

LANGUAGE AND COGNITION IN DEVELOPMENT: OLD QUESTIONS, NEW DIRECTIONS¹

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Abstract

The relation between language and cognition in child development is one of the oldest and most debated questions, which has recently come back to the forefront of several disciplines in the social sciences. The overview below examines several universalistic vs. relativistic approaches to this question, stemming both from traditional developmental theories and from more recent proposals in psycholinguistics that are illustrated by some findings concerning space in child language. Two main questions are raised for future research. First, substantial evidence is necessary concerning the potential impact of linguistic variation on cognitive development, including evidence that can provide ways of articulating precocious capacities in the pre-linguistic period and subsequent developments across a variety of child languages. Second, relating language and cognition also requires that we take into account both structural and functional determinants of child language within a model that can explain development at different levels of linguistic organization in the face of cross-linguistic diversity.

Keywords: Linguistic relativity, Child development, Structure, Function, Space.

1. Introduction

Recent developments in several cognitive sciences (anthropology, linguistics, psychology, neurosciences) have revived some old questions concerning the relation between language and cognition in child development. Two main questions, which have always been at the center of traditional developmental theories, need to be further addressed in the light of new evidence from developmental psycholinguistics: Are language and thought at all related during child development and, if so, how should we conceive of this relation? What are the implications of our views of language for how we conceive of this relation?

This paper first proposes a brief overview of several approaches to development, with particular attention to the perspectives they offer on the relation between language and cognition (Section 2). For our purposes here, three types of approaches are roughly distinguished: Innatist modularist views, according to which children's knowledge

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representations are universal, domain-specific, and mainly determined by their biological endowment; some types of constructivist views, according to which development is the result of general underlying capacities that are gradually constructed in a universal fashion; relativistic views, according to which the course of linguistic and cognitive development is tightly linked to the systemic properties of language and partially variable across languages.

These views are illustrated below with several theoretical perspectives and with available results based on studies focusing on different phases of child development, including the pre-linguistic period, the emergence of language, and subsequent developments until adulthood. Particular attention is placed on the development of spatial cognition, since this domain has been particularly rich in providing contrasting views concerning the relation between language and cognition. After a brief reminder of some differences in how languages express spatial relations and motion (Section 3), we turn to developmental studies that have examined these aspects of child language within different perspectives, concluding either that acquisition in this domain follows a universal course or that it shows different developmental patterns across languages (Section 4).

On the basis of these illustrations, several research directions are suggested (Section 5). First, more studies are necessary to articulate the perceptual and cognitive capacities displayed by children during the pre-linguistic period and during subsequent phases of development. According to universalistic views, early capacities provide necessary prerequisites for later development and strong constraints that universally determine its course independently of language. According to relativistic views, early capacities are substantially reorganized by language (or by particular languages), that affects what information is most salient or accessible to children and how they organize this information. More generally, cross-linguistic research should examine the potential impact of linguistic variation not only on the rhythm and course of language development, but also across a variety of other behavioral domains. It is also suggested that particular populations which present dissociations of various kinds might be particularly revealing in this respect. Finally, some of the research reviewed below, focusing on the impact of language on discourse organization, indicates the need to relate structural and functional determinants of language acquisition in order to provide an adequate account of the relation between language and thought within a cross-linguistic perspective.

2. Perspectives on language and cognition in development

Different perspectives concerning the relation between language and cognition during child development have been proposed. These different views vary along many dimensions, such as the following: The innateness of knowledge vs. its gradual construction by the child; the domain-specificity of knowledge representations vs. their general and connected nature; the existence of perceptual or cognitive prerequisites and determinants of language acquisition vs. the structuring role of language and of language-specific properties in cognition; the relative importance which is attributed to structure vs. function in language in different views of child language development (cf. a more detailed discussion in Hickmann, forthcoming). We briefly summarize only some of these debates here, merely to highlight the recurrence of some of these old debates in the history of developmental psychology, as

well as their renewal in current research concerning child development.

2.1. *Innateness, domain-specificity, and structure*

The first debate concerns the relative role of innate endowment vs. learning in our account of child development. With respect to language, innateness has been typically invoked as a solution to the logical problem of *learnability*, in the face of the fact that all children seem to quickly display knowledge of the rules of grammar, regardless of the wide diversity of environmental factors surrounding them and despite an imperfect and fragmentary input that cannot provide them with sufficient evidence in order to determine the properties of linguistic structure. As a result, nativist approaches, best represented by Chomsky's (1981) theory of Universal Grammar, have postulated that the grammatical structure of language is species-specific and that it must be present at birth, notwithstanding cross-linguistic variations, accounted for by the additional assumption that the child has to find the particular settings of its language along a set of universally available *parameters*.

In this view, then, infants are equipped with a brain that is entirely pre-programmed for the structure of human language. Developmental change occurring after birth is seen as involving either no learning at all or a relatively limited set of deductive processes that are assumed to be necessary and sufficient to account for the discovery of (innately available) universal structural properties of language. The most extreme nativist positions view changes in child language as directly reflecting a process of physiological maturation. Less extreme views postulate that, despite a complex biological endowment providing children with all universal properties of linguistic structure, they must nonetheless make some inferences on the basis of the linguistic input that surrounds them, particularly in order to discover the specific properties which characterize their native language (cf. Bloom 1996; Hickmann 1998a, forthcoming).

Massive learning processes, on the other hand, have been typically invoked in the face of several types of phenomena. For example, learning accounts for the existence of striking regularities in the developmental sequences that are observed after the emergence of child language. As summarized below, such gradual and late progressions, which evolve only slowly over a long stretch of time, have been attributed to a number of factors, which are either mainly endogenous or mainly exogenous in nature, depending on the model. Furthermore, as illustrated below in relation to the domain of spatial cognition, some important cross-linguistic variations are observed in these developmental patterns. These variations have been attributed to the impact of language-specific factors during the developmental process, which is assumed to occur at some point after birth, although its precise temporal locus remains to be determined. Most studies show some such impact from three years onwards, but some studies focusing on the emergence of language (from around 18 months of age onwards) suggest that it might occur much earlier.

