CHAPTER 8

DEVELOPMENTAL PERSPECTIVE ON THE RELATIONSHIP OF LANGUAGE AND COGNITION

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INTRODUCTION

However how one looks at it, whatever theoretical perspective one espouses, language acquisition must entail the development of mappings between linguistic forms and meaning. Meaning in language, in all its many guises and manners of encoding (lexical meaning, meanings of grammatical forms, sentential meaning, pragmatic/illocutionary force, speaker meaning, etc.), is integrally connected with human conceptual understanding of the meanings encoded. The natural question that arises is what the exact relationship is between language (and more specifically, meaning as it is encoded in language) and human conceptual understanding. And, more directly related to the concerns of this book, what is the relationship between the development of language (especially meaning encoding in language) and the development of cognition?

The amazing advances that occur in both the linguistic and the cognitive realms in children's advancing knowledge are inextricably linked in time (at least in normally developing children) . Between birth and the early school years children are developing both a very complex and productive command of the language they are learning and a very complex and often implicit knowledge of the world around them. To what extent are these two realms of development interconnected? Do developments in language depend on and build on the prior development of corresponding non-linguistic concepts? To what extent might linguistic developments 'push' the child to develop corresponding non-linguistic concepts? These questions relate to a wealth of developments in both language and cognition in the early years. The answers ultimately have wide-ranging implications for possible universals of thought and language and for the more general question of the dependency of thought on language, most radically exemplified in the Sapir-Whorf hypothesis (Sapir, 1924/1949; Whorf, 1936/1956, 1940a/1956, 1940b/1956).

At every turn, the meanings encoded in and through language have potential correlates with non-linguistic concepts and human ways of processing the world. The following section gives, first, a brief introduction to the types of developments in each realm that might be linked, followed by an overview of the potential links that one might speculate could exist, given the co-occurrence in time and the coherence/similarity of content across the two domains. This is followed by a presentation of four logically possible theoretical positions, and then evidence bearing on each.

Linguistic Developments

The linguistic developments that relate to the expression of meaning and, hence, may be inextricably linked with cognitive developments, include, perhaps most obviously, the acquisition of labels and word meanings--learning what words 'mean' and can mean in the language being learned. But they also include, perhaps less obviously, the acquisition of morpho-syntactic structures and their functions, starting from the identification and marking of types and roles of individual linguistic forms--word classes (e.g., nouns, verbs), grammatical functions (e.g., subjects of sentences, direct objects), grammatical class distinctions (e.g., masculine/feminine grammatical gender, mass/count distinction). They include the means for expressing semantic roles and notions (e.g., agents of actions, receivers of actions; sources, paths, and manners of movement) and for encoding the extension of actions and events through time and space--whether they are punctual, enduring, iterative, etc. They include, further, developments in syntax, insofar as meaning is expressed through syntactic form. The developments range from the early formation of primitive sentences, at the early two-word stage, to longer simple sentences, to more complex sentences with one or more embeddings. They include the acquisition of language-specific means for "packaging" meaning underlying both lexical and syntactic structures. And they include the acquisition of rules for conversational interaction and the expression of meaning in discourse, and the principles governing the pragmatics of language use.

Cognitive Developments

A wealth of cognitive advancements that could be related to these linguistic developments occur during this same period. These include the discrimination and differentiation of entities perceived in a variety of modes (visual, auditory, tactile); the formation of categories and concepts, including concrete, abstract, and social concepts, and including notions of space and time; the understanding of relations between entities; the appreciation and understanding of quantities, qualities, functions, social constructs, and systems in which these participate; the understanding that anything can be viewed (both literally and metaphorically) from a variety of perspectives; the appreciation of what is shared knowledge, e.g., in a community or in a conversation, and what is 'new' information; the discovery of conventional norms, whether these concern behavioural norms (e.g., how to eat food, how to act in a concert), cultural norms (e.g., how families are structured, what is

expected of children at school, what is 'normal' dress and what is 'odd', how one measures time), norms concerning how one views items or actions in the world (e.g., is a dog for petting or for eating, are females considered inferior or equal to males), and, of course, norms for speaking or remaining silent.

The potential links between these linguistic developments and these cognitive developments are numerous and pervasive. Researchers have speculated on potential links on the basis of commonalities of timing and content, as follows.

POTENTIALLY LINKED AREAS

A. In relation to the basic "building blocks" of language:

Let us start with what one might consider the "basic building blocks" of language--universal (or near-universal) formal aspects of language that constitute the elements out of which the structure of the language is built. These often appear to have common meaning-based cores or correlates across languages, even if they are essentially syntactic in nature. These universal building blocks might include, for example, word categories (such as Nouns versus Verbs), semantic/thematic categories (such as Agents, Patients/Receivers of Actions, Possession), grammatical functions and roles (Subjects, Objects of a verbs), and grammatical forms expressing modifications of the basic categories (including tense marking, aspect marking, number marking, classes of nouns or verbs, and the like). These constitute some of the most fundamental components of language, and all of them undergo developments in the early years, just at the time that potentially relevant cognitive developments are occurring. Since each linguistic element revolves around a particular central meaning core, development in each might be expected to connect with the relevant aspect of children's developing cognitive understanding of the world around them.

Examples of potential connections between these "building blocks" of language and cognition include the following.

<u>Word categories</u>:

<u>Nouns</u> prototypically refer to whole concrete objects (*ball, table, girl*, and so forth) (although they are not restricted to these--e.g., *party* refers to an event, *exhaustion* refers to a state, and so forth (see, e.g., Ross, 1973; Maratsos & Chalkley, 1980; Nelson, 1988; but see also Newmeyer, 2000)). Nouns form an important part of children's early lexicons, and may build crucially on certain perceptual properties of concrete objects, the prototypical referents of nouns (Gentner, 1982; Gentner & Boroditsky, 2009).

Concrete objects have stability across time and space (unlike, e.g., actions, which are transitory and variable), so the development of nouns as a category may relate to early cognitive abilities developing (or present) in the first year of life concerning notions of objects and object permanence (Piaget, 1952; Baillargeon, 1987; Spelke, 1990; Spelke, Breinlinger, Macomber, & Jacobson, 1992; see also Thelen & Smith, 1994)). (Cognitive) knowledge that objects exist and endure through time and space could be intimately linked not only with (a) learning labels for such objects (*ball, table*, etc.) (Gentner & Boroditsky, 2009), but also (b) learning (linguistically) that there are certain types of words that refer to objects (i.e., nouns).

Within Nouns, one can differentiate several linguistically important types, according to the kind of things they refer to. One type is "proper nouns", nouns that refer to unique individuals (*the Eiffel Tower, President Obama, the Tate Modern*); this contrasts with "common nouns", nouns that refer, not to individuals, but to categories of entities (*cats, tables, spices*). Common "count nouns" typically refer to categories of individuable, countable objects (*tables, cats*); common "mass nouns" typically refer to categories of substances (*water, sand*). Infants' early cognitive differentiation of individuable entities from non-individuable substances (Xu & Carey, 1996; Huntley-Fenner, Carey, & Solimando, 2002) could potentially be linked with the acquisition of the linguistic means used for referring to them.

Furthermore, classes of things can be divided into those for which the members of the class share shape (BALLS, POLES), or share texture (FUR, JELLO), or share function (MAGNETS, HAMMERS), or share social/cultural significance or role (COUSINS, PARTIES), etc., or share some combination of these. A very logical hypothesis is that the development of the <u>concept</u> of the category (or type of category) labeled by a term is linked developmentally, in one way or another, with the acquisition of the term/label. For labels relating to unique individuals, learning a mapping between <u>that thing</u> and <u>this word</u> (a proper Noun) may suffice, but even here children often overgeneralize such terms as if they were not proper but common nouns (e.g., using *moon* for round or crescent-shaped things; using *daddy* for any adult male). For labels relating to classes of individuals or of substances, an understanding of or an ability to categorize according to a shared property (shape, texture, function, etc.) seems *a priori* crucial (how can one call anything a "magnet"

without understanding, on at least a rudimentary level, what magnets do?), but that still leaves open the question of whether the concept comes first and the label maps onto it, or whether the label comes first and the child develops a concept to go with what the label maps onto.

Verbs prototypically refer to actions (*kick*, *clean*, *swallow*, and so forth) that a doer performs and that affect a recipient of the action. (They are not restricted to these, however--e.g., *sleep* refers to a state, *receive* is what the recipient of an action, not the doer, does, *develop* has to do with the creation of a product, and so forth (Maratsos & Chalkley, 1980)). The acquisition of verbs in language may connect in some way with early cognitive abilities developing in infancy concerning the understanding of actions and states.

