1956) but recently revived by neo-whorfian approaches (Bowerman and Choi 2003; Gumperz and Levinson 1996; Lucy 1992; Nuyts and Pederson 1997; Slobin 2003), goes further by postulating that language-specific properties also result in a partial transformation of our representations, thereby leading to particular patterns of behaviour during language acquisition (its rhythm, its course) and in cognitive organization itself. As can be well illustrated in the domain of space, these new approaches suggest that languages "filter" and "channel" the flow of information by biasing the salience of some informational components, bringing the child to focus his/her attention on some aspects of reality, which then become cognitively more available and accessible. Language thereby invites the child to construct a particular system of categories (Bowerman and Choi 2003) and to follow a particular "mold" when organizing information in discourse (*thinking for speaking*, Slobin 1996).

Opponents (e.g., Jackendoff 1996; Landau and Jackendoff 1993; Landau 2003; Clark 2003) reject this approach on several grounds, highlighting especially the problem of circularity in empirical attempts to demonstrate the impact of language on cognition merely on the basis of data concerning

language use. Although some admit that language-specific properties (or at least some of them, such as obligatory markings) might influence our language behaviors, they argue against the idea that such properties can influence our representations beyond language itself and that our variable language behaviors should reflect variable modes of cognitive organization. The crucial point of disagreement, then, revolves around the impact of language on non-linguistic representations. This question constitutes perhaps the most difficult challenge for future research in psychology, that will have to address at least two of its facets: To what degree is the fully developed cognitive system of adults affected by the properties of their mother tongue? When and how do children's initial representations "connect" with their later representations during ontogenesis?

These different issues are discussed at length in this volume. First, from a typological point of view, Talmy's analysis (in Part II) of substantial differences between spoken and signed languages leads him to challenge Fodor-Chomsky's model, according to which there would be a special language module or "linguistic organ" in our brain. He admits the existence of a "core" language system, that would be responsible for common properties of spoken and signed languages. However, he argues that this system is more limited in scope than the one proposed by Fodor and Chomsky, and that it further connects with different systems responsible for properties that are specific to signed vs. spoken languages. With respect to signed languages, this system would connect with particular parts of the neural system that are responsible for visual perception, accounting for finer granularity, iconicity, gradience, and aperture limitations. With respect to spoken languages, it would connect with neural systems responsible for particular properties, such as the packaging of spatial elements into a stable closed set of patterned combinations, as well a system for generalizing or deforming these packets.

Second, from a philosophical epistemological perspective, Dokic and Pacherie challenge Levinson's neo-Whorfian claim that the (egocentric, absolute, or relative) frame of reference that is dominant in a given language should infiltrate spatial representations in non-linguistic modalities. Admitting the fact that languages need not adopt a relative or egocentric frame of reference, they critically discuss the further assumption that one and the same frame should coordinate language and perception. Their first step is to argue against the assumption that frames of reference are necessary at the most basic level of perception and that this assumption leads to a logical flaw or infinite regress. According to this analysis, geometrical properties of objects can be perceptually encoded independently of intrinsic frames of reference, for example perceiving a bottle in front of a chair is tantamount to perceiving it near a particular (front) side of the chair. Similarly, with respect to absolute frames, the perceptual identification of directions across contexts presupposes their non-absolute identification

within a given context, for instance using demonstratives (*this direction*). Finally, perception need not use relative frames in order to *distinguish* directions in the perceptual scene (left/right vs. right/left), since the relevant distinction can be drawn in each perceptual context by demonstrative means (*from here to there*).

Furthermore, relative frames of reference can be *implicit* in perception. Our perception of spatial entities exploits our situation relative to them, which need not be represented as such. Whereas a relative frame of reference in language implies the explicit representation of relations among referent, relatum, and point of view, such a frame is necessarily implicit (not explicitly represented) in perception. Implicit frames can explain information transfer across modalities without any appeal to additional assumptions. Thus, it is not necessary to assume that the target state can only exploit explicit representations in the source state, since relevant information can be implicitly nested in or associated with the source state. When we perceive a bottle next to a chair, we need not perceptually represent the bottle and the chair *as* bearing different spatial relations to parts of my body. Spatial information can be carried over, even though it is not perceptually represented, thereby producing perspective-bound representations, despite the fact that explicit representations may be incompatible. Dokic and Pacherie conclude that frames of reference best characterize high levels of cognitive processing, whereas perception may be perspective-free at the most basic level.