Several types of approaches have provided accounts of how learning mechanisms drive developmental change. At one extreme, early behaviorist models have postulated that the infant is not endowed with any pre-programmed capacities and that it must therefore construct all of its knowledge representations by means of gradually more complex associations between stimuli and responses. Such an extreme view is not held as such by any reasonable current theory anymore. More recent constructivist views postulate the existence of some innate predispositions on the part of the infant to learn the rules of

language and/or to acquire knowledge in other domains. At least two such views have been proposed, cognitivist and interactionist views, which vary with respect to the learning mechanisms they postulate, partly as a function of the type of initial equipment they attribute to the infant at birth.

Cognitivist positions see language development as the consequence of more general cognitive mechanisms, which are themselves determined by biologically pre-programmed processes. Interactionist models see social-cultural factors as the most important determinants of learning mechanisms underlying all of child development, including language, cognitive, and social development. With respect to initial equipment, then, cognitivist models postulate a general cognitive capacity allowing the infant to construct a gradually more complex representation of the world as a result of underlying endogenous processes. In comparison, interactionist models equip it with an initial capacity for interpersonal interaction, allowing for complex forms of communication, which provide exogenous factors driving the child's construction of the world. In both cases, language plays an important role in providing a powerful symbolic system for the child's epistemological constructions or for its interactions with other members of its culture. As shown below, however, theories vary here in how special or crucial they consider the role of language to be and/or in the extent to which they view particular aspects of children's cognitive or communicative capacities as being pre-programmed and species-specific.

Theoretical positions concerning the relation between language and cognition also differ with respect to the relative specificity of human linguistic capacities in relation to other forms of knowledge. Most nativist models have adopted a modularist position, which conceives of human capacities as being independent from each other (Fodor 1983). Language capacities are autonomous in relation to other more general cognitive capacities and they themselves consist of different modules, each of which is relatively independent from other modules (phonology, syntax, semantics, pragmatics). In contrast, constructivist approaches have rather adopted a connectionist approach which conceives of human behaviors as belonging to complex networks, organized in a hierarchical and horizontal fashion, and assumed to reflect interconnections of neural networks (e.g., McWhinney & Bates 1989). In this view, language is linked to other cognitive capacities and its different components are linked to each other. Yet other intermediate models (Karmiloff-Smith 1987, 1992) acknowledge the modularity of the final state (adult system), but argue that children begin with general language-independent capacities and gradually evolve towards a modular system. In this type of model, then, development evolves from general to more specific and autonomous capacities. At some point during its development, the child discovers that language has particular properties and constitutes its own "problem-solving space". Nonetheless, the main developmental mechanism driving development apply to all domains of knowledge, resulting in similar developmental phases during both language and cognitive development.

The positions adopted by different models with respect to innateness are not unrelated to their particular approach to language, particularly to their differential foci on structural vs. functional properties of language. Several nativist approaches have focused on the syntactic structure of language, with the aim of accounting for our linguistic competence and for its development in children in terms of general and specific properties of grammar. In contrast, constructivist approaches have adopted different views of language, some focusing on syntactico-semantic language properties, others on functional

properties. The latter functional versions of such models conceive of language as a complex system of multiple form-functions relations that is intrinsically linked to its context of use. In this view, the child's job during language acquisition consists of determining the precise links among forms, functions, and contexts that characterize the linguistic system, thereby discovering simultaneously linguistic structure and the uses to which it is put.

Tightly related to this differential focus on structural vs. functional properties of language is the relative importance that is attributed by different theories to abstract linguistic competence vs. performance factors. Structural models typically consider that the grammatical structure of language is part of the linguistic knowledge which speakers bring to bear on any occasion of language use, constituting the stuff of their linguistic competence. The many performance factors that might influence language use are considered to be external to this basic competence, such as various difficulties linked to young children's immature cognitive system or pragmatic factors linked to the functions of linguistic devices in particular contexts of use. In contrast to such a view, functional models see performance factors as central to linguistic behavior and some even reject the distinction between competence and performance entirely, considering that performance factors constitute the core object of study in an adequate account of development.

Finally, a subsidiary question resulting from these divergent views is the extent to which language might be discovered instantaneously (or at least very early) vs. acquired during a long and gradual process, resulting in rather late developments. The nativist position predicts strikingly early developments. Child language researchers in this tradition have frequently pointed out the surprising speed with which language is acquired, from the initial phase characterized by the emergence of productive speech (at around 18 months) to a later phase (typically said to occur by five years), where children have been assumed to master language (or at least its grammatical system). Some recent research (e.g., Hirsh-Pasek & Golinkoff 1996) has aimed at showing that yet more precocious recognition or comprehension processes occur before the emergence of productive language. In contrast, other lines of research have argued that many developments occur after five years (until adolescence or adulthood). For example, these developments include the growing ability to organize utterances within discourse, implying knowledge of linguistic rules that operate beyond isolated sentences in order to allow speakers to regulate information flow in larger stretches of discourse. Whereas these developments have been typically attributed to external performance factors within the first approach, they are considered to be central to the child's linguistic competence in the second type of approach.

2.2. *Language and cognition*

Approaches to language acquisition which do assume some relation between language and cognition further vary with respect to the particular developmental mechanisms that is postulated to underlie change. Among them, three main views can be distinguished, as sketched in (1) below. Some theories view this relation in terms of general properties of language (L) and of cognition (C), either postulating an overall cognitive determination for linguistic change or, inversely, assuming that language has a structuring role in cognitive development. Yet others consider that language-specific factors affect the process of language development and perhaps even the development of cognitive organization itself.

I illustrate the first view with Piaget's theory, the second view with Vygotsky's theory, and the third view with more recent proposals in developmental psycholinguistics that have revived Whorf's hypothesis of linguistic relativity.

- (1) C → L
 L → C
 L1 → C1; L2 → C2; L3 → C3 ...

The best example of the first approach is Piaget's theory, which has been perhaps the most influential theory concerning cognitive development. Piaget conceived of human cognitive development as following a series of stages, each resulting from a major qualitative reorganization of the knowledge constructed at the previous stage: An early *sensori-motor* period, a *pre-operational* stage, a stage of *concrete operations*, and a stage of *formal operations*. This sequence of stages results from a process of *adaptation*, whereby the child constructs reality by means of two complementary processes: *Assimilation*, whereby it transforms reality according to his knowledge representations, and *accommodation*, whereby its representations are modified as a function of its interactions with the world. The interplay of these processes results in children's gradual *decentration*, enabling them to take into account several dimensions of the same objects and/or several perspectives on the same situations. Roughly, children become gradually liberated from their immediate perceptions and able to construct more abstract representations.