As with categories of objects, categories of actions and states can be grouped on the basis of some shared characteristic. Note that the grouping does not mean the members of the group are identical -- e.g., *running* can refer to both the way a two-year-old uses her legs to move quickly across the room and the way that Florence Griffith-Joyner moves around a track; *thinking* can refer to both the (laborious) mental activity that a freshman in high school goes through in algebra class and the elegant theorizing that Stephen Hawking goes through when cogitating about the nature of the universe; and so forth. And languages can differ dramatically in terms of what gets "packaged" into verb meanings. One salient example in the literature, to which we will return, concerns verbs of motion (Talmy, 1985).

Do children learn verbs and what verbs are by mapping linguistic forms onto (non-linguistic) concepts of actions and states? Or are there possible linguistic developments taking place independently of or prior to the development of comparable cognitive notions?

Semantic/thematic categories:

In addition to word categories, languages also have ways of expressing basic thematic categories -- the roles played in a sentence by the nominal component parts of those sentences. These thematic roles include:

Agents: Agents are prototypically intentional actors who carry out an activity directed at affecting some recipient (*Martha kicked the ball*; *Five ants carried a crumb into that hole; The cake was iced by the baker*). The most typical agents are intentional and human (but

occasionally words referring to non-intentional or non-human things can take on agent-like meanings in sentences, rather by inheritance because of the syntactic roles they take on (*The hurricane blew all the houses away*) (see Schlesinger, 1982, 1988).

Patients, conversely, exemplify characteristics of passive receivers of actions, are typically non-animate, and typically undergo some change because of the action of the agent (*Martha kicked the ball*; *Five ants carried a crumb into that hole; The cake was iced by the baker*).

The acquisition of linguistic means for expressing agents and patients may be related, like the acquisition of verbs, to certain aspects of cognitive understanding-- e.g., of means-ends relations and causality. Perhaps, for example, children learn that humans can cause things to happen to objects and then connect linguistic means for expressing agent-hood with the former and for patient-hood with the latter.

Grammatical functions:

In addition, other linguistic "building blocks" include grammatical functions of parts of sentences.

Subjects and objects of sentences are nominal expressions that act as arguments of a verb. The linguistic marking of Subjects and Objects is particularly important in transitive clauses: Languages maximally differentiate the linguistic marking of subjects and objects when verbs have two noun arguments (Comrie, 1989; Dixon, 1994), thus allowing speakers to communicate which nominal form carries out which role expressed through the verb (*He kissed me; I kissed him*). Subjects prototypically express agents that are intentional and human and that, in transitive sentences, causally affect a recipient expressed as the Object.[1] (Subjects of intransitive verbs (*John coughed; the book fell*) tend to fall somewhat between the two extremes of agents and patients: The verb has only a single argument, so the single noun phrase

[1] Subjects of sentences are also often the topic of the sentence (*Mary opened the door*), though they need not be (*As far as chocolate ice cream is concerned, you* [non-topic] *couldn't find a child within 10 miles of here who doesn't like it*). In languages like English, subjects and topics often coincide and are undifferentiated linguistically. In some languages, such as Japanese and Korean, subjects and topics are differentiated linguistically. In Japanese, for example, topics are marked with the postposition *wa*, subjects with the postposition *ga* (see Kuno, 1973).

occurring in the sentence unambiguously takes on the only role of that argument.) Because of the high likelihood of subjects being agents and objects being patients, there is a high correlation between the expression of thematic roles (agents) and grammatical roles (subjects). However, subjects need not be agents (*The letter* [patient] *came through the mailbox*, *The door* [patient] *was opened by Mary*, *The boy* [experiencer] *heard a noise*). That is because subjects are essentially syntactic, while thematic roles are semantic: Subjects express the "external argument" of the verb; objects the "internal argument", no matter what the thematic roles of those arguments might be. [2]

On inspection, it can be seen that every verb has certain thematic roles typically associated with it: compare, e.g., *receive* and *arrive at*: *The office received the package* vs *The package arrived at the office*. Both verbs have arguments that express the Goal (end location of the movement) and the Figure (thing moving), but those arguments take on distinct grammatical functions in the two cases. With *receive*, the Figure (the package) is the direct object, with *arrive*, it is the subject of the sentence.

Because of the close link between agentive/patient roles and grammatical subjects and objects, it is possible that, as above, children's developing understanding of subjects and objects correlates with their developing understanding of doers and receivers of actions, and of means-ends relations (cf. Gopnik & Choi, 1990). That is, it is possible, for example, that the child comes first to a cognitive understanding of doers and receivers of actions and then learns to map relevant linguistic means onto such non-linguistic notions.

[2] It should be noted that, for the purposes of discussion, this is simplifying matters quite a bit. There is considerable crosslinguistic diversity in the way in which arguments are marked and expressed in languages. While many European languages, for example, favor a nominative-accusative structure in sentences, others might favor an ergative-absolutive structure (see discussion below). Similarly, whereas argument demotion is not a prevalent process in English, it is common in many other languages in the use of impersonal and middle constructions (see, e.g., GeniusÛiene, 1987; Kemmer, 1988).

Grammatical modulations:

Languages also have common linguistic means for encoding modulations of the meanings expressed with the above "building blocks". Some have noted that there is a universal (or near-universal) set of types of grammatical markings that recur across languages (Talmy, 1985). These include, among others, the following:

Tense markers, which encode the time of occurrence of an event or state relative to the time of utterance (*Mary open<u>ed</u> the door*). Tense markers generally get attached to verbs.

Aspect markers, which encode the "contour" of an event or state through time--whether it occurs at one moment in time, or iteratively, or over an extended period, and so forth (*Mary is open<u>ing</u> the door; Mary has lived in Madrid for 40 years*). Aspect markers, like tense markers, typically attach to verbs.

Number marking, which indicates whether the referent of an expression is a single entity or more than one entity (or, in some languages, a few other possibilities--e.g., two entities) (*The boy<u>s</u> are opening the door*). Number marking is common with nouns, although it can also occur frequently with verbs, adjectives, and articles.

Person marking, which indicates whether a sentence or proposition concerns the speaker, the addressee, or a third party or parties (*<u>I/you/he/she</u> opened the door*).

The child's development of any one of these modulations of linguistic meaning may have links with the developing understanding of related concepts--of time, of sequencing of events, of the profile of an event through time, of number and of numerosity, of participants in a conversation.[3]

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[3] At the same time, there are other aspects of our cognitive understanding that do not surface in any common grammatical fashion in languages. E.g., languages do not usually have ways of grammatically encoding the color of participants in an event, whether an event took place indoors or outdoors, what time of day the event or state occurred, whether the individual participants were bored or interested in the event, and so forth (see Talmy, 2000). Any complete account of the relation between language and cognition will have to include an explanation for which concepts get expressed grammatically and which do not in languages. See Slobin, 1997b.

B. Language-specific "packaging":

In addition to these core building blocks of language, there are many domains of meaning that are commonly encoded linguistically across languages, but sometimes in drastically different ways, with considerable variation across languages in how the linguistic information gets "packaged" lexically or syntactically. The linguistic encoding of these domains of meaning appears to recur in part because these domains correspond to aspects of conceptual understanding that form an important part of the human condition and experience. These commonly expressed, but linguistically varied, elements include the following:

Spatial Relations: Languages encode notions such as the 'containment' of one object within the space of another (*the ball is in the box*) or the 'support' of one object by another (*the ball is on the table*), and the like. However, they differ as to which semantic aspects get lexicalized -- e.g., some languages focus on containment vs support, some distinguish one type of support from another (differentiating, for example, 'the book is on the table' from 'the picture is on the wall'), some highlight tightness of fit (distinguishing, for example, putting a cassette tape in its case [tight fit] from putting a rubber duck in the bath water [loose fit]) (Choi & Bowerman, 1991; Bowerman & Choi, 2001). There could, theoretically, be some universally available conceptual understanding of space, and language gets linked from the beginning with that universal starting space.

