How space gets into language: a novel approach

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Abstract

There exist several proposals regarding the relation between Cognition and Language with respect to ‘Space’, our understanding of objects and their changing position in the world. Some earlier approaches assume that Language conveys a radically impoverished amount of information than that processed at a visual level (Landau & Jackendoff, 1993). More recent approaches instead argue that ‘spatial language’ is closer in richness to ‘spatial cognition’, but do so by positing a blurrier boundary between the two levels of comprehension (Coventry & Garrod, 2004). In this paper I will offer an argument for a novel synthesis of these two positions, based on what counts as ‘spatial cognition’ and ‘spatial language’, and what core properties can be found across these two levels of information-processing. I will also propose that there is also a crucial difference between these two levels: that of fine-grainedness, namely the amount of information we wish to convey and to omit when we produce a sentence regarding objects and their position.

Keywords: Spatial Cognition; Spatial Language; syntax; semantics; Pragmatics; events; memory.

Some Linguistic Background

Our daily experience often revolves around navigating the surrounding environment, and thus processing visual information about ‘where’ things are in the world. At the same time, we can exchange this spatial information with other fellow human beings, by using sentences such as (1) and (2):

(1) The tank engine is in front of the station
(2) The tank engine is going to the station

These sentences can be understood as defining a certain set of coordinates, in which one object (the station) acts as reference point or ground, whereas a second object (the tank engine) is the located entity, or figure (Talmy 1978,2000). The tank engine’s position is then defined, in (1), as occupying a certain part of the station, its front, whereas in (2) the figure is understood to be moving, and as a consequence of this movement it will end up at the station.

From a morphological and syntactic point of view, sentences conveying spatial information can be segmented into smaller units, each with its own specific content. Specifically, nouns (e.g. ‘the tank engine’) convey information about figure and ground (i.e. ‘objects’), whereas verbs and adpositions convey spatial information, although in slightly different ways. The two adpositions ‘in front of’ and ‘to’ specifically have this function, and can be distinguished as ‘static’ and ‘dynamic’, respectively. Specifically, ‘dynamic’ adpositions capture a change of position for the figure, as opposed to ‘static’ adpositions (Cresswell, 1978; Zwarts & Winter 2000 inter alia).

One obvious aspect about these sentences is that the ‘amount’ of spatial information they convey is rather impoverished, with respect to a scene they can be a proper description of. In (1), no precise information is given about the tank engine’s distance from the station. In (2), the train will likely reach the station after moving, but nothing else is said with respect to its trajectory, for instance.

Prima facie, there seems to be a radical disparity between ‘visual’ information (as the primary source of spatial information) and which part of this information makes its way into language. Such conundrum is aptly captured by the following question (Bierwisch, 1996):

(3) ‘How Much Space gets into Language?’

There exist at least two lines of thought regarding which is the most appropriate answer, one based on the notion of ‘space’ as a purely geometric one, and another based on a ‘richer’ notion of space. I will review two particularly relevant proposals, as an illustration of these two different, but not necessarily opposed strands of research.

Precedent Proposals

The first approach is represented by Landau & Jackendoff (1993) (henceforth: L&J), and takes a geometric tack to the problem, as well as approaching linguistic matters in a rather fine-grained way. L&J assume that at a linguistic level, nouns convey information about objects, acting as linguistic ‘labels’ for the object’s geometrical structure or shape. L&J also assume that adpositions are the chief part of speech that captures spatial information, and that they

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1 Throughout this paper, I will follow the convention found in Linguistic literature of numbering linguistic examples, and place them in centered position.

2 More common labels in the literature are ‘locative’ for static adpositions, and ‘directional’ for dynamic ones. I introduce these novel labels to highlight the ‘temporal’ dimension of adpositions’ meaning.

3 Although the underlying assumptions are quite different, the framework of ‘Vector Grammar’ also proposes that adpositions convey a substantially geometric type of information, which can be represented via ‘vectors’ (O’Keefe 1996;2003).

4 Note here that ‘adpositions’ can be further distinguished in adpositions proper (e.g. ‘in’, ‘at’), verb prefixes (e.g. ‘in-sert’), verb particles (e.g. ‘come in’), or case markers for languages.
only convey basic ‘geometrical’ information, such as (topological) inclusion or the lack thereof (cf. ‘in’ vs. ‘out’), and orientation (e.g. ‘in front of’).