A classical illustration of the method used by Piaget to study problem-solving is the type of reasoning displayed by young children in *conservation* tasks. For example, the child is presented with two identical containers A and B, containing the same quantity of liquid. The liquid of B is then poured into a third container C of different height and width (therefore provoking different levels of the liquids in the two containers) and the child is asked if A and C contain the same amount of liquid. At the stage of concrete operations, children typically give a negative answer, responding that there is less liquid if the level goes down or more if it goes up. Later on, children become able to coordinate all dimensions of the problem, thus abstracting away from the visual illusion provoked by the level differences. The same process can be observed in different domains of behavior (e.g., conservation of liquid, of matter, of number), despite some temporal lags across them.

In Piaget's view, language use is no different from any type of behavior, constituting but one of the many domains of child development that are determined by the same general underlying processes. Thus, just as young children fail conservation tasks, they also display particular types of language behaviors reflecting their stage of cognitive development, using and interpreting linguistic devices in different ways during the course of development. On the basis of observations made in various types of situations (free games, explanations, narratives), Piaget (1923) interprets the child's language as being *egocentric* before becoming social. During the period of egocentric speech, children sometimes use speech to accompany their own actions, rather than towards any communicative goal in interpersonal interactions. When they do use speech to communicate with others, they have difficulties placing themselves in the perspective of others when it differs from their own.

In contrast, Vygotsky's theory (Vygotsky 1962) attributes to language use a privileged status in relation to other types of human behavior and a structuring impact on cognition. In a phylogenetic perspective, Vygotsky postulates that human language has

transformed the behavior of our species, allowing the emergence of rational thought and of complex social interaction. Similarly, from an ontogenetic point of view, the emergence of language implies a fundamental cognitive reorganization, simultaneously allowing the child to construct abstract concepts and to participate efficiently in interpersonal interaction. Vygotsky explicitly aimed at relating thinking and speaking within a functionally inclined perspective that places language at the center of cognitive and social development by attributing to it the role of providing a special type of *semiotic mediation* (cf. Wertsch 1985 for a detailed overview).

Such a view considers language as having two main interrelated functions throughout development: A representational function, essential for reasoning and for the formation of concepts, and a communicative function, essential for social interaction. During an initial phase the child has not yet differentiated these two functions and development involves a gradual process of functional differentiation resulting from the internalization of external social speech for the regulation of cognitive activity. This internalization process begins in interpersonal interaction, where children learn the regulatory function of language in a *zone of proximal development*. Egocentric speech reflects an intermediary phase in this process, whereby the child uses language to regulate its own actions.

Vygotsky's view of child development is compatible with functionalist models of language development, in that it places the inherent multifunctionality of language at the center of the child's development. In contrast, although Piaget has acknowledged the social communicative nature of language, he has almost exclusively focused on its representational function, particularly on the impact of its logical properties for the study of cognitive development. These differential foci also constitute a major point of disagreement among theories of cognitive development. Piaget places emphasis on the structural properties of rational thought, viewing these properties exclusively in terms of a global and universal logico-mathematical structure. In contrast, a number of views focus primarily on cognitive processes in relation to the context in which they occur. Perhaps the best example of this second approach is the Soviet school in psychology (cf. Wertsch 1981) that puts forth a theory of human activity in which any action, including language use in communicative situations or reasoning in problem-solving situations, is considered to be highly linked to goal-directedness, function and context.

In contrast to Piaget's view, Vygotsky's view is also compatible with a number of other hypotheses, including the hypothesis of linguistic relativity discussed in more detail below from a developmental point of view. Although Vygotsky himself did not address this question directly, focusing rather on the impact of universal functional properties of language on human behavior, revivals and extensions of his theoretical framework have begun to draw its implications for questions concerning cross-linguistic variation. For example, Lucy & Wertsch (1987) have pointed out that Vygotsky's view of child development shares many affinities with Whorf's view of the relation between language and thought in adulthood. Both saw language as providing a semiotic system simultaneously mediating human communicative and cognitive processes, Whorf from a synchronic comparative perspective, Vygotsky from a developmental perspective.

2.3. Universals and cross-linguistic variability

Whorf (1956) put forth what is known as the hypothesis of *linguistic relativity*, according to which the systemic properties of languages have an impact on human behavior. As shown by Gumperz and Levinson (1996), this hypothesis can be broken down into two premises and a conclusion. The premise of *linguistic difference* states that the semantic structures of languages present substantial differences. The premise of *linguistic determinism* goes on to posit that linguistic categorizations (whether implicit or explicit in a given language) may partially determine all types of linguistic and non-linguistic behaviors (categorization, memory, perception, reasoning). The implied conclusion is that individuals' thinking differ across linguistic communities, partially because of the properties of their native language. As shown below (from Gumperz & Levinson 1996: 25), the resulting *Whorfian syllogism* is in sharp contrast to the more commonly accepted *anti-Whorfian syllogism*, historically well represented by the Kantian tradition.

The Whorfian syllogism

- (1) Different languages utilize different semantic representation systems which are informationally non-equivalent (at least in the sense that they employ different lexical concepts);
- (2) semantic representations determine aspects of conceptual representations;
therefore
- (3) users of different language utilize different conceptual representations.

The anti-Whorfian syllogism

- (1') Different languages utilize the same semantic representation system (if not at the molecular level then at least at the atomic level of semantic primes);
- (2') universal conceptual representations determine semantic systems, indeed THE semantic representation system just is identical to THE propositional conceptual system (the innate "language of thought");
therefore
- (3') users of different languages utilise the identical conceptual representation system.

From a developmental point of view, universalistic views have been predominant until very recently. These views postulate that the same fundamental capacities and developmental processes underlie children's language development, irrespective of cross-linguistic variation. As summarized above, Piagetian theory (and other neo-Piagetian approaches) have accounted for particular aspects of language development on the basis of underlying universal perceptual and cognitive development. Similarly, other constructivist models have postulated general mechanisms accounting for developments in all domains. Thus, Karmiloff-Smith (1987, 1992) postulates the existence of developmental phases involving the interplay of *bottom-up* and *top-down* cognitive processes, that are recurrent in all domains of children's behaviors. None of these approaches have seriously considered linguistic relativity, let alone tackle the question of linguistic determinism, and it remains to be seen whether they could account for early linguistic constraints on cognition, such as those to be illustrated below. In general, such views have typically assumed that the results

obtained with children of one particular language or language group hold for all children, regardless of their native language and despite anecdotal cross-linguistic differences that may be occasionally noted.