Motion: All languages express the movement of entities and beings ("Figures") relative to some unmoving background ("Grounds") via certain Paths (*the mouse went into the hole*), and with specifiable Manners (*scurrying*). However, again, languages differ dramatically as to which aspects of a Motion event get "conflated" lexically (Talmy, 1985). For example, some languages, like English, tend to express the Manner of motion in the main verb and the Path of motion outside the main verb, in a "satellite" like a prepositional phrase-- *the mouse ran/scurried/slithered into the hole; the mouse hurried up the hill*; some other languages, like Spanish, tend to express the path of motion in the main verb and the manner of motion outside the main verb -- *el ratón entró en el*

agujero (corriendo) 'the mouse entered in the hole (running)'; *el ratón subió la colina de prisa* 'the mouse ascended the hill quickly'. Again, it is possible, in principle, that there is some common non-linguistic conceptualization that gets linked universally from the beginning with the linguistic expression of motion. We could find, for example, that all children try to express each of the components of motion--MOVE, FIGURE, GROUND, PATH--as independent elements and then learn how their language organizes these--that is, learn which aspects are typically conflated into a single lexical item.

Universal human activities and experiences, such as eating, falling, cutting & breaking: Again, these universal human activities and experiences get lexicalized in vastly different ways across languages. Especially relevant is the fact that in some languages general-purpose words are available ('eat', 'fall', 'break', 'cut'), while in others, more specific lexical items are used (either alongside or instead of more general forms) ('eat.fleshy' food, 'slice', 'shatter') (e.g., de León, 2009; Bowerman, 2005; Majid, Bowerman, van Staden, & Boster, 2007; Narasimhan & Brown, 2009).

It could be that there is some common conceptual basis that both types of languages are linked to from the beginning. For example, it is possible that conceptually either the broader groupings or the more specific groupings are "primary". If broad groupings are primary, children learning a language with more specific categories will need to grow to differentiate them more fully. If specific groupings are primary, children learning languages with broader categories will eventually need to eventually collapse finer distinctions.

Categorization of objects, states, actions: The entities in the world that are grouped into classes do not come in the world in discrete, separated groupings. Rather, the groupings are, at least in part, imposed by humans--and this is especially true in relation to the boundaries between groups. The conventional groupings of objects are influenced by the language-specific conventions of each language. Even casual observation of any two languages makes it clear that no two languages "package" observable phenomena in the world into categories in exactly the same way. For example, English makes a distinction between a *shadow* and *shade*; in Welsh, these two are subsumed under a single category, *cysgod*; Welsh makes a distinction between a

(complete) hill, *bryn*, and an incline, *gallt*, but English groups these into one category, *hill*; *snoring* and *growling* are treated as "different" in English, but they fall into one conceptual category in Welsh, *chwyrnu*; while English *tree* includes anything growing of a certain height, Arabic distinguishes between date trees, *nakhla*, and others, *shajarah*; and so forth. Thus, even though we humans might be faced with similar entities in the world, our language conventionalizes what gets grouped together and where the lines are drawn between those groups: In relation to concepts and conceptual systems, "…most of the time we are covering up the fact that the world does not have simple joints where it can easily be carved…" (Hampton, 2007: 377) (This conventionalization of categories into distinct groupings by language may even be true of "natural kinds" (such as gold, cat, or positively charged objects); see excellent exposition on the debate on the ontological status of natural kinds in Bird & Tobin, 2008.)

For all of such items, the relevant question is whether children begin with a universal conceptual understanding of these relations or experiences and initially attach the linguistic expressions they are learning to those concepts (and gradually move into the language-specific means of encoding), or are instead influenced from the beginning by the language they are learning.

C. Complex conceptual understanding and linguistic encoding:

And, finally, there are many more advanced aspects of human conceptual understanding that also appear to link up with associated linguistic expression. These include, e.g., the following:

Scalarity, or the notion that items can be ranked relative to one another along some scale (size, amount, color intensity, loudness, etc.). Scalar notions are expressed in language through structures such as the comparative (*bigger, faster*) and the superlative (*the biggest, the fastest*), and through other scalar expressions that lie along a continuum (*tiny…small…medium-sized…large…huge…humongous*) or indicate location along a scale (*as big as, fast enough, too big for Y*, etc.). To what extent is the development of such expressions linked with related cognitive understanding of scalarity (e.g., seriation, Ehri, 1976; Shaffer & Ehri, 1980), and, if there is a relationship, which is the direction of influence?

Perspective-taking and the ability to understand that there may be multiple perspectives from which one could view (literally or metaphorically) the same situation or event. For many structures in language, proper use demands taking the listener's or another's perspective. This includes, e.g., use of *the* versus *a* (where *the* entails the speaker's inference that the listener can uniquely identify the referent of the noun (compare, e.g., *She's going to buy the book* vs *She's going to buy a book*). It includes the framing of topics (shared focus of the discourse) and comments (new information) within discourse. The speaker's ability to anticipate what the listener knows or assumes can also affect how the speaker frames assertional and presuppositional components in a sentence (and, so, conversely, can also be used by the listener to surmise the speaker's presuppositional attitudes from the framing of the sentence)--e.g., *Galileo realized that the earth is round* presupposes that the earth is round vs. *Galileo concluded that the earth is round* carries no such presupposition. And this similarly affects conversational implicatures--e.g., an expression like *John earns $20,000* normally carries a conversational implicature that he does not earn more than that, e.g., $40,000.

One can hypothesize that the cognitive abilities needed for assessing the speaker's and listener's knowledge base are linked in some way with proper use and interpretation of such linguistic means for encoding such information. Children's ability to take non-egocentric perspectives and their development of a theory of mind (knowing that others may have beliefs or knowledge distinct from one's own) occur during the preschool years (Piaget & Inhelder, 1948/1956; Wimmer & Perner, 1983; Perner, 1991; Gopnik & Wellman, 1992; Epley, Morewedge, & Keysar, 2004). How do these linguistic and cognitive developments interact in development?

This is just a sample of the points at which language and cognition may be linked or intersect. Various aspects of these have been examined for evidence bearing on the questions of concern here, and we will touch on some of those. Key to all considerations is the question of how one can determine what influences what and how the two realms, the linguistic and the cognitive, might evolve relative to each other in the process of language acquisition. The logical possibilities fall into at least four major possibilities, laid out in the following section. This will be followed by a discussion of the evidence available on these questions.

LOGICALLY POSSIBLE HYPOTHESES

The logically possible relations between language and cognition in development fall into four main groups: I. cognition precedes (and directs) language, II. language precedes (and directs) cognition, III. language and cognition develop independently, and IV. language and cognition are mutually inter-dependent in development. Under each of these, we can make certain predictions concerning (1) what the initial linguistic developments in language are based on, (2) how 'universal' children's first steps into language will be, (3) the timing of cognitive developments themselves, and (4) the timing of linguistic developments relative to (related) cognitive developments. We can also make predictions concerning the shape of adult languages--in particular, (5) whether language influences cognition and (6) how universal the meanings encoded in adult languages will be. These are laid out in Table 1 and elaborated below.

I. Cognition precedes and directs Language (C > L)

First, the child's cognitive understanding of the world and things in it may precede and direct the acquisition of language. This position draws on the long tradition in Western thought that language maps onto cognitive concepts. As we noted in chapter on the acquisition of word meaning, the objectivist tradition holds that there are things out there in the world--plus categories and relationships between things--and that language, as a symbolic system, symbolizes and maps onto these. Within this traditional view, the process of acquisition can be seen as one of taking the cognitive categories and distinctions and finding the linguistic categories and distinctions in the language being learned and linking the two. Under this view, the task of the child is, at least at first blush, a relatively simple one of finding linguistic symbols for the cognitive categories and concepts and mapping the former onto the latter.

Under this position, the child's understanding of the world and things in it develops independently from and prior to language, and language serves to "tag" the concepts as the child finds the relevant expressions that map onto those independently developed concepts. Thus, for example, the concept of individual objects (balls and what they do, tables and what they are for, girls and what they are like) may precede the attachment of words (*ball, table, girl*) to each of those objects; the concept of a class of concrete things (objects) may precede the development of a certain type of word (nouns) that serves to label them; the concept of particular actions (running) and states (being tired) will precede the development of labels to talk about those actions (*run*) and states (*tired*) in language; the concept of Figures moving

through space relative to a Ground via certain paths (into it, out of it, through it, under it, over it, etc.) will precede the acquisition of motion verbs and path expressions in language; concepts related to number and scalarity will precede and direct the acquisition of means for expressing scalarity in language; and so forth.

Under this possibility, we can make several predictions:

Predictions, C > L:

A. Developmental:

P1, C > L: Basis of Initial Linguistic Developments: Cognition. Linguistic development will be based on cognition: Children's initial steps into language will be associated with cognitive "primitives" or developing cognitive concepts:

(a) For early developments, the earliest linguistic steps should correlate with basic conceptual understandings associated with infant cognition and should map directly onto those. (Such cognitive understanding, it should be noted, could be either innate or emergent knowledge--that is, this position and prediction do not depend on the innateness of the conceptual basis on which language is built.)