Their analysis does not extend to ‘dynamic’ adpositions, but has the advantage of defining a clear mapping from pre-linguistic information to linguistic discrete units (nouns and adpositions). It also has problems in accounting for certain patterns of linguistic data, such as:

(4) The hand is in the glove
(5) The tank engine is at the station

In (4), we understand that the hand is sharing some region of space with the glove, but also that if the hand grabs something, the glove will also be involved in this ‘mechanical’ task. In (5), we instead understand that the tank engine may be actually located in front of the station, or behind it, or perhaps inside the station: beside a spatial relation of proximity between figure and ground, not much else is said about their exact geometrical or causal configuration.

Several other cases can be put forward, and have been considered as evidence that ‘mechanical’ and ‘functional’ aspects play a role in the meaning of adpositions in the literature (Talmy, 1988; Landau et al. 1998; Feist & Gentner 2003, inter alia). The intuition should be however simple: there is more than just ‘geometry’ behind adpositions’ meanings.

For this reason, a broader and perhaps more abstract conception of space has been introduced in the ‘Functional-Geometric framework’ of Coventry & Garrod (2004) (henceforth: FGF). In this theory there exists a distinction between ‘ideal’ meaning, the complete lexical entry we may associate to an adposition, and ‘actual’ meaning, which partial meaning we use and its relation with the extra-linguistic context.

An ideal meaning is furthermore ‘stratified’, so that ‘geometric’ information is the most basic level of information, on top of which ‘mechanical’ and ‘functional’ information is then stacked. FGF, however, takes a ‘holistic’ approach on parts of speech and their content: sentences as ‘whole’ are assumed to convey spatial information. Furthermore, they do not cover ‘dynamic’ adpositions, much like L&J.

Summing up, both theories lack a complete coverage of data (no analysis of dynamic adpositions), but offer a good analysis of some aspects: from L&J we have a good understanding of the mapping from ‘cognitive’ to ‘language’ units, from FGF a fine-grained analysis of the content of these units.

Ideally, a synthesis of these aspects can be simply obtained by merging the good and useful parts of these analyses into one proposal, further enriched with a theoretical treatment of dynamic adpositions and their content. In such a way, it should be ideally possible to obtain a simple and yet theoretically sound answer to Bierwisch’s question. In short, we can have a novel theory about ‘space’ which is able to cover more facts, and at the same time incorporate ‘old’ explanations.

I shall propose such a synthesis by first focusing on spatial cognition, attempting to define its ‘basic ingredients’ and the relevant notions for our topic.

**Theories of object recognition**

At an intuitive and pre-theoretic level, spatial cognition is about how we ‘find’ objects in the world, or how we can process information about them. Hence, the most basic level of comprehension is that of object recognition, how we can recognize objects in the first place. For the sake of clarity, I shall distinguish between ‘static’ and ‘dynamic’ theories of object recognition, respectively theories of the recognition of non-moving and moving objects. Within ‘static’ theories, I will present some more ‘representational’ set of theories and compare them with a ‘derivational’ theory.

My starting point is the theory of object recognition found in Marr (1982)’s model of Vision, since it introduces many basic notions regarding object recognition. Marr assumes that the process by which we come to recognize objects goes through three steps or sequential ‘sketches’: the primal sketch, the 2½ D sketch and the 3D sketch, which act as level of representation.

At the level of the primal sketch, basic information about e.g. edges and contours of a human body is extracted. At the level of the 2½ D sketch, this information is integrated into a level of representation of bi-dimensional surfaces, their orientation and texture. At the level of the 3D sketch, we obtain a complete representation of an object, obtained by integrating all the bi-dimensional aspects into a coherent, three-dimensional whole. Sketches are computed in a rigid order, so if no primal sketch can be computed for an object, the process will halt (no 2½ D or 3D sketches). If we cannot detect the surfaces of a hand, we will not obtain the full 3D sketch of this hand.

One important notion emerging from this model is that of *parthood*, the relation between a whole and its parts. Sketches are organized so that each level of representation is part of the next level of representation: information about the human body and its ‘surfaces’ are preserved

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5 The topic of representations and, to a lesser extent, derivations has a long history in cognitive science. In simple words, representational theories assume that information is overtly represented in form of ‘mental objects’ or ‘states’, possibly as the result of some process. Derivational theories do away with such objects, and place a greater emphasis on the processes themselves. There needs not to be an opposition between the two approaches, as I will show throughout the paper.

6 A more technical label found in the Logic literature is that of ‘mereology’, but in this paper I will use this more intuitive and pre-theoretic label.
when we obtain information about the fully human body. At a parallel level of comprehension, a hand can be represented as an object in its own right (i.e. it has its own 3D sketch), but also as part of the body’s 3D sketch.