Other proposals in psycholinguistics (e.g., MacWhinney & Bates 1989; Slobin 1985) have placed cross-linguistic variations at the center of their models in order to account for the production, comprehension, processing, and acquisition of language. However, although these models do directly address the question of linguistic relativity, they have not tackled the issue of linguistic determinism. For example, Slobin (1985) proposed a number of universal perceptual and cognitive *operating principles* determining the relative ease or difficulty with which children use different devices when constructing their particular language. MacWhinney & Bates (1989) also argue that speakers best process the cues that are the most available and reliable in their language when recovering semantic and grammatical relations during sentence processing, a result which can be observed with a wide age-range from two years to adulthood (notwithstanding some more complex accounts in some languages).

More generally, developmental psycholinguistics has witnessed a growing interest for cross-linguistic research as a way to generalize or invalidate claims about the universals of development. However, it is only recently that a growing number of such cross-linguistic research has explicitly revived the implications of linguistic relativity for linguistic determinism in child development across domains. Such comparative research has begun to cast doubt on some previous universalistic claims, showing that some developmental patterns might vary as a function of the properties of the particular native language being acquired. Furthermore, some research discussed below has begun to entertain the implications of linguistic diversity from a functionalist perspective, particularly in studies of children's discourse organization from three years on. Finally, as also shown below, cross-linguistic variations have been observed not only during such relatively late phases of development, but also during the very emergence of language, that is at a point in development previously assumed to be most strongly determined by universal constraints.

All of this research has led to two sorts of claims and hypotheses. The first claim is that language-specific properties have an impact on the rhythm and course of language development. The second and stronger claim, which is still in the state of a hypothesis, is that language-specific properties may also have an impact on cognitive organization itself. The more recent Whorfian view of development in this respect is that language filters and channels incoming information, leading children to pay more or less attention to different aspects of reality, which therefore become more or less salient and available in every day functioning. As discussed further below, more cross-linguistic research is still necessary to substantiate this latter version of the relativistic view, particularly in order to provide an empirical basis for the more ambitious claim that language has an impact on non-verbal behavior.

Finally, this research must be considered in the light of recent advances concerning early infancy. This period of child development is presently the locus of much theorizing in the face of results which strongly question some of the assumptions and conclusions of traditional theories of child development, such as those illustrated above by Piaget's or Vygotsky's theories. In particular, these findings suggest the existence of a surprisingly precocious and complex knowledge of the world, that is observed across several domains (such as space, number, time, or the object concept) and across several modalities (visual,

auditory, tactile), well before the age at which children should be expected to display such abilities according to more traditional theories (cf. a review the findings in Lécuyer, Streri & Pêcheux 1996).

This discovery of infants' early knowledge has emerged from the use of various experimental techniques, focusing for example on their reaction to novelty or their preferential looking to different stimuli. In the first case, children are shown visual stimuli belonging to the same class until habituation (loss of interest). With the presentation of a stimulus from another class, their renewed interest is interpreted as showing that they have perceived a categorical distinction. In the second case, children are shown, for example, two visual scenes while listening to an auditory linguistic input that matches only one of these scenes. The assumption is that, if children understand the linguistic input, their visual behavior should reflect their strive for coherence, resulting in a longer amount of time spent attending to the matching stimulus. As discussed below, this research has led either to nativist and modular views of early knowledge or to constructivist views of the same findings interpreted as showing the impact of early and massive perceptual processes.

Taken together, these different lines of research raise some questions which are yet to be further addressed by research aiming at articulating evidence for linguistic relativity and determinism, on the one hand, and for precocious perceptual and cognitive universals, on the other hand. We return to these questions in the concluding remarks, but first illustrate below some of these different views with developmental research focusing on space in child language, after a brief summary of some universal vs. variable aspects of this domain that are relevant to this research.

3. Space and language

Following Talmy's (2000) terminology, spatial reference minimally involves two components: The *figure*, about which motion or location is predicated, and the *ground*, to which the figure is related within various types of situations, among which the following are distinguished in all languages. A first distinction contrasts *static* situations, in which the figure is located in relation to the ground by means of some spatial relation, and *dynamic* situations, involving some displacement of the figure in relation to the ground (*to be/run in the kitchen*). A second distinction contrasts motion events that do or do not result in a change of location, i.e., displacements that take place within one general location vs. those that imply distinct locations (*to run in/into the kitchen*).

Furthermore, other aspects of dynamic situations may be represented in the predicates of all languages: The path of motion, which might involve a boundary to be crossed (*into/across*) or a particular direction to be followed (*up/down*); deixis, when motion takes place in relation to a specific *origo* (*to leave/arrive*); the manner with which motion is carried out (*to run, to swim*); causativity, which distinguishes displacements that are voluntarily carried out by an agent or provoked by some external cause (e.g., transitive and intransitive uses of English *to roll*). As summarized below, languages present wide variations in the systems they provide for the marking of some of these distinctions.

3.1. Packaging motion

A first major typological difference concerns the ways in which languages *package* spatial information in the clause, particularly in utterances which represent changes of location. In this respect, Talmy (2000) classifies languages into two major groups. *Satellite-framed* languages (such as English) typically encode the manner of motion in the verb root and various pieces of information relevant to its path in verbal satellites that are combined with the verb, such as prepositions, particles, adverbials, and the like. In contrast, *verb-framed* languages (such as Romance languages) encode the path of motion in the verb root and its manner by peripheral means (if manner is encoded at all, see below). This distinction mainly hinges on which part of the denoted information concerning motion is lexicalized or grammaticalized (e.g., English *to run into the kitchen* grammaticalizes the path, whereas French *entrer dans la cuisine en courant* ‘to enter the kitchen by running’ lexicalizes this piece of information).

Despite a number of exceptions within any one language and despite the many differences that can be otherwise observed across languages belonging to the same family, these paradigms correspond to the prototypical characteristics of these two language types that run not only through the language of motion, but also beyond it to encompass the expression of grammatical relations. Thus, as noted above, caused and spontaneous motion can be expressed in the same verb form in English when used intransitively vs. transitively (e.g., *to roll*), whereas special constructions are necessary in some languages to transform intransitive events into causative situations (e.g., French *la balle roule* ‘the ball rolls’ vs. *il fait rouler la balle* ‘he makes the ball roll’).