(b) For later developments, the linguistic steps should be associated with (and follow) related cognitive developments. Language will be mapped directly onto a conceptual platform that has developed prior to and independently of language.

P2, C > L: Universal first linguistic steps? Yes. Across languages, children's first steps towards the development of specific types of linguistic structures will be universal, since children's "entry" into their linguistic systems will be based on the cognitive primitives or concepts to which the language is mapped. Thus, for example, all children's initial steps into the use of nouns might be associated with (whole, concrete) objects; children's first steps with tense marking will be based on children's earliest understanding of time and time relations. Where languages differ from the cognitive primitives, children learning those languages will have to later move on from this initial mapping and will need to alter their use away from this initial mapping as they develop further.

With developments related to language-specific "packaging" of semantic notions, we might also expect universal preferences for certain types of encoding. For example, where languages differ in whether they use specific encoding or general encoding for space, for eating, or for falling, we might expect all children to start with either specific mappings or general mappings as they "look for" the linguistic means to express their emerging cognitive

notions--notions that should be similar across groups because they develop independently from language. Only later will the children whose languages vary from the initial specific or general mapping move away from that towards patterns more like those in their language. Any influence of the specific language will come in later, as the child gains a greater command of the network of structures in that language.

P3, C > L: Timing of cognitive developments: Universal. The timing of cognitive developments should be uniform across languages and cultures. That is, cognitive advances should not be influenced by language and, hence, should occur at about the same time and in the same order, regardless of the language being learned.

P4, C > L: Timing of linguistic development relative to cognitive development: Language subsequent to cognition. In all cases, the linguistic developments should follow (or at least never precede) the cognitive developments. We might even expect that there would usually be a relatively close correlation in time between the development of cognitive understanding and the development of the linguistic means for expressing the related cognitive notions, since acquiring the linguistic forms should be relatively simple, involving a simple mapping of the linguistic forms directly onto already developed cognitive concepts. Or, if not close in time (e.g., it might be the case that for some concepts that the child is not sure at first which linguistic items that s/he is hearing should map onto those concepts), when the linguistic means for expressing the cognitive notions do come in (suggesting the child has "found" the relevant linguistic forms), they should do so fairly rapidly and effortlessly.

B. Adult Languages:

P5, C > L: Influence of language on cognition, Adult language: Minimal. Language should not influence cognition. If language is learned through a process of mapping linguistic meaning onto conceptual understanding, under a strong version of this hypothesis, language should never influence cognition.

P6, C > L: Universality of meaning in adult language? Yes. Adult languages should be similar: Under a strong version of this hypothesis, adult languages should look very similar in terms of the meanings expressed (and expressible).

II. Language precedes and directs Cognition (L > C)

The logically complementary position, that language precedes and directs the development of cognition, leads to some alternative predictions:

Predictions, L > C:

A. Developmental:

P1, L > C: Basis of Initial Linguistic Developments: Not cognition. Children's initial steps towards language should not be directed by cognition, but by something else. That something else could be something external, such as the input language they are hearing, or something internal that is independent of cognitive development, such as either innate knowledge of the principles of language, or 'Universal Grammar', or some natural implicational hierarchy within language itself.

P2, L > C: Universality of first linguistic steps? Not necessarily. First steps might be universal or not universal. If what guides linguistic development is external (e.g., input), then children should be guided from the beginning by the language they are learning. Children learning different languages should show differences in accordance with the differential means for encoding messages in the adult languages they are learning. If what guides development is internal (e.g., a language acquisition device or some natural implicational hierarchy within language itself), children's steps into language should be more uniform across languages.

P3, L > C: Timing of cognitive developments: Not universal. The timing of cognitive development will be influenced by linguistic, or by language-specific, structure: Language will influence cognition as the child gains facility with the specific linguistic means and manner of expressing concepts in language or in his/her language.

P4, L > C: Timing of linguistic development relative to cognitive development: Language prior to cognition. Linguistic development will occur prior to the development of related cognitive concepts.

B. Adult Language:

P5, L > C: Influence of language on cognition, Adult language? Yes. Language will influence cognition: What is encoded in language, or in the specific language spoken, will affect, for example, attentional preferences or memory for instances.

P6, L > C: Universality of meaning in adult language? Not necessarily. If what drives language development is external (input, and, therefore, the specific language), then there is no *a priori* reason why languages should express the same or similar meanings. If what drives language development is internal (a language acquisition device or some natural

implicational hierarchy within language itself), then languages should express similar meanings.

III. Language and cognition develop independently (L </> C)

Under both I and II, either cognition drives language or language drives cognition. A third logical possibility is that language development and cognitive development occur independently. Development in the linguistic realm will not initially entail or rely on prior cognitive advances, and development in the cognitive realm will not initially entail or rely on prior linguistic advances. (This possibility would still allow for the two to become linked at some later stage, although they are not linked initially.)

Predictions, L </> C:

A. Developmental:

P1, L </> C: Basis of Initial Linguistic Developments: Not cognition. As in the prior possibility, children's initial steps towards language should not be directed by cognition, but by something else. That something else could be something external, such as the input language they are hearing, or something internal that is independent of cognitive development, such as some predetermined language acquisition device or some natural implicational hierarchy within language itself. At the same time, children's initial steps towards cognitive concepts need not be in line with what they know or are learning linguistically.

P2, L </> C: Universality of first linguistic steps? Not necessarily. Also as in possibility II above, under this possibility, first steps into language might be universal or not universal. If what guides linguistic development is external (e.g., input), then children should be guided from the beginning by the language they are learning, and children learning different languages should show differences in accordance with the differential means for encoding messages in the adult languages they are learning. If what guides development is internal (e.g., a language acquisition device or some natural implicational hierarchy within language itself), children's steps into language should be more uniform across languages.

Predictions 3, 4, and 5 set this possibility off from possibility II (L > C):

P3, L </> C: Timing of cognitive developments: Independent from language. The timing of cognitive developments will occur independent of the timing of linguistic developments. Since cognitive advances are not influenced by language, nor, importantly, by differences across languages, cognitive development is most likely to be uniform across languages and

cultures. That is, cognitive advances should occur at about the same time and in the same order, regardless of the language being learned.

P4, L</> C: Timing of linguistic development relative to cognitive development: Independent. There will be no necessary link in the timing of development of linguistic and cognitive concepts, even if they might appear on the face of it to bear some resemblance.

B. Adult Language:

P5, L </> C: Influence of language on cognition, Adult language? No. Under a strong version of this position, language will not influence cognition.

P6, C </> L: Universality of meaning in adult language? Not necessarily. As under possibility II (L > C), if what drives language development is external (input, and, therefore, the specific language), then there is no *a priori* reason why languages should express the same or similar meanings. If what drives language development is internal (a language acquisition device or some natural implicational hierarchy within language itself), then languages should express similar meanings.

IV. Language and cognition interact in development (L ~ C)

A fourth position, an interactionist position, holds that Cognition and Language mutually interact in affecting developments. This leads to the following predictions:

Predictions, L ~ C:

Developmental:

P1, L ~ C: Basis of Initial Linguistic Developments: Mixed. In some cases, children's initial steps towards language will appear closely associated with cognitive processing and developments, and in other cases they may be guided by something else, such as the input or some internal language acquisition device. Similarly, in some cases, children's conceptual understanding will be influenced by the language-specific structures they are learning, in other cases not.

P2, L ~ C: Universality of first linguistic steps: Mixed. Some aspects of linguistic development may appear universal, others may appear non-universal. To the extent that linguistic developments build on prior cognitive developments, we can expect similarity across languages in linguistic development. Where linguistic developments are independent of cognition, the extent to which language development is universal will depend on whether external factors (input from the specific language) or internal factors (a language acquisition

device, or even language-internal progression (e.g., implicational hierarchies in development)) are influential.

P3, L ~ C: Timing of cognitive developments: Mixed. The timing of development will in some cases show cognition preceding language, and in some cases, language preceding cognition.

P4, L ~ C: Timing of linguistic development relative to cognitive development: Mixed. There is no necessary correlation between the timing of linguistic and cognitive developments; at times cognition will appear to precede language; at other times, language will appear to precede cognition.

Adult Languages:

P5, L ~ C: Influence of language on cognition, Adult language? Mixed. In some ways language may be seen to influence cognition, in other ways cognition may influence language.

P6, L ~ C: Universality of meaning in adult language? Mixed. Adult languages will be similar in some respects, different in others in terms of the meanings encoded and the relationships between meanings encoded.