After Marr’s seminal work, there have been different proposals attempting to improve on his original insights. A popular representational model is that known as Recognition By Components (henceforth: RBC, Biederman, 1987; Hummel & Biederman, 1992).

RBC differs from Marr’s theory on a number of details. First, it postulates a richer set of sketches before a full ‘object’ can be represented. Second, it does away with a final 3D sketch: an object is considered as the successful integration of many 2½ sketches into a ‘single’ value or index, rather than a distinct level by itself. The third and most important difference is that there is a basic library of (36) shapes acting as ur-elements or geons, which can be combined into more complex shapes.

Geons exhaustively represent the possible combinations between more basic properties and their values, such as symmetry or curvedness. Since a geometric shape can be curved or not, and symmetric or not, there can be at least four possible combinations of these binary values, which in turn can be combined with other properties.

RBC also maintains the relevance of the parthood relation, and the sequential nature of the representational process: objects represented as complex geons can be defined in terms of what more basic geons is part of their representation, and no proper representation can hold at a given level if prior representations fail to be computed.

It further introduces the notion of dynamic binding. Dynamic binding amounts to how different levels and units of information are integrated over time into a coherent representation. If we process information about edges at a first level of representation and at an interval time t (or the first interval), the integration of this information into the subsequent level of representation (e.g. surfaces) will occur at the subsequent interval t+1 (e.g. the second interval). If we have n levels of representation (e.g. seven levels), the complete integration process would be completed at the interval t+n (the seventh interval).

These two principles, and their interaction, define a rather sophisticated theory of object recognition, which however crucially hinges on postulating a certain sequence of representational steps, before we can effectively recognize objects as such. A derivational theory which does away with ‘static’ levels of representation is instead H-MAX, short for ‘hierarchical MAXimization’ (Poggio & Edelman, 1990; Riesenhuber & Poggio 2002, inter alia).

In H-MAX, there are no levels of interpretation, and every single ‘visual entity’ is considered an object: there is no conceptual difference between a hand, a finger and a body. However, several possible values can be entertained for a single object (e.g. a hand), as possible perspectives under which we can index the same object. Such inputs can be then ‘modeled’ via two basic operations: SUM and MAX.

The SUM operation consists in the summing of different inputs into a single value (e.g. ‘a+b+c=d’). In this way, we intuitively have an ‘averaged value’ when several inputs are equally good candidates.

The MAX operation, on the other hand, operates in an ‘eliminative’ way, by selecting the most likely visual candidate as the proper output of a computation, discarding the less relevant candidates. If ‘a’ is the best candidate, ‘b’ and ‘c’ will disappear from the remainder of the computation.

SUM and MAX are thus operations that allow the ‘modeling’ of the flow of information, so that at any ‘interval’ in a derivational history we obtain an object. At the same time, the relation between derivational cycles and the objects they compute also allows us to define how different objects are organized into a hierarchical structure.

A hand as well as the tip of a finger can be represented as distinct objects, but since a tip of a finger will be computed at earlier step of the derivational process, it can be defined as part of its corresponding hand, itself a (complex) object. As in RBC, these bits of information are dynamically bound together, i.e. they are integrated over time and the unfolding of the process.

Differences aside, both theories place great emphasis on parthood, and how this relation acts as a powerful hierarchial principle of organization. One missing aspect in both theories, however, is how objecthood is preserved in dynamic situations or, simply put, how we ‘find’ moving objects.

One theory can help us in covering this conceptual hole, Multiple Object Tracking (henceforth: MOT) Pylyshyn, 1989;2004)7. In MOT, an ‘object’ is any entity which is perceived as instantiating some conceptual property. For instance, a red ball can be perceived and tracked as a unique object, since it instantiates the properties ‘red’ and ‘ball’. ‘Physical’ properties can also be combined with less concrete properties: we can track an object of dubious shape, if for instance we can conceptualize it as having the function of a ‘box’.

Properties thus act as ‘virtual’ fingers pointing at some object, or Fingers of INSTantiation (henceforth: FINSTs). They allow us to focus our attention on an object out of a visual context, and can be dynamically bound together. Although we are unconsciously aware of the color of an object (e.g. a yellow table) as soon as we look up at a scene, we use this property when we will need to identify such an object.