Third, two papers (Landau and Lakusta, Denis et al.) partially support the same view, arguing for the relative autonomy of language-based and other behaviours, on the basis of empirical evidence from pathologies (Williams syndrome, Alzheimer) showing dissociations – and therefore some independence – between linguistic and cognitive representations. Thus, patients with Williams syndrome (WS) have been classically described as showing a dissociation between linguistic and non-linguistic spatial knowledge, since they seem to suffer from severe non-linguistic spatial impairments, while displaying relatively spared language. Landau and Lakusta ask to what degree and in what way spatial language depends on non-linguistic spatial representation or can emerge autonomously. More specifically, they examine whether spatial language is necessarily affected when one or more aspects of non-linguistic spatial representation is impaired.

They first note that these questions have not been convincingly resolved in the available literature, since the only available evidence for a deficit in spatial language among WS speakers is far from conclusive. Although this evidence seems to point to a common general deficit in language use and in non-verbal behaviours, which would support the hypothesis of a relation between linguistic and non-linguistic spatial knowledge, it does not allow us to distinguish among many different mechanisms that may cause apparent linguistic deficits. They then present further evidence from two studies

concerning how WS speakers represent motion events and static location.

First, when WS subjects describe voluntary motion that is carried out in different manners (e.g., fly, slide, jump) and over different paths (FROM, TO, VIA), their responses show that the structure of their spatial language is preserved overall and that they only differ from matched controls in the frequency with which they express source information (“Source Vulnerability”). Source vulnerability, however, seems to be a general characteristic of cognitive architecture, also applying to normal populations (adult and children), who prefer to mention goals over sources.

Second, static location was examined in three tasks. A non-linguistic task required subjects to judge whether an array was the same as a target array after small changes in the original location of an entity (on or off the extension of a square’s axis for the relations *above*, *below*, *left*, and *right*). In a language production task they had to complete sentences of the form “The circle is [where?] to the square” in order specify the location of a target entity by (which also fell on or off the extension of the square’s axis for the same relations). A language comprehension task examined their responses to requests of the form ‘Put a dot... to the square’ (in which 14 different spatial terms were inserted). The non-linguistic task shows that WS and control subjects both perform better with on-axis than with off-axis locations, suggesting that they can impose mental axes on the reference entity. In both linguistic tasks WS and control children respect cardinal axes (*above/below* or *over/under* and *next to* or *beside*) and neither population correctly produced or comprehended horizontal directional terms (*right/left*). However, errors in direction on the vertical axis were more frequent among WS children than among controls (misusing/misinterpreting vertical positives for vertical negatives, e.g., *above*, *over* instead of *below*, *under*). This directional fragility in the WS population seems to reflect other deficits in their non-linguistic representations.

Landau and Lakusta’s conclusion highlights the fact that our view about the relation between language and cognition largely depends on “where we look”. They propose a complex two-fold answer to their initial questions. Spatial language emerges with normal structure, despite the presence of other impairments, if we look at performance in tasks where language can only encode the spatial world in a coarse manner. However, linguistic impairments echo non-linguistic deficits if we look at tasks where spatial language encodes the spatial world in a fine-grained manner.

Similarly, Denis et al. examine spatial discourse in Alzheimer patients, who are known to present impairments in their ability to navigate in space. Their main aim is to determine the nature of these patients’ difficulties, and more specifically to disentangle different cognitive components in their ability to generate spatial discourse. In order to do so, they compare the verbal performance of patients and of control subjects across three complementary studies involving spatial tasks that placed different demands on them. In the first study, the participants were asked to provide oral route directions in a

familiar urban environment. In the second they were invited to describe familiar environments from memory, but without any request to transform their knowledge into navigational instructions, while the third study allowed them to rely on a map when generating their spatial discourse.

The patients' route directions in the first study contained far less relevant spatial information than that of control participants, providing in particular virtually no reorienting instructions locations that could guide a moving person's displacements. Although the second study did not require navigational instructions, their descriptions also provided less information than those of the controls. Furthermore, they also produced substantially more modalizing expressions, suggesting that visuo-spatial knowledge was less accessible to them (e.g., *I don't know very well, I can't remember the name of that street, It is quite difficult to explain*). However, their deficit in generating spatial discourse virtually disappeared in the third study, where they were allowed to use maps. For example, like controls, they were sensitive to the relative relevance of actions vs. landmarks in different segments of their descriptions. Thus, their main difficulty in generating route directions stems from their difficulty in retrieving spatial information, rather than from any underlying (purely) linguistic disturbance.