Table 1. PREDICTIONS concerning development under the C > L, L > C, L</> C, and C ~ L positions

	Predictions regarding:	C > L	L > C	L </> C	C ~ L
DEVELOPMENTAL	Initial Linguistic Developments based on:	P1: Linguistic development based on cognition: first steps in language associated with cognitive "primitives" or developing cognitive concepts P1a: Early linguistic developments associated with infant cognition P1b: Later linguistic development associated with complex cognitive developments	P1: Children's initial steps towards language should not be directed by cognition, but by something else. That something else could be something external, such as the input language they are hearing, or something internal that is independent of cognitive development, such as either some predetermined language acquisition device or some natural implicational hierarchy within language itself.	P1: Children's initial steps towards language should not be directed by cognition, but by something else. That something else could be something external, such as the input language they are hearing, or something internal that is independent of cognitive development, such as either some predetermined language acquisition device or some natural implicational hierarchy within language itself. initial developments in cognition will not be influenced by the language being learned	P1: In some cases, the development of linguistic structures will be guided by conceptual understanding; in other cases, children's conceptual understanding will be influenced by the language-specific structures they are learning
	Universality of first steps into linguistic meaning	P2: Universal first steps: children across languages should map language onto same initial cognitive concepts; universal preferences for "packaging" of meaning	P2: First steps might be universal or not universal. If what guides linguistic development is external (e.g., input), then children should be guided from the beginning by the language they are learning. Children learning different languages should show differences in accordance with the differential means for encoding messages in the adult languages they are learning. If what guides development is internal (e.g., a language acquisition device or some natural implicational hierarchy within language itself), children's steps into language should be more uniform across languages.	P2: First steps might be universal or not universal. If what guides linguistic development is external (e.g., input), then children should be guided from the beginning by the language they are learning. Children learning different languages should show differences in accordance with the differential means for encoding messages in the adult languages they are learning. If what guides development is internal (e.g., a language acquisition device or some natural implicational hierarchy within language itself), children's steps into language should be more uniform across languages.	P2: Some aspects of linguistic development will appear universal, others will appear non-universal

	Timing of cognitive developments	P3: Universal timing of cognitive developments (and prior--or at least not subsequent to--language)	P3: Timing of cognitive developments will be influenced by language and language-specific structure	P3: The timing of cognitive developments will occur independent of the timing of linguistic developments. Since cognitive advances are not influenced by language, nor, importantly, by differences across languages, cognitive development is most likely to be uniform across languages and cultures. That is, cognitive advances should occur at about the same time and in the same order, regardless of the language being learned.	P3: Timing of cognitive developments will in some cases show C prior to L, in others L prior to C
	Timing of linguistic development relative to cognitive development	P4: Linguistic developments should be subsequent to (or at least never prior to) the cognitive developments. Perhaps close correlation in time between cognitive developments and linguistic developments.	P4: Linguistic developments will be prior to related cognitive developments	P4: There is no necessary correlation in timing between the development of linguistic concepts and the development of related cognitive concepts	P4: There is no necessary correlation in timing between the development of linguistic concepts and the development of related cognitive concepts; however, in some cases there will be clear associations between the two in development

Table 1. (continued) PREDICTIONS concerning development under the C > L, L > C, L</> C, and C ~ L positions.

		C > L	L > C	L </> C	C ~ L
ADULT LANGUAGE	Influence of language on cognition, Adult language	P5: Language should not influence cognition	P5: Language will influence cognition: What is encoded in language, or in the specific language spoken, will affect, for example, attentional preferences or memory for instances.	P5: Language should not influence cognition; cognition should not influence language	P5: In some ways language will influence cognition, in other ways cognition will influence language
	Universality of meaning in adult language	P6: Adult languages should be similar in the meanings encoded and the relationships between meanings encoded	P6: If what drives language development is external (input, and, therefore, the specific language), then there is no *a priori* reason why languages should express the same or similar meanings. If what drives language development is internal (a language acquisition device or some natural implicational hierarchy within language itself), then languages should express similar meanings.	P6: Adult languages could be vastly different in the meanings encoded and in the relationships between meanings encoded; also, language will influence thinking, and inguistic structure in one sub-area can influence thinking associated with another area	P6: Adult languages will be similar in some respects, different in others in terms of the meanings encoded and the relationships between meanings encoded

POSITIONS AND EVIDENCE

Evidence bearing on these predictions has been accruing over the last few decades as researchers have been grappling with means of examining the available data and theorizing from them. The following presents some of the major work. I will restrict discussion to the predictions that have to do with children's language (not the adult language), presenting evidence bearing on each of the four major questions on which the predictions are outlined above.

Prediction set 1. Basis of initial linguistic developments.

Is initial linguistic development based on cognition (or is it guided by something else--such as the input, an inborn language acquisition device, some (language-internal) implicational hierarchy)?

Much of the evidence on this question has focused on the earliest stages and the basic "building blocks" of development, such as the acquisition of Nouns and Verbs, of Subjects of sentences, and the like. The research can be grouped into three major sets of proposals: proposals growing out of Piagetian theories and studies of infant cognition, proposals concerning attentional preferences and processing, and proposals arising from nativist positions of language development in children.

Proposals based on Piaget and studies of infant cognition

One early version of the cognition-first hypothesis can be found in the work of researchers in the 1970's who drew on Piaget's posited universals of cognitive development and cognitive processing (Piaget, 1952) to propose that children's linguistic development maps onto, or is directly dependent on cognition. Piaget's theories posited universal stages of cognitive development that occurred according to a biological/cognitive time-clock in all children, across all cultures. During the first 12 to 18 months of life, Piaget argued, the child goes through a "sensorimotor" period, at the end of which the child discovers and arrives at a "stage" of understanding--a fundamental, globally encompassing, and stabilised understanding of the world and things in it. Some key attainments of the sensorimotor period, according to Piaget, were 'mental representation' (a figurative ability to produce a mental copy of something in the external world), the understanding of 'object permanence' (an understanding that objects

continue to exist out in the world even when they are out of sight and the infant's immediate environment), 'tool use' (the ability to use an object as an instrument for achieving some goal unrelated to that tool), and the understanding of 'means-ends'.

Given the concurrence in timing and the similarity of these concepts to children's early use of words, Piaget and other investigators proposed that these cognitive developments were directly linked with, and were prerequisites for, key linguistic developments in children. For example, Bloom (1970) argued that perceptual-cognitive functioning and abilities were key to, or prerequisites of, the development of object words (e.g., Bloom, 1973; cf. also McCune-Nicolich, 1981). Bloom & Lahey (1978) argued, "It is reasonable...to expect that children will learn the names of many objects only after they have achieved the sensorimotor landmark of learning about object permanence..." (p. 81) (with exceptions in the case of person names and names of objects closely associated with a child).

Further, the sensorimotor abilities were argued to be key for the emergence of syntactic structures. Bloom (1970) argued, "The fact that productivity of basic grammatical relations in the speech the children used was developmentally progressive leads to the conclusion that the emergence of syntactic structures in their speech depended on the prior development of the cognitive organization of experience that is coded by language" (p. 228) [emphasis added].[4]

Similarly, McCune-Nicolich (1981), as well as Sinclair (1972), proposed that mental representation, manifested in such behaviors as symbolic play (play in which one object is used as if it were another that it may or may not resemble), deferred imitation, recognition of pictured objects, and tests of object permanence, might be a prerequisite for the emergence of two-word utterances in language.

Challenges to these claims were not long in coming. First, as work within Piagetian theory itself progressed, researchers began questioning certain basic tenets, particularly Piaget's notion of "stages" and the methods that had been used in much Piagetian-based research (see, e.g., Brainerd, 1977, 1978). This caused some to try to modify the pursuit of cognitive

[4] But note: a child's linguistic competence was seen ultimately to be the product of an intersection of cognitive-perceptual development, nonlinguistic experience, and linguistic experience (Bloom, 1970: pp. 231-232).

prerequisites for language and to identify links between particular cognitive advances and particular linguistic achievements, rather than with broad developments like object permanence or the achievement of broad sensorimotor intelligence.