For instance, we can identify some object via the FINST ‘table’ at some interval of time, and then dynamically bind the FINST ‘yellow’ on this earlier

7 Interestingly, there is a certain paucity of theories of ‘objects in motion’, most theories being derivational in nature. Some interesting exceptions can be found in the literature (i.e. Ullmann, 1979;1996).
FINST. If we move the table to the left of the sofa, the more complex FINST ‘left-of-sofa’ will become active, while the FINST ‘table’ will allow us to keep track of the table during the ‘event’ of motion, since it preserves its objecthood.

Much like RBC and H-MAX, MOT also assumes that parthood acts as a driving principle of visual organization. A first object can be defined as part of a second object, so that when one FINST can be defined to track the ‘whole’, then it can be used to track a part too. If an entire ‘table’ is also ‘red’, then its single part (e.g. a ‘leg’ part) can also be identified as being ‘red’.

At this point we possibly have a more throughout picture of object recognition and, in general, how we point at objects in the world, whether they are moving or not. Two basic principles of organization also emerge as conceptually necessary: that of parthood and that of dynamic binding. The former allows us to record structural relations between objects and the properties they instantiate, the latter to integrate properties as they occur over time.

Consequently, a more complex level of comprehension emerges, in which properties (FINSTs) themselves are organized into conceptual structures, and which will be the topic of the next section.

Theories Of Events

The principle of dynamic binding suggests that properties are treated as unique and distinct ‘objects’ in a computation, at some level of understanding. One distinction is between properties that hold over time and properties that represent ‘change’: if we move a table, the table will be ‘moving’ for a while, but it will still be a ‘table’ before and after this movement. A common practice is to label stable properties as ‘states’, changing properties as ‘events’ (Pylyshyn, 1984; inter alia).

The notions of state and event are often used in a rather pre-theoretic form in cognitive science, and only recently a proposal has been made to fixate such concepts, which is the framework of Event Segmentation Theory (henceforth: EST, Zacks et al. 2001a;2007, 2008).

EST is based on the idea of mental ‘events’ being no more than ‘dynamic’ realizations of objects over time, a concept rooted in Quine’s philosophy (Quine, 1960). The basic idea is that events and states are ‘conceptual projections’ of objects, similarly to FINSTs in MOT. EST is thus organized along the following theoretical principles.

Objects per se can be understood in terms of partonomy (our parthood) and taxonomy, the relation between an object (e.g. a chair) and the abstract ‘kind’ it belongs to (e.g. supporting objects). As dynamic entities or events, they are subject to unitization: if an event of sneezing occurs, we recognize it as one or we don’t.

Events can be simple or complex: if we observe a woman stacking pillows on the bed, we will be aware of the single pillow-stacking events or those of pillow-grabbing, as well as of the ‘global’ event of pillow-stacking.

Events can also be old or new: we will maintain the representation of an event of pillow-stacking until it will hold, and once our woman moves to take another pillow, we will update the (now) old event of ‘pillow-stacking’ event with the ‘pillow-grabbing’ one.

Within the emerging structure of a complex event, some ‘smaller’ events play a special role: when our woman places a pillow on the bed, and moves to grab another pillow, neither the old nor the new event will hold, and this ‘event of change’ will act as a boundary event between old and new information.

Obviously, in some cases boundary events represent more than ‘simple’ change: if we observe a boy smashing a glass on the floor, we will not expect the ‘broken-glass’ event to be realized, if some preliminary change does not occur.

Complex events and their inner structure, in terms of precedence/causality relations, constitute event models (also Johnson-Laird, 1983). Event models, in turn, instantiate event schemata, abstract (event) structures composed of complex sequences of events and the prototypical functions or roles objects discharge in them, e.g. our boy being the ‘agent’ in the smashing event-sequence.

If event schemata can be seen as complex entities record in long-term memory, event models are their instantiations in short-term/working memory, and are connected in a relation akin to that of taxonomy.

The picture emerging from EST is that events can be seen as defining most, if not all, of the ‘higher order’ properties of objects proper, including their spatial-temporal location. Although in EST parthood/partonomy is defined as having a more restricted domain of application, the other structural relations are similar enough to consider EST as offering a case in favour of parthood as a central principle of events and their conceptual organization.

Let us now take some stock, before having a second look at language. One simple observation is dynamic binding and parthood, emerge as central notions in all of the theories we have seen, beyond the domain of ‘pure’ object recognition.