With respect to the discourse issues discussed above (in relation to part II), note that the patients' verbal performance in the first two studies seem to indicate that they may also have had some difficulties in organizing spatial information in discourse. As noted by the authors, these patients' spatial discourse not only contain less relevant referential content, but it is also less coherent. For example, it frequently consists of a series of successive statements providing unrelated spots with little information about the surroundings or about relevant actions and they infrequently position landmarks relative to each other or relative to the observer.

Finally, some chapters propose quite a different view of the relation between spatial language and spatial cognition on the basis of cross-linguistic developmental evidence. These chapters examine the linguistic and cognitive factors determining how children acquire spatial language across typologically different systems, suggesting that acquiring different languages implies acquiring different forms of cognitive organization. As noted above (in relation to Part I), Slobin proposes that typological properties of languages determine how speakers talk about space, leading them to pay more or less attention to the manner of motion in discourse and to construct particular modes of cognitive organization. Similarly, Hickmann shows that the typological properties of French and English (as verb-framed and satellite-framed languages) strongly influence how adults and three- to five-year-old children talk about voluntary motion (upwards/downwards motion, crossing events, arrivals, departures). English speakers express path and manner in compact structures (e.g., *to run in, to run up/down, to run away*), while French speakers do so less systematically, frequently focusing on path alone (e.g., *descendre* 'to descend') or

distributing path and manner information across utterances (e.g., *elle fait du vélo [...] et elle traverse la route* ‘she is biking [...] and she crosses the road’), depending on various factors (event properties, discourse context, lexicalization patterns). These differences result from verb- vs. satellite-framing, that leads speakers to pay less attention to manner in French than in English. In particular, they partly result from different lexicalization patterns across these languages. In the controlled experimental situations examined, verbs typically encode path alone in French (*monter* ‘to ascend’, *descendre* ‘to descend’, *traverser* ‘to cross’, *arriver* ‘to arrive’, *partir* ‘to leave’), with the only exception of one common verb that describes path and manner in relation to upwards motion (*grimper* ‘to climb up’). And it is indeed with this event type that the responses of adults and of children most frequently contain both path and manner.

However, similar developmental progressions can be observed in both languages. Regardless of language, children tend to encode path alone at the youngest ages, then to increasingly encode both manner and path with age. This result reflects the impact of general cognitive factors. Encoding one information component is obviously simpler than encoding more information components from a cognitive point of view. Furthermore, when only one type of information is encoded, it is predominantly the path of motion, which is more basic than its manner, particularly with changes of locations that have implications for discourse organization. Nonetheless, dense manner+path utterances are significantly more frequent at all ages and with all event types in English than in French. Furthermore, this developmental progression is most striking in French, where speakers are increasingly able to use complex subordinate structures in order to jointly express path and manner (e.g., *Il descend/traverse en courant* ‘He descends/crosses by running’). Finally, French children display some gaps in their verbal lexicon. In particular, with crossing events, adults typically use the verb *traverser* (‘to cross’), but this verb does not seem to be part of the repertoire of young children, who focus on manner alone (*Il court* ‘He’s running’), rather than on path alone (*Il traverse* ‘He crosses’), as might have been expected on the basis of French typological properties.

Along with other developmental studies (Choi and Bowerman 1991; Slobin 2003, this volume), this research raises questions concerning universal vs. language-specific determinants of first language acquisition. Children’s language of motion seems to be language-specific, reflecting typological properties, despite similar developmental progressions across languages, that result from general cognitive determinants. From early on children construct a spatial language that tightly fits the adult system and they then further tune into this system during language and cognitive development.

Finally, Cadiot et al.’s proposal (in Part II) is strongly opposed to all of these views. They argue for a holistic conception of both language and cognition that heavily relies on a number of fundamental principles borrowed from phenomenology and from Gestalt psychology. They object

to both a pre-built space that is independent from other dimensions of perception and the primacy of spatial meaning in the semantics of motion verbs. Language, in their view, reflects perceptual experience in which space (like time) is constantly reconstructed by the perspective of an active subject and consequently must anticipate, accompany, and record these perpetual adjustments.