Bates, a pioneer in this regard, and her colleagues (Bates, 1979), for example, conducted a series of studies examining the emergence of linguistic abilities relative to more specific Piagetian skills, like tool use or symbolic play. These researchers found that, while tool use (i.e., 'object-to-object' tool use) emerged before conventional signalling (i.e., "person-to-object" tool use, or the 'protoimperative' of communicative use of reaching, and "object-to-person" tool use, or the 'protodeclarative' of communicative use of pointing), in some infants the order was the reverse (Bates, 1979: 141-143). When Piaget's Stage 6 developments were compared individually with the emergence of vocal naming, Bates, Camaioni, & Volterra (1975) found that only some of these correlated with vocal and gestural naming: e.g., while imitation and tool use did, object permanence did not (Bates, *et al.*, 1975; Bates, 1979:149). Bates concluded that, rather than developments in either domain being a prerequisite for developments in the other, the evidence supported a position in which cognitive developments and linguistic developments "share common structures because the associated tasks require the invention of independent but structurally similar solutions" (Bates, 1979:136); she argued for "homology through shared underlying 'software'" (Bates, 1979: 138). Examples of underlying developments might involve memory and attention: "specifically, the ability to interrupt a goal system and to maintain that goal system in memory, while simultaneously carrying out a search for alternative means" (p. 143).

Around the time that these challenges were being voiced, research was beginning to show much earlier cognitive capacities in infants than Piagetian theory had allowed for. Drawing on more sophisticated methods for examining infant cognition than were available in Piaget's time, researchers have identified a myriad of cognitive capacities demonstrably present even in the first weeks and months of life. These include some relatively sophisticated knowledge of the stability and coherence or spatiotemporal continuance of objects (Baillargeon, 1987; Spelke, 1990; Spelke et al.,1992); they include infants' discrimination of numbers of individuals (1 vs 2, 2 vs 3) (Starkey & Cooper, 1980; Strauss & Curtis, 1981; Antell & Keating,

1983; Starkey, Spelke, & Gelman, 1983; Van Loosbroek & Smitsman, 1990; Bijeljac-Babic, Bertoncini, & Mehler, 1991; Wynn, 1996; Carey, 2001); they include infants' discrimination of object-like entities from continuous substances (Xu & Carey, 1996; Huntley-Fenner, Carey, & Solimando, 2002); and they include understanding of dynamic events--a perceptual and motor understanding of the world--as well as of the potential for reversibility of movements across time and space (McCune-Nicolich, 1981; McCune, 2006).

Perhaps it is here, in these early prelinguistic cognitive abilities, that we should look for the language-to-cognition mappings that the C > L hypothesis would predict. Do infants develop abilities with nouns by mapping their earliest uses and knowledge of object words (nouns) onto object concepts? Do they develop use of number words by mapping their earliest uses of them directly onto the early cognition of numerosity? Do they map their earliest use of mass and count nouns onto the object-substance distinction from infancy? Do they map their development of dynamic event words directly onto their understanding of dynamic events?

The evidence comes quite strongly down against these possibilities. With regard to nouns, for example, in possible support of the C>L position, there is the suggestion (Gentner, 1982; Gentner & Boroditsky, 2001, 2009) that mapping words onto objects might be easier across the world's languages than mapping words onto less stable, more transient referents such as events. Thus, according to Gentner's Natural Partitions Hypothesis, nouns are easier to learn than verbs. (See Au, Dapretto, & Song, 1994; Choi & Gopnik, 1995; Tardif, 1996; Tardif, Gelman, & Xu, 1999, for debates on this issue.) Curiously, however, not all early nouns, indeed not all early words, are words for objects. Nelson (1988), for example, has continually argued that children's first words are not restricted to object words and, instead, include a relatively high proportion of personal/social words. (Among non-object noun words used by my granddaughter Sadie by the age of 18 months, for example, were substance words like *milk, water, paper, drink, money, poop* and words that involved non-concrete objects, actions, or transitory referents like *party, walk* (as in *go for a walk*), *lap, music, hug,* and *piggies* for requesting the toe game of "piggy went to market".) If early nouns include non-object words, the child's acquisition of Nouns as a linguistic category of words cannot in principle be based on an appreciation of objects in the world and a mapping of words onto that type of referent.

Even if nouns do indeed have a special status for acquisition, in that the pairings of words with their referents might be easier with nouns, it is important to note that this may tell us very little about the acquisition of the categories labeled by such nouns. That is, it is not necessarily the case that the earliest use of such nouns is categorical in any sense. Gentner & Boroditsky (2009) themselves leave open the possibility that categories may arise out of influence from the language being learned: "The natural partitions hypothesis concerns the relation between a word and a referent; there is no theoretical commitment to the early existence of categories. It may be that early categories *arise out* of the process of word extension, rather than determining the set of extensions" (p. 6).

Nor, importantly, are early nouns always used to refer exclusively to the objects that might correspond to the expected (adult norm) "object concepts". The very detailed work carried out by Dromi, for example, on her daughter Keren's early word use showed that at the very beginning stages (during the one-word period) of the acquisition of nouns and verbs, a child can show quite unstable usage of words. One pattern of usage that Dromi (1987, 1993, 2009) reports on is what she called "unclassified" uses: Words used ambiguously for actions and objects (e.g., the Hebrew word *sus* 'horse' used for bouncing movements, for riding, and for horses); used associatively rather than referentially (e.g., the word *dod* 'uncle' used for strangers and for whenever the child heard noises coming from outside); or used with shifting reference, sometimes for specific objects, sometimes for actions, or sometimes as cover terms for whole unanalyzed situations (Dromi, 1987, 1993, 1999, 2009). Dromi (2009) reports: "Unclassified behaviors, which comprised the most idiosyncratic and least conventional uses of words, were mainly recorded during initial weeks of production. Words that showed this behavior exhibited it over a long period of time (M = 7 weeks, range = 1-24 weeks)," despite Keren's mother's own attempts at modelling conventional usage of these words. Furthermore, during the initial phase of development (the first four months of the one word period), unclassified behaviors were recorded frequently, and often predominated. This is not what one would expect if nouns and word meanings are mapped directly onto pre-developed conceptualizations of objects and actions. The data suggest, instead, the acquisition of individual words in association with whole contexts or schemas of experience. This unpredictable use of words stopped suddenly just before

Dromi's daughter showed a lexical spurt, after which point she largely used words with more conventional meanings. The lexical spurt seems to be related, at least in part, to a realization of "how words mean".

Thus, although infants exhibit prelinguistic notions regarding objects, such notions do not appear to (always) be mapped directly onto nouns being acquired; the child must first learn what words do (often first associating words with whole schemas) and must learn that some words refer to objects, some to actions, and so forth.

Similar conclusions can be drawn from evidence in relation to infants' cognitive processing of number and the acquisition of number words and in relation to infants' appreciation of objects versus substances and their acquisition of the mass/count distinction. In relation to number, Carey (2004), for example, comments on the wide-ranging evidence showing that infants have abilities to discriminate small numbers of objects (e.g., one versus two or three). She proposes that infants possess two systems, an "analog magnitude representation" of numerosity, and a "parallel individuation model" for number. Both of these systems fail, however, to provide the means for understanding number fully, which she argues the child gains through learning "the count list" (see also Gelman's Stable Ordering Principle, e.g., Gelman, 1978; Gelman & Gallistel, 1978; Greeno, Riley, & Gelman, 1984; Gelman, Meck, & Merkin, 1986) and other aspects of language that encode numerosity, such as the singular-plural distinction and *some* and *a* in English. (See Gelman & Gallistel, 1978, for a conflicting view.) The child's acquisition of language related to numbers does not appear to build directly on infant cognition for number. Carey points out that Wynn's (1990, 1992b) work showed that children can count long before they attach appropriate number meaning to the words. They treat, e.g., *two* and *three* as if they mean 'many' (Gathercole, 2009, shows similar use of *two* for 'many' or plurality).

The language being learned, in fact, affects the semantic notions associated with numbers. Children learning distinct languages, languages that encode numerosity in different ways, learn the meanings of numbers at different times:

> Consider first classifier languages such as Chinese and Japanese that do not mark the distinction between singular and plural in nouns, verbs, or adjectives. Two independent studies have found that although children in China and Japan learn the count list as

> young as English-speaking children do, they become one-knowers [i.e., know what 'one' means] several months later and are relatively delayed at each stage of the process. Conversely, Russian has a complex plural system in which the morphological markers for sets of two, three, and four differ from those for five through ten. Two independent studies have shown that even Russian one- and two-knowers distinguish between the meanings of the number words 'two,' 'three,' and 'four,' on the one hand, and 'five,' 'six,' 'seven,' and 'eight,' on the other. (Carey, 2004: 64)

With regard to knowledge of substances versus objects and the acquisition of the mass/count distinction in language, while infants appear to be able to distinguish objects from substances, children do not appear to initially draw directly on this prelinguistic knowledge of objects versus substances to learn mass/count structures in language. In a series of elegant studies, for example, Gordon (1982, 1988) attempted to determine whether children drew on object- versus substance-like properties of referents in learning mass and count nouns. He contrasted this possibility with the possibility that children drew on linguistic aspects, such as occurrence with *a* (count) versus *some* (mass), to build the system. He found that children were more likely to use linguistic information in assigning nouns mass or count status. Similar results were obtained and reported in Gathercole (1985) in relation to children's acquisition of *much* (mass) and *many* (count) in relation to nouns: Children did not perform better in judgments of the use of *much* versus *many* when nouns related to prototypically object-like or substance-like referents than when they related to non-prototypical referents. In fact, there was some evidence that the link between *much* and *many* and the referential, countability properties of quantification of referents emerged as a late development, after around age 8 ½. A separate longitudinal study of the development of such terms (Gathercole, 2009) revealed that the development of *much* and *many* is a protracted and laborious process. (We will return to this below.)