This should not be surprising, as they represent two very basic forms of organization that can be seen to be necessary for any information-processing ‘device’: the ability to integrate different types of information about an object over time, and the ability to organize different

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8 We actually have seen that at least some types of information (color of objects, like ‘red’) become a different part of speech in a language like English, that of adjectives. Here matters become complex from both a language- and cognitive-bound perspective, especially once we move across languages. I shall refer the reader to Stassen (1997), Kay (1999) and references therein.
levels of comprehension into a coherent hierarchical structure.

Another simple observation is that we can conceptually integrate insights about object recognition as themselves part of a broader theory of events, as it is implicit in EST somehow. I will not attempt to do so within the limited space of this paper. I will just observe that such a theoretical task would not be impossible on conceptual grounds: at least dynamic binding and parthood emerge as general properties of spatial cognition and its ‘sub-modules’. Thus, the notions of space and time emerge as a set of perspectives by which we can identify objects and their parts, in a sense locating them in our conceptual maps and their temporary realizations. Informally, as long as it is possible to define a property that individuates an object, then it is possible to find its ‘place’ for that object in our mental maps, regardless of the property’s precise nature. With this snapshot of spatial cognition in mind, I shall turn back to language, and analyse ‘how much’ space we can find in Language.

**Theories Of Spatial Language**

In the first section I have introduced some basic notions on adpositions and their spatial meaning. I have also shown that a ‘temporal’ or more precisely causal level of understanding is necessary for the analysis of dynamic adpositions. Precedent proposals in the linguistic literature do not necessarily converge to these conclusions, so I should review some of them first.

Certain proposals contend that adpositions mostly express geometrical relations, namely inclusion and orientation (Jackendoff 1983,1990). Some proposals have been offered to capture this idea in model-theoretic terms (Cresswell 1978; Wunderlich 1991; Nam 1995; Zwarts & Winter 2000; Kracht 2002).

In some proposals (e.g. Nam and Kracht’s), the parthood relation is the chief principle used to define such geometric relations. They further assume objects/individuals and ‘regions’, as primitive entities, the latter a sub-type of states/events. Static adpositions such as ‘in’ and ‘on top of’, then, capture a parthood relation between these states, further restricted to one specific sub-type.

For ‘in’, we intuitively have one special case, in which two objects roughly share the same state at a certain interval of time, that of being located in the same portion of space. For ‘on top of’, instead, we intuitively first define a certain region as being the top, external part of a ground, with the figure also being located in this region. Note, though, that the figure is not effectively located in a ‘real’ portion of the ground, but ‘fills’ a region of space which is defined with respect to it.

As it should be obvious, most of the theories are basically ‘geometric-bound’ in their nature, and little has been said about other aspects of adpositions’ meaning. The relevance of other aspects is somewhat acknowledged, especially in cross-linguistic studies (Levinson & Meira, 2003). It does not however find its way in a full theory of adpositions (aside Talmy 1988; Jackendoff, 1993, Zwarts (2007), *inter alia*).

Another strand of research, that of ‘event semantics’, has instead investigated the role of adpositions and how they introduce relations between individuals and ‘eventualities’, events and states expressed by a sentence (Davidson, 1967; recently Parsons 1990; Landman 2000,2004; Pietroski 2005; Ramchand 2008; *inter alia*).

In a semi-formal rendition of first order predicate logic, an adposition like ‘in’ is a ternary relation between figure, ground and the event in which they partake. If Alex is buttering a toast in the kitchen, the logical translation of ‘in the kitchen’ will roughly correspond to:

\[ (6) \exists e [\text{in}(\text{kitchen}, \text{Alex}, e)] \]

In words, ‘there is at least one event in which Alex is in the kitchen’.

Nothing else is said, however, about the exact nature of the relation that ‘in’ should stand for, so that there would not be any difference if we were to substitute ‘in’ with any other adposition, in the formula. Certain works study in detail how adpositions capture the internal structure of event ‘structures’ or models, but without connecting spatial and temporal/causal topics (Krätzer 2000;2003; Rothstein 2004; Zwartz 2005; Winter 2006; *inter alia*).

An exception is Parsons (1990), which suggests that adpositions have both a spatial and ‘causal’ level of meaning, as they express temporal relations between events and states. In this theory dynamic adpositions introduce a relation between an event with its antecedent or consequent state, while static adpositions do not introduce any events, only states holding over time.