3.2. The universe of spatial relations

Another type of variation concerns the different ways in which languages organize the universe of spatial relations, highlighting some features of these relations more than others and providing different implicit ways of grouping spatial configurations. As illustrated by Bowerman (1996), speakers of different languages do not ‘cut up’ this universe in the same way in their description of static or dynamic situations. Thus, English uses the preposition *on* to represent a number of spatial configurations, which are further distinguished by the prepositions of other languages (e.g., Dutch *op* for ‘fly-on-door’, *aan* for ‘painting-on-wall’, *om* for ‘ring-on-finger’) or, inversely, which are typically under-specified (e.g., Spanish *en* for both containment and contact relations). Yet other languages imply other types of groupings. For example, Finnish case markers distinguish a figure that is either contained in a ground or tightly in contact with its outside surface (inessive –*ssa* for ‘apple-in-bowl’ and for ‘fly-on-door’), one the one hand, and a figure that is loosely in contact with the outside surface of a ground (adessive –*lla* for ‘painting-on-wall’ or ‘cup-on-table’), on the other hand. Korean distinguishes relations as involving a tight vs. loose fit between the figure and ground (e.g., with the predicates *khitta* for ‘a cassette-in-its-case’ or ‘a-lid-on-its-bowl’ vs. *nehta* or *nohta* for ‘apple-in-bowl’ and ‘cup-on-table’, respectively).

As already suggested above, the information concerning location may be found in a variety of devices, such as spatial prepositions or postpositions, as well other parts of the clause, such as the verb or a variety of morphological markings. For example, static

predicates may be simple copulas or more complex predicates providing further information, such as position, posture and/or some features of the spatial configuration (e.g., English or German verbs such as *stand*, *lie*, *sit*, *hang*). Although such predicates exist in all languages, the extent to which they are used or even obligatory is variable. Some analyses (Brown 1994; Levinson 1994, 1996, 1997) also show that some languages require speakers to focus on numerous properties which characterize the figures. In such languages the locus of the spatial relation is to be found in how the figure is denoted and identified, rather than in its relation to the ground. Such a system does not correspond to Talmy's typological options, raising some questions concerning the postulated existence of a universal *What/Where* distinction (Landau & Jackendoff 1990), opposing entities and locations not only in linguistic analysis, but also in several other disciplines among the cognitive sciences.

3.3. *Spatial information in discourse*

Finally, the expression of motion and location also requires that speakers relate their utterances to the contexts of use. For example, the way in which they describe some spatial configurations may partially depend on pragmatic factors, including which entity is most topical at a given point in discourse and/or which is to be considered as the figure (e.g., *The cheese is under the bowl* vs. *The bowl is on top of the cheese*). Furthermore, the extent to which speakers specify different aspects of motion may vary as a function of communicative purpose in a given situation. For example, they might be more likely to specify the manner of motion together with its path in a context where this information is particularly relevant, such as an emphatic context in which one manner is contrasted to another. The impact of such factors may be most striking in verb-framed languages, where manner is typically expressed on the periphery or not expressed at all (e.g., *Ils sont montés tous les deux, mais LUI il est monté tranquillement, alors qu'ELLE elle est montée en COURANT à toute vitesse* 'They both went up, but he went up quietly, while SHE she RAN up as fast as she could').

Finally, we rarely specify fully both figures and grounds, nor both source and target locations in the case of motion events, often relying on presuppositions established in discourse. For example, presuppositions follow the general principle of *anchoring*, whereby some reference point serves as the basis for the interpretation of locations or of location changes in subsequent utterances. This process often involves associative reference and/or inferences from world knowledge in the domain of spatial reference. For example, in an utterance such as *My cat wanted to catch a bird's nest, but it fell down while climbing up* we can interpret the predicates *fall down* and *climb up* from our knowledge of the world, assuming that birds' nests are typically located high in space (e.g., in trees). Nonetheless, the extent to which speakers specify ground entities in discourse also depends on formal constraints, which may vary from language to language. Thus, English prepositions require some ground specification (e.g., *The cat is on the couch* vs. **The cat is on*), while particles do not (e.g., *The cat ran up*). In comparison, languages such as French or German present a number of forms, allowing speakers to presuppose the ground referent when expressing the corresponding spatial relations (e.g., *Le chat est dessus*, *Die Katze ist drauf* 'The cat is on(it)').

4. Space and language acquisition

We now turn to developmental studies that have examined one or the other of these aspects of space in language. These studies stem from different traditions and disciplines, all of which are relevant to address current controversial questions in this domain concerning the relation among different (perceptual, motor, categorical, linguistic) components of spatial cognition during ontogenesis. A large number of studies have examined the acquisition of spatial devices that are necessary for the expression of motion and/or of location. For ease of presentation, I divide these studies into two main groups. The first and largest group has focused on universal cognitive or semantic determinants of acquisition. These studies have typically linked developmental sequences in the acquisition of spatial devices to initial sensori-motor capacities and to subsequent phases of cognitive development, driven by endogenous developmental mechanisms and/or by the universal properties of language. A second group of studies, more recent in this domain of child language, has begun to examine children's comprehension and production of spatial devices across languages, concluding that language-specific factors also affect the developmental process. As a result, some researchers have begun to explore a version of the linguistic relativity hypothesis, according to which language affects children's attentional processes and cognitive organization from an early age onwards.

4.1. *Universal determinants*

The largest number of studies framed within universalistic approaches has examined cognitive and perceptual determinants in the acquisition of spatial devices. Within the Piagetian framework (Piaget & Inhelder 1947), frequently used as the basis of interpretation, such progressions begin with an initial phase, during which children construct what might be called a *practical* space based on their perception and manipulation of objects during every day activities and displacements. This type of space involves topological relations such as neighboring, separation, order, covering, and continuity. Later phases follow the universal sequence of cognitive stages postulated by Piaget (cf. Section 2.2. above). The construction of a projective space begins at around six years, as children become able to conceive of a relative perspective on objects, while the gradual development of a Euclidean space results in a system of axes and co-ordinates.