Similar conclusions can be drawn regarding children's encoding of dynamic event words. In a review of children's early words and word combinations across languages, McCune (2006) argues that children's initial words are mapped onto dynamic event concepts. However, she adds that children's early cognition associated with dynamic events gets encoded in language-specific ways in the earliest utterances of children across languages. She argues in particular that

a perceptual and motor understanding of the world, and understanding of the potential for reversibility of movements across time and space, are critical to children's single-word repertoires, but these show up in distinct manners in each language. These understandings include reference to path (vertical and deictic), to space (Figures and Grounds) and to time (reversible event sequences). However, McCune argues that the cognition associated with the sensorimotor period does not imply specific 'conceptual' categories. She argues that children are dependent on language to mould this consistent early cognition toward concepts.

Thus, some of these key areas in which early infant cognition might have revealed a language-maps-onto-cognition mapping process as suggested by the C > L hypothesis fail to provide support for it.

Evidence based on attentional preferences

Some of the cognition-first work drew more generally on observations of attentional preferences in children, attentional preferences that appeared outside of language and independent of it. Among the most influential thinkers in this area was Slobin (1973, 1985). Slobin's work has been concerned over the years with what crosslinguistic comparisons of acquisition can reveal about the processes of acquisition. His early work focused on the striking similarities in the way in which children seemed to 'break into' the linguistic system. He argued that children seemed to use 'operating principles', or strategies that allowed them to focus on particular elements of the linguistic input, and it is there that they begin the learning process.

Some of Slobin's Operating Principles concerned what children paid attention to in the linguistic system or input itself. For example, his (1985) Operating Principle (ATTENTION): END OF UNIT was 'Pay attention to the last syllable of an extracted speech unit….' (p. 1166). This attempted to capture the fact that across languages, children appeared to pay attention to final syllables, among others (e.g., stressed, and initial syllables). Since such a principle has to do with the child's means of breaking into the linguistic code itself, rather than the relation between the language and cognitive knowledge, we will not address those here.

However, some of Slobin's operating principles concerned children's non-linguistic attentional biases and how these affected their language acquisition. Among these notions, for example, was Slobin's concept of "prototypical scenes/events". Slobin argued that

crosslinguistically there was evidence that children paid particular attention to certain kinds of activities or events. One of the most salient types of events was what he termed the "Manipulative Activity Scene" (corresponding to Lakoff and Johnson's (1980) "prototypical direct manipulation"). In this type of scene, an intentional, active agent performs some action that directly affects some patient, or receiver of the action: "the experiential gestalt of a basic causal event in which an agent carries out a physical and perceptible change of state in a patient by means of direct body contact or with an instrument under the agent's control" (Slobin, 1985: 1175). An example would be someone deliberately breaking a vase with a hammer. Such a manipulative activity scene, he argued, was "the prototypical Scene reflected in linguistic marking of transitivity..." (p. 1175).

Slobin argued that children take advantage of such prototypical scenes to map grammatical elements onto concepts. Thus, the child will learn to use linguistic means for marking direct objects (with accusative markers, word order, and the like) first in relation to patients involved in such prototypical object manipulation (e.g., the window in *John breaks window*), and only later extend such usage to less prototypical objects (e.g., the window in *John sees window*); similarly, children will learn the marking of subjects in relation to direct object manipulation, prototypically in transitive clauses, and then extend the linguistic marking to subjects of other types, as in intransitive clauses not involving object manipulation (*he ran*, for example).

Bowerman (1994 [1989]) examined such a suggestion by comparing the acquisition of nominative-accusative languages and the acquisition of ergative-absolutive languages. The two types of languages differ in how subjects of intransitive sentences are treated. In nominative-accusative languages, subjects of intransitive sentences are treated in the same fashion as subjects of transitive sentences--e.g., in English, one uses nominative form *he* in *he ran*, comparable to the form used for subjects of transitives, as in *he punched him* (not *him*, **him punched him*). In ergative-absolutive languages, subjects of intransitive sentences are treated like objects of transitive sentences: Agents in transitive sentences are marked with ergative marking, patients with absolutive marking; doers in intransitive sentences share the absolutive marking, like patients of

transitive sentences. (These characteristics of the two types of languages are summarized in Table 2.)

Thus, according to Slobin's proposal, if children map grammatical forms onto a prototypical concept of object manipulation, then children in both types of languages should learn how to express subjects and objects first in transitive sentences, and only later in intransitive sentences. In fully transitive sentences, two nominal expressions are used, one to express the agent, the other the receiver of the action. (Or, alternatively, children from both types of languages should begin by treating subjects of intransitive clauses in identical fashion--either like subjects of transitives or objects of transitives [i.e., so in one of the language types, children will have the incorrect marking].)

Table 2. Nominative-Accusative vs Ergative-Absolutive Languages

Universal Conditions:

Transitive clauses involve two NPs [order irrelevant]:

NP 1 V NP 2 (as in John opened the box)

Semantically, these two NPs typically express:

NP 1: animate agents/ topics -- intentional actors in prototypical object manipulation

NP 2: inanimate patients -- affected objects in prototypical object manipulation

Intransitive clauses involve a single NP [order irrelevant]:

NP 3 V (as in John cried)

Semantically, this NP typically expresses:

NP 3: often animate ; but often patients, receivers, not intentional actors

Grammatical marking in the two types of languages:

Nominative -- Accusative languages:

NP 1 & NP 3: Nominative; **NP 2**: Accusative

Ergative -- Absolutive languages:

NP 1: Ergative; **NP 2 & NP 3**: Absolutive

On examination of the available evidence, Bowerman discovered that right from the beginning, by the two-word stage, children learning each type of language treat intransitive constructions, in ways that conform to the structure of the language they are learning (Bowerman, 1994:352-354 [1989]; see also Schieffelin, 1985:556-564; Pye, 1992: 274-276).

Another type of attentional preference that has been observed in the last few decades is a preference for attaching linguistic forms to meanings in which certain perceptual characteristics are prominent. Some cognition-first work posits that the linguistic means of expressing salient concepts should be learned by children first, those expressing less salient concepts later. One area in which this approach was evident was in work positing a shape bias in children. As noted in the chapter on the acquisition of word meaning, a large body of research has posited that children assume that new nouns are extendible on the basis of shape [p. 41 ms]. But as we saw, one of the major proponents of such a bias has ultimately concluded that this bias is not a cognitive stepping stone for breaking into word meaning, but rather is an outgrowth of learning words, specifically nouns. [pp. 49-50 ms]. That is, it is an emergent property that grows out of learning many nouns and drawing out commonalities among them.

In-born mappings

A third set of proposals that can be interpreted as falling into the cognition-first view posited that there is specific in-born knowledge concerning which types of concepts or meanings get mapped onto (which aspects of) language. The innate linguistic endowment provides specific guidelines concerning what types of concepts to map onto what types of linguistic elements, or concerning which types of concepts are grammaticizable with grammatical morphemes. (Note that these theories are not usually expressed explicitly in terms of a cognition-first approach, but on close examination they entail such a position.)

Semantic Bootstrapping:

Such a proposal is the Semantic Bootstrapping Hypothesis (Pinker, 1984, 1987, 1989). This claimed that children are born with innately endowed knowledge that certain conceptually accessible notions, such as objects, actions, agents, are linked universally with specific linguistic

categories like Noun, Verb, Subject.[5] The original impetus for Semantic Bootstrapping was the observation that young children's early two-word utterances across languages could generally be described as encoding a small set of semantic relations such as Agent-Action, Action-Patient, Agent-Patient, Action-Location, State-Location, and so forth (Brown, 1973, Schlesinger, 1988). If children's early grammars were based on semantics, how did they move from semantics-based rules to syntax-based rules?