The intuition behind Parsons’ proposal can be captured in semi-formal terms (and with some simplifications), in the following way:

\[ (7) \alpha'(l,s,t) \rightarrow \alpha'(l,s,t+n) \]
\[ (8) \bar{t}'(l,e,t) \rightarrow \bar{t}'(l,s,t+n) \]

The formula in (7) says that if a state s of being ‘at’ some location / holds at a certain interval \( t \), then the same state will hold at any sub-sequent interval of time \( t+n \). In (8)

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9 Note that these works actually consider ‘regions’ or other geometric entities as distinct from events proper. This distinction is however not linguistically so solid, and can be left aside for our purposes.

10 I follow here a standard notation format and translate natural language terms into non-logical constants via the use bold characters, so that the term ‘kitchen’ is turned into the non-logical constant “kitchen”.

11 The topic of aspect and its relation to temporal expressions (‘tense’) has received much attention in the literature, and is here not crucial, so I shall refrain from going into more detail. Comrie (1976,1985) are two classic introductions on the topic. It is also common practice to differentiate between ‘dynamic’ events and other ontological primitives such as ‘states’, as kinds of ‘eventualities’. Here I will use these labels interchangeably.
we have a formula that expresses a slightly different concept, namely that an event e of going ‘to’ a certain location will be then followed, as a ‘natural’ consequence, by a state of being ‘at’ that location.

Although Parsons (1990) does not explicitly offer a theory of dynamic binding, his ideas have found an implementation in ‘dynamic’ theories of meaning (Chierchia 1995; Kamp & al, 1993; 2005, Hamm & van Lambalgen, 2004). Such a task has been realized in dynamic theories of meaning, usually labelled as dynamic semantics.

In very informal words, dynamic semantics theories assume that discourses are made of logically connected sentences, so they will express event structures which must have a certain internal cohesion, and which can be then connected together according to the same principles found at an intra-sentential level.

One such principle is dynamic binding, which in a linguistic context is roughly the possibility for sentences or smaller units to be integrated into bigger units of discourse. As different parts of speech must be coherently integrated together, their integration over time creates event structures which also express the order under which events occur, hence defining another level of ‘dynamism’, that of interpretation of sentences.

At this point, we have all the basic ‘ingredients’ and also motivations for the proposal of a new synthesis, and from this proposal, some conclusions to be made.

**A Novel Synthesis, And Some Conclusions**

The brief review of the literature I have made, although not exhaustive by any means, allows me to offer some basic considerations.

First, ‘parthood’ and ‘dynamic binding’ act as general principles underpinning our cognitive architecture, both in cognition and language computations. Similarly, we have a uniform ontology of information units, objects and events.

Second, we can maintain L&J’s basic assumption regarding parts of speech and their cognitive content: nouns stand for objects/individuals, adpositions stand for a specific relation which can be defined for two special objects, figure and ground.

Third, let the nature of this relation be abstract. It captures the relation between the states and events that a sentence conveys information about, and which can have at least two relevant coordinates, spatial and temporal. We thus assume that adpositions express not just ‘where’ things are, but also ‘when’, they define an abstract order at which different ‘static’ and ‘dynamic’ properties of a

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12 The substantial similarity between inter- and intra-sentential principles can be seen via (a) and (b):

(a) Mario came in the room. He then went out.

(b) Mario came in the room and then went out

As we understand that in both sentences Mario is involved in the same order of events, and with ‘the room’ as the (same) ground.

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13 This point is often suggested, but not pushed to its ‘conceptual limit’, in some of Jackendoff’s recent work (e.g. Jackendoff, 1991; 1997), and has been suggested in some model-theoretic work as well (Fong, 1997; 2001).

14 Here the pun is cheeky but also appropriate, I believe.
It should also be possible to connect these theories with the ‘Hippocampus as a Cognitive Map’ hypothesis, which assumes that memory is akin to a ‘mental map’ in which objects are assigned a state in memory via the interaction of the ‘place’ and ‘misplace’ functions (O’Keefe & Nadel, 1978; O’Keefe, 1983;1990; Burgess, 2003). Such extensions would lend further support to my proposal, but for the moment are left as ideas for further research.

A final point is that this evidence can be seen as supporting a view in which certain properties of the mind are ‘domain-general’ (as in Fodor, 1983) although this is certainly not mandatory. As always, further research may help in testing whether the proposal I have introduced here is empirically viable or not.

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15 Note here that ‘Vector Grammar’ has been introduced by O’Keefe as a theory of spatial expressions, and is substantially a ‘linguistic’ counterpart to ‘Hippocampus as a Cognitive Map’ hypothesis.


Fong, V.(2001)."Into doing something": where is the path in event predicates?, Paths and Telicity in Event Structure (ESSLLI Workshop),Manchester.


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