Children's comprehension and production of spatial prepositions have been the most studied aspect of some child languages in this domain. Despite a number of divergent results, most studies have argued that these devices are acquired in a regular and universal order (cf. reviews in Bowerman 1989, 1996). Depending on the theoretical perspective adopted, such regularities have been interpreted to follow Piagetian stages and/or other principles of sequencing that are linked more specifically to universal semantic properties of the linguistic system (e.g., Clark 1973). Among other results, the following sequence is frequently observed. The first prepositions to be acquired mark neighboring relations and containment. The child then acquires prepositions implying a relation along the vertical axis, following several developmental steps (e.g., *first in*, then *above*). Finally, prepositions implying the sagittal axis are the last ones to be acquired along a gradual progression (e.g., *first behind*, then *in front of*)

which is partly related to particular properties of the object serving as reference point (e.g., *behind/in front of* are first acquired in relation to objects presenting an intrinsic orientation).

Another line of research has put forth universal prerequisites and determinants, while strongly questioning some of the assumptions and conclusions of these models. In particular, a growing number of findings concerning early developmental phases during the pre-linguistic period suggests that infants of a few months have extremely precocious perceptual and cognitive capacities (cf. reviews in Lécuyer, Streri & Pâcheux 1996). Such preverbal knowledge includes a variety of concepts, including fundamental concepts concerning the unity of the object, as well as a number of discrimination abilities, some of which are particularly relevant to the representation of space. For example, some results suggest that infants may have concepts of support, of containment, of spatial relations such as above/below, of spatial orientations, and the like (cf. van Geert 1985, for an overview of some studies). Although the behavioral patterns obtained by means of various experimental methods clearly show that infants display precocious spatial knowledge, the interpretation of such findings is not uncontroversial, resulting in at least two views. From a nativistic perspective, these results reflect the existence of innate knowledge which can take the form of concepts that are pre-programmed and modular. In contrast, from a constructivist perspective, the same results reflect massive processes of perception that allow the very young child to discriminate complex distinctions, but that need not show the existence of underlying innate concepts. In this view, precocious spatial knowledge is acquired through an early active process of construction, which occurs very early and which is mediated by perception.

4.2. *Language-specific factors*

Cross-linguistic research has also brought into question some universalistic claims about the development of spatial cognition by showing the impact of language-specific factors on development (e.g. Berman & Slobin 1994; Bowerman 1989, 1996; Bowerman & Choi 2001; Choi & Bowerman 1991; Hendriks 1993; Hickmann 1995, 1998b, forthcoming; Hickmann, Hendriks & Roland 1998; Johnston & Slobin 1979; Slobin 1991, 1996). Some systematic comparative studies of the production and comprehension of spatial devices across languages (e.g., Johnston & Slobin 1979) report that children's acquisition of locative expressions follows a similar sequence, suggesting the strong impact of universal cognitive determinants. However, they also show important cross-linguistic variations. For example, children have less difficulty in Italian and Turkish than in English and Serbo-Croatian, a result which has been attributed to the impact of language-specific factors (prepositions vs. postpositions, morphological complexity, lexical diversity, synonymy). Other results (Bowerman 1996) also show that, as early as three years of age, children's descriptions of spatial configurations look more like the descriptions that are produced by adults of their language group (cf. Section 3.2 above) than like those that are produced by children of the same age in the other language groups. For example, English children use the preposition *on* to represent a large number of spatial configurations, for which children of other languages provide either additional distinctions (e.g., Dutch) or different implicit groupings altogether (e.g., Korean). Such results at least show the insufficiency of universalistic views that do not take language-specific factors into account.

Similarly, longitudinal studies (Choi and Bowerman 1991) show that children under two years already produce the devices that are most typical in their language when

expressing motion. For example, they use path particles in English, e.g., *out* (wanting to go out), *up* (wanting to be picked up), *down* (sitting down), whereas they distinguish voluntary and caused motion in Korean, acquiring the equivalents of English path particles for spontaneous motion only later. In another study (Bowerman 1996) children and adults had to describe actions that consisted of displacing an object from one location to another. The results show again that these descriptions are quite different across the two languages. For example, Korean subjects group together actions that involve a 'tight fit' (putting on pants, putting a cap on a pen, putting a cassette into its case) by means of different predicates, whereas English-speaking subjects use other criteria to group actions differently by means of spatial prepositions (e.g., putting on pants vs. putting a cassette into its case). Similar results (Bowerman & Choi 2001) were also collected with much younger English-speaking and Korean children (at around 20 months of age) on the basis of stimuli involving the comprehension of items containing English *put into* and Korean *kkita* (interlock, fit tightly). At this age already, that is during the very emergence of language, children's attentional behavior shows that they group together spatial relations that are denoted in the same way in their language, even though they have not yet even used these devices in production.

My own ongoing research (cf. Hickmann forthcoming) concerning French also shows the impact of language-specific properties from early on, as well as an increasing specificity of the responses with age, reflecting the impact of more general developmental factors. Thus, in tasks where subjects (adults and three- to six-year-old children) have to locate entities in descriptions of static configurations and of caused motion events, they roughly differentiate situations for which they use a specific preposition (*sur* 'on', *dans* 'in', etc.) from others, for which they use the all-purpose neutral preposition (*à* 'at', which is not particularly spatial) or no preposition at all. Furthermore, the use and non-use of particular prepositions partially depend on the verb that is used. In particular, for a large number of configurations, the use of the all-purpose preposition or the absence of any preposition is all the more likely that the verb selected contains specific semantic information relevant to the spatial relation (e.g., *emboîter*, 'to join by putting in', *coller* 'to stick/glue', *enfiler* 'to make fit', *accrocher* 'to hang on a hook', etc.). These patterns are observed at all ages from three years on, although some developmental change also occurs with age. In particular, young children overgeneralize uses of the preposition *sur* ('on'), using it for some static situations where adults would use the neutral preposition. Furthermore, there is a clear increase of specific verbs with age, as well as a corresponding increase in uses of neutral *à* ('at') or of responses without prepositions. The results therefore show an interaction between predicates and prepositions in French, which is not observed in English and which increases with age.