6. Concluding remarks

Space has been and remains a rich source of intriguing and challenging questions for the cognitive sciences. As shown in this volume, it provides the grounds for debates concerning the existence and implications of universal and variable aspects of linguistic and cognitive systems. It furthermore highlights issues concerning the very nature of language and of cognition, which are perhaps best illustrated by one of the most central questions in the cognitive sciences, namely the relation between human linguistic and cognitive processes. Across disciplines various approaches based on complementary descriptive and experimental methods have converged or diverged with respect to these issues, reaching conclusions that have led to extremely different theoretical frameworks.

The contributions in this volume present two sorts of data. They provide general analyses of space in language, as well as specific empirical evidence showing the diversity of spatial systems across languages and during their evolution in history. They also present theoretical discussions and empirical evidence concerning human spatial behaviors, both verbal and non-verbal, their evolution in ontogenesis, and their break-down in pathology. On the one hand, some of this evidence points to the diversity of spatial systems, raising questions about some previously postulated universals of language. On the other hand, some analyses in different perspectives agree that, beyond this diversity, the data show common patterns in how human languages are organized and evolve over centuries.

These debates have two major types of implications. They first renew old questions concerning the nature of language, which has been viewed either in terms of distinct and entirely autonomous levels of organization or as an integrated semiotic system relating forms, functions, and meanings in communicative context. Such renewed questions also have implications for our understanding of cognitive processes, viewed either as entirely autonomous from linguistic processes or as intimately related to them, whether in the developed system of the adult or in the developing system of the child. Evidence from both linguistic and psycholinguistic analyses indicate that varied modes of cognitive organization are (at least partly) associated with varied modes of linguistic organization, but also that linguistic and cognitive organization may be (at least partly) dissociated, for example in the cases of speakers suffering from various pathologies.

Many empirical questions remain open and require further evidence across disciplines. Among them, future research will need to be particularly

attentive to two problems. As shown in this volume, one fundamental point of disagreement concerns the relation between our linguistic and non-linguistic representations. In this respect, the revived Whorfian hypothesis of linguistic relativity that is presently debated across the cognitive sciences needs to be tested on the basis of evidence that directly relates speakers' verbal and non-verbal behaviours in such a way as to go beyond two pitfalls: circular arguments that aim at showing the impact of language merely on the basis of language behaviours; arguments that aim at dissociating language and cognition merely on the basis of a small range of low-level perceptive processes that cannot capture the complex nature of human behaviour. Related to this point are a number of controversial questions, both theoretical and methodological, concerning how to define and capture non-linguistic representations, as well as demonstrate their linguistic mediation: Are non-linguistic representations pervasive and implicit to any behaviour? Should they be assessed in situations that are not immediately mediated by language and, if so, how? If they are linguistically mediated, what is the nature of the resulting changes? How permanent must these changes be? How central are attentional processes and do they result in different categorical systems?

A related point concerns the debated specificity of human language and cognition in relation to the systems that are found in other species. In this respect, empirical evidence from phylogenesis is necessary to provide evidence for or against the significant role of human language in shaping human-specific cognitive processes during evolution. Few answers are available and they show again the methodological and theoretical difficulties facing any attempt to specify the qualitative cognitive changes that might result from human language (see recent discussions in Gentner and Goldin-Meadow 2003). Although this volume does not directly tackle phylogenetic development, the contributions therein provide developmental (diachronic, ontogenetic) analyses concerning systemic evolution, that point to some of the directions to be pursued. For example, more evidence must come from initial phases of child development, which are typically assumed to be under major biological influences, in order to provide strong support for the views that cognition is linguistically mediated from very early on or rather that linguistic mediation is but a secondary phenomenon that characterizes only subsequent phases, without any major impact on the child's pre-existing representations.

These questions require an interdisciplinary approach that can fully spell out and empirically address the many problems that still remain to be solved. The joint interdisciplinary enterprise that is illustrated in this volume shows the invaluable merits of crossing the boundaries that have long prevented researchers from going beyond the limits of their scientific traditions in order to construct general theories of human language and cognition. Such theories must be continuously renewed and revised in the light of

theoretical, methodological, and empirical advances, that present recurrent challenges across the cognitive sciences.

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