Another set of results concerns how French- and English-speaking subjects express voluntary motion, when presented with short cartoons showing various types of displacements (e.g., upwards motion, crossing of a boundary). English-speaking adults and children (three to six years) systematically express manner and path in compact sentences with all types of displacements. French-speaking adults also do so, particularly with events involving the crossing of a boundary, expressing the path in the verb root and frequently specifying manner in a peripheral construction (e.g., *Il traverse en nageant* 'he crosses by swimming') or in the nominal phrase denoting the figure (e.g., *un nageur traverse la rivière* 'a swimmer crosses the river'). However, the conjoined expression of path and manner is less systematic than in English and it is clearly less frequent with events involving upwards

or downwards motion. In these cases, French adults often focus exclusively on path, ignoring manner (*monter/descendre* ‘to go up/down’). Furthermore, French children have difficulties expressing both path and manner with all types of displacements. With upwards and downwards motion, they mostly focus on path. With boundary crossing, they either focus on manner alone or on path alone, using in the latter case a verb which is ambiguous with respect to the type of path covered by the figure (particularly *passer* ‘to pass’) and/or adverbial phrases specifying boundaries (e.g., *jusqu’à l’autre bout* ‘until the other side’). When both types of information are expressed, they are typically distributed across utterances in discourse, rather than within compact structures.

Finally, recent cross-linguistic research has shown that typological differences affect what spatial information adults and children focus upon in more extended narratives. Berman and Slobin (1994) compare five languages that fall into the two major groups described above (cf. Section 3.1. above): English and German (satellite-framed languages) vs. Spanish, Hebrew, and Turkish (verb-framed languages). The results of their analyses show clear cross-linguistic differences from the youngest ages tested (three years) onwards. For example, whereas English speakers elaborate the trajectories followed by protagonists in their displacement through space, Spanish speakers provide simpler displacements with less elaborate paths and more static information situating protagonists and scenes. Thus, static locations must be inferred from paths in English, whereas paths must be inferred from path-verbs and static locations in Spanish.

More generally, several such analyses concerning both the expression of spatial information and the uses of temporal-aspectual devices in discourse have led Berman & Slobin (1994) to claim that children first use the obligatory morphosyntactic devices of their native language for the expression of spatio-temporal relations in discourse, thereby asserting and presupposing different aspects of their narratives. On the basis of such conclusions, Slobin (1991, 1996) reformulates the issue of linguistic determinism, arguing that the locus of the impact of language is to be found in attentional processes, which are reflected in how speakers select and organize information in discourse. In this view, “experiences are filtered through language into verbalized events [...which are] constructed on-line in the process of speaking” (Slobin 1996: 75). As a result, the linguistic expression of experience in communication mobilizes a special form of thought, “thinking for speaking”, which may vary from language to language, and “in acquiring a native language, the child learns particular ways of thinking for speaking” (Slobin 1996: 76).

Other cross-linguistic comparisons show related results (Eisenberg, Kako, Hightner & McGraw 1998; Hickmann forthcoming; Hickmann, Hendriks & Roland 1998). For example, analyses of narratives produced by four- to ten-year-olds and adults in four languages that are either verb-framed (French) or satellite-framed (English, German, Chinese) show large cross-linguistic differences that can be summarized in terms of three dimensions (Hickmann forthcoming): Diversity, compactness, and focus. Thus, the French corpus shows relatively few dynamic predicate types, in sharp contrast to the considerable diversity of predicates observed in the other languages. Furthermore, utterances are also much less compact in French than in the other languages. French predicates rarely contain multiple types of information, which are distributed across utterances in discourse, whereas the utterances in the other languages frequently combine multiple types of information within the clause. Finally, one finds the most static predicates in French, especially at younger ages, and some information is expressed with difficulties or not expressed at all,

such as causativity in the case of provoked motion.

A final point in these data concern spatial anchoring. In all languages, one finds a gradual developmental progression in children's ability to provide sufficient spatial anchors, which emerges at around six years of age and continues to evolve after ten years. This result is in line with previous studies investigating how children organize spatial information in discourse, for example in tasks involving room descriptions (Ehrich 1982) or route directions (Lloyd 1991; Weissenborn 1986). In general, the results of these studies show that children have difficulties establishing and maintaining spatial frames until a late age, which have been attributed to their cognitive immaturity and to their resulting inability to take a relative perspective on the denoted situations, for example when addressing an interlocutor who does not share mutual knowledge of the denoted situation.

The developmental progression we observed in this respect was strikingly similar in all languages examined, despite the large cross-linguistic differences that were found in other aspects of the narratives, i.e., not only in the expression of motion (as shown above), but also in the precise nature of the spatial anchors selected (types of referents, richness of the information presented concerning them) and in other aspects of the utterances used to present these referents (types of predicates, of referring forms, and of structures). This striking similarity was not expected. For example, it could have been expected that French speakers should be more concerned with spatial anchoring, since their language might invite them (like speakers of other verb-framed languages) to focus on static situations. Young children's difficulties with spatial anchoring, then, seems to reflect the impact of general factors linked to cognitive development, such as the ability to plan information and to organize it across clauses in discourse, irrespective of the strong impact of language-specific properties that is otherwise observed from three years onwards.

Furthermore, similar results were obtained in relation to other aspects of the narratives, such as children's uses of devices for the marking of new vs. old information status or for the grounding of information in discourse (cf. Hickmann 1985, 1998b, forthcoming). In general, the results across these different discourse referential domains show surprisingly similar developmental progressions in typologically different languages, as well as wide cross-linguistic variations. For example, when introducing referents in discourse, Chinese children systematically use *local* markings of newness (numeral determiners, specific classifiers) at the same age as children acquiring French or English (indefinite determiners at around six years of age), despite the fact that these devices are not obligatory in their language. However, only the French children make heavy use of *global* markings for discourse purposes from four years onwards (e.g., structural variations such as existentials and dislocations), even though their ability to differentiate newness and givenness by means of such markings evolves subsequently. In contrast, it is not until much later on (ten years of age) that children rely on clause structure to mark information status not only in English, but also in Chinese, despite the fact that such markings are obligatory for information status (e.g., new information must be postverbal in Chinese). These results suggest that systemic properties of languages, such a weak or non-existent morphology in English and Chinese, may lead young children to reserve clause structure for the marking of grammatical relations, relying first on the functionally less complex local markings to mark information status and only subsequently learning how to use the same devices for such discourse functions. In conclusion, at least three factors determine acquisition in different domains: Universal discourse factors governing information flow; cognitive factors resulting from the greater functional complexity of global markings; language-specific factors

related to how different systems map both grammatical and discourse functions onto forms and structures.

5. Concluding remarks

These various results show first that no simple answer can be given to the question of whether and how language and cognition are related during development. Language acquisition depends in part on precocious and perhaps innate predispositions or capacities, as well as on some universal aspects of subsequent cognitive development. However, the cross-linguistic variability that is observed, both very early and during later phases, suggests that these are not the only factors determining acquisition. This variability requires developmental models that can account for early linguistic constraints in addition to early cognitive constraints, bringing into question two of the more accepted views about development in the spatial domain. The first one states that language acquisition can be accounted for by an underlying cognitive development that would be general to all domains of knowledge and that would take place over a long stretch of time. The second one postulates domain-specific cognitive capacities, that are innately given to the child as part of its biological endowment. In both views, the child match linguistic representations to prior nonlinguistic representations, that are independent of language and universal across languages, regardless of whether they are present at birth or constructed gradually over time.

Clearly, both universal determinants and language-specific factors affect language acquisition, accounting for why its course is partially similar and partially different across different languages. In this respect current models suggest that language filters and channels information, inviting speakers from the earliest age on to pay attention to different aspects of reality. Note that the research presented here does not exclude that some capacities may be specific to linguistic competence. However, some results go in the direction of models postulating an evolution from general to specific processes, while other results suggest the precocious impact of language-specific properties, which cannot be easily accounted for in these models. As further discussed below, the precise timing of this impact remains to be determined, since we do not yet know how early it can be measured.

Second, some results show that acquisition is determined by both structural and functional factors. The mastery of devices that contribute simultaneously to the sentence and discourse levels are a central part of children's language acquisition, regardless of the language being acquired. As they learn to produce well-formed utterances to represent events, children are also learning to regulate the flow of information across utterances in discourse as a function of various contextual constraints, such as those that are linked to presupposition and focus. The development of discourse organization provides children with a powerful semiotic medium allowing them to use language as its own context. This contribution to two levels of organization (the sentence and discourse) follows some universal principles, as well as some language-specific ones. An adequate model of acquisition in this domain, then, requires an account of how discourse and sentence-internal functions interact within a cross-linguistic perspective.

Given these two questions, future research is still necessary in at least the following two directions. First, we need to know more about the relation among speakers' perceptual, cognitive, and linguistic capacities within a cross-linguistic perspective. In particular,

findings that show the impact of language properties on language use itself can only substantiate a weak version of the hypothesis of linguistic determinism, since this impact has been so far restricted to particular linguistic behaviors. A stronger version of this hypothesis requires showing more profound differences that go beyond language use. In this respect, the extent to which different types of linguistic organization might affect children's cognitive organization is still an open question that remains to be further explored in several domains. This type of research requires combining psycholinguistic studies focusing on children's production and comprehension of various linguistic devices from the emergence of productive language onwards with studies investigating the potential impact of language-specific properties on non-verbal behaviors (e.g., implicit memory, categorization responses in classification tasks).

A related question concerns particularly early phases of development. Substantial evidence is necessary in order to articulate more precisely the capacities displayed during the period that precedes the emergence of productive language at around 18 months and during subsequent periods. In this respect, the so-called *pre-linguistic* period is clearly not *non-linguistic*, since the child is completely immersed in language from birth onwards. Two views can be distinguished here concerning this period. According to one view, early capacities constitute strong universal constraints that actually determine the course of language development from the very beginning onwards, independently of language-in-general or of the properties of specific languages. In contrast, another view would be that early capacities merely constitute prerequisites for subsequent language development, that would be universally available during an initial phase, but that would then be partially reorganized through the emergence of language (and of particular languages). Some of the results summarized above indicate that children are sensitive to some of the particular spatial distinctions encoded by their language as their productive language barely emerges and before they have ever produced the particular linguistic devices tested. More cross-linguistic research is necessary with very young children before, during, and after the transition characterized by the emergence of productive language. For example, further studies are necessary to determine at which point early non-verbal categorization, as displayed by infants' discrimination behaviors, is affected by linguistic categories that are implicitly or explicitly encoded by language (language-in-general) and/or by the properties of their particular native language.

Second, further research is also necessary to determine precisely how the sentence and discourse levels of linguistic organization interact during the acquisition process. Discussions about the relation between structural and functional determinants of language should be centered around two questions: What are the implications of different views of language for the position we adopt with respect to the universal vs. variable nature of cognitive processes? Conversely, what are the implications of our relativistic vs. universalistic views for how we conceive of language? These questions open new perspectives which might shed some light on our conclusions concerning whether or not to adopt the hypothesis of linguistic relativity and determinism. As mentioned above, although both types of determinants affect acquisition, we still know too little about their relation during the course of development.

Some of the results presented above suggest that this relation should be a two-way process. On the one hand, semantic and syntactic ones influence some aspects of discourse organization. Thus, the ways in which different languages structure temporal and spatial information within the sentence affect how (young and older) speakers organize larger

discourse contexts, resulting in their relative focus on states vs. processes. On the other hand, despite cross-linguistic differences, discourse factors influence some aspects of sentence organization, such as uses of structural variation, and the processes whereby children learn to mark discourse distinctions (information status, information grounding) follow a similar developmental progression across languages. Such results have led to the conclusion that any adequate developmental theory must account for the relations existing between language and cognition, on the one hand, and between linguistic structure and linguistic functions, on the other hand, with the aim of explaining both invariant and variable aspects of development.

Finally, in the attempt to address some of these questions, research with some particular populations might prove to be extremely revealing. In particular, some populations display particular types of dissociations, that may provide an opportunity to separate factors normally confounded during the course of child development. Thus, comparisons between children's first language acquisition and adults' second language acquisition allow us to control the degree of the learner's cognitive maturity (in the process of development with children, already developed in adults). Furthermore, studies examining the cognitive and linguistic development of children who display sensory or motor deficits would contribute to our understanding of the role of visual perception or of motoric capacities on development in the spatial domain. Finally, some aphasic patients display dissociations between their syntactic and lexical knowledge, that raise a number of interesting questions from a cross-linguistic perspective. Thus, it would be of interest to compare the performance of agrammatic vs. anomia patients in languages that lexicalize vs. grammaticalize the same spatial information, e.g., on the basis of tasks requiring them to describe motion events. Such a study would allow us to test the hypothesis, for example, that agrammatic patients should encounter more difficulties in such a task if they are English-speaking in comparison either to anomia patients of the same language or to agrammatic patients speaking a verb-framed language such as French. Testing bilingual aphasic patients in such tasks would further provide additional information concerning the relation between language and cognition within the same brain.

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