Under Semantic Bootstrapping, the answer was that the task for the child was one of anchoring their first grammars to the conceptual/semantic categories that the infant understood (agents, objects, actions). S/he had to find the linguistic forms or means of referring to these conceptual types and linking those with the conceptual/semantic categories that each expressed: objects-Nouns, agents-Subjects, actions-Verbs. This linkage provides a 'foot in the door', so to speak, into the linguistic system to be learned, which eventually had to move from a semantically based system to a syntactically based system.

To move to a more syntactically based system, the process of language acquisition entailed work beyond these initial mappings. This is because none of the linguistic categories (Noun, Verb, Subject, Count Noun, Mass Noun, etc.) uniquely corresponds to the conceptual types in question. Thus, for example, as noted above, the category Noun not only involves words referring to objects, but also includes words for emotions (*happiness*), social constructs (*party, father-in-law*), abstract concepts (*ingenuity*), parts of objects (*arm*), materials (*felt*), and so forth; the category Subject not only applies to the expression of agents, but also includes words expressing instruments (*The key opened the door*), patients (*The building was destroyed*), sources (*The stalactite dripped continually*), goals (*The boy received the letter*), and so forth. To accommodate this lack of a

[5] A note on the term 'Semantic Bootstrapping': Although the term 'semantic' is used, it is clear that it is the cognitive accessibility of concepts of objects, actions, agents, and the like that give them the status they have in these theories as entry-ways into the system. If one makes a distinction between cognitive knowledge and what gets systematized semantically in language, as, e.g., in Schlesinger (1988), a distinction that recognizes that different languages have distinct semantic systems (just as they have distinct syntactic systems, Croft, 2001), then semantic concepts of 'agent' and so forth have to be derivative from the system and cannot be 'given'.

one-to-one correspondence between the cognitive and linguistic categories, the theory proposed that the child does not stop with just getting the foot in the door through the innate linkages. Children combine this initial mapping with subsequent distributional analysis, eventually broadening the linguistic categories beyond the cognitive categories entailed by the innate linkages.

The child accomplishes this broadening by comparing the linguistic patterns associated with the forms involved in the innate linkages with the patterns involving other types of referents. That is, the child pays attention to the patterns of distribution for the forms first mapped to the cognitive concepts. Then any other forms that share the same distributional privileges as these initial forms will be grouped with the latter. In this way, the child extends the linguistic category to any other forms that have the same type of distribution. For example, the child figures out how words for objects or words for agents get expressed in the language--in English, words for objects like balls can appear with *the*___, with *a*___, with ___*s*, after *my*___, and so forth. Since words like *party, father-in-law, ingenuity, arm, felt*, and the like can occur in (some of) these same contexts, they will be grouped with *ball* in the category of Nouns. Similarly, words for agents, linked with the linguistic category Subject, in English typically appear at the beginning of a sentence, in front of the predicate, and can control whether the predicate occurs with a word-final ___*s* (*The clown make*s *the children laugh*). Since the instruments, patients, sources, and goals in sentences like those above share these distributional privileges with agents, then the category Subject will be expanded to include these.

There are several predictions one could make to test the Semantic Bootstrapping Hypothesis . Among these, one could predict, first, that the earliest linguistic forms used in relation to a particular concept would be those that conform with those that are considered most 'central' to the mapping. Thus, the earliest Nouns would be words for objects, the earliest Verbs would be words for actions, the earliest Subjects would be ones expressing agents, and so forth. Furthermore, any forms that deviated from this central mapping would be harder for children to learn and would take longer. Thus, for example, prototypical agent-patient verbs should be acquired before other types of verbs.

These predictions have been shown not to hold up against the scrutiny of real child language data. Bowerman (1990) argued that in the speech of her two daughters, some of the structures that were predicted to be least problematic for children were ones in which her daughters made word order errors. Uziel-Karl (2006, 2007; Uziel-Karl & Budwig, 2007) has reported similar findings for Hebrew. In data from young Hebrew-speaking children, the earliest Subjects were not restricted to agents, and early verbs were not limited to agent-patient verbs. In fact, the data point to verb-by-verb learning and influence of the input, even in cases where two verbs have similar meanings and transitivity value. Morris, Cottrell, & Elman (2000) argued, further, that syntactic constructs like "Subject", rather than being "given", emerge from rote-learned "mini-grammars" that eventually merge. In fact, these authors argue, linking rules of the type posited by the Semantic Bootstrapping theory appear late in development (age 6 or later) and represent "highly abstract generalizations" resulting from the mastery of large portions of the grammar. (See further comparison of semantic versus syntactic beginnings in Braine, 1992. See also Ninio, 1999, 2000.)

Language Bioprogram Hypothesis:

Similar to the Semantic Bootstrapping Hypothesis, Bickerton's (1981, 1984) Language Bioprogram Hypothesis posited that certain semantic and conceptual categories or distinctions are innately programmed for marking in the language to be learned by the child. Among those categories were distinctions relevant to tense and aspect marking: *state* versus *process* and *punctual* versus *nonpunctual* events. Bickerton held that early in development, these distinctions will be respected, in that children will map distinct grammatical forms to the semantically distinct concepts. (See Bickerton, 1999, for later formulations.)

As with Semantic Bootstrapping, this hypothesis has not gone unchallenged. Li and colleagues (Li & Bowerman, 1998; Li & Shirai, 2000; Li, 2009), for example, have argued that Chinese-speaking children differ from English-speaking children in the way in which they "carve up" the aspectual and tense distinctions they are learning. Importantly, children appear sensitive to the way in which the language being learned structures distinctions. Li (2009) argues, instead, that semantic categories emerge from children's statistical learning of the input language: "children are highly sensitive to language-specific properties of the input, and are capable of

extracting systematic patterns from the input" (p. 264).

In another study, Shirai & Miyata (2006) examined the early acquisition of the past tense marker -*ta* in Japanese. They found that the children they studied all arrived at productive use of this morpheme long before they used it semantically appropriately. They conclude that a child's syntactically or morphologically 'correct' use of a form does not necessarily entail full understanding of the conceptual underpinnings associated with that form. These researchers also point out that subtle semantic differences across languages in the use of forms is often overlooked in broad theoretical accounts that attribute clear-cut semantic distinctions to such forms (see also Slobin, 1997b).

With regard to the first set of predictions, then, concerning whether linguistic forms are built by mapping language onto already developed cognitive concepts, the weight of the evidence fails to support this. The evidence cited above suggests, instead, that language, at least in many cases, develops as its own system. That system may have links with cognition (see below), but it is not "built" directly using cognitive concepts as the base or the "bricks" of the system.

Prediction set 2: Universality of first linguistic steps

Let us turn to the second set of predictions, those that concern the possible universality of linguistic developments. The predictions, again, if language is built directly onto a cognitive base, are that across languages, children's first steps should be uniform. What children appear to be trying to say across languages, and the way in which children attempt to put their non-linguistic knowledge into language/words, should be very very similar, if not identical. Again, the bulk of the evidence shows that, at least for many, many aspects of language, this is not the case.

We can start with evidence from even within a single language. As noted above, one impetus behind the Semantic Bootstrapping Hypothesis was the evident similarity in children's two-word utterances across languages in terms of the semantic notions children were expressing; it consisted of an attempt to bridge a perceived gap between such early semantic grammars and later syntactic grammars. Brown (1973), for example, noted a very small set of semantic relations that appeared to be expressed over and over in children's two-word utterances across languages.

These included, for example, the relations Agent-Action, Action-Object, Possessor-Possessed, Entity-Attribute, and so forth. But even at this early date, in a very influential monograph, Braine (1976) carefully examined the emergence of semantic and syntactic categories and rules in individual children's two-word utterances. On the basis of the relative timing of emergence and the consistency of word order in children's two-word utterances, Braine traced the rules governing several children's early word combinations. One of the striking findings he reported was that, although there was an overall similarity across children's two-word utterances, with children generally expressing the types of semantic notions others had reported, the similarities in fact grew as children's abilities increased. At initial stages, however, the rules governing any two children's word combinations might be so different that there is no overlap between them. Braine concluded that children's earliest word combinations were based on limited scope formulas, not on general semantic (or syntactic) notions. It was only with the expansion of those limited scope formulas that children's early word combinations begin to converge and take on the look of expressing the more general semantic relations posited in others' work. Others' work, most notably that of Lieven & Pine (Pine & Lieven, 1993, 1997; Lieven, Pine, & Baldwin, 1997; Pine, Lieven, & Rowland, 1998), has extended the theory that language development emerges on the basis of such limited scope formulas. They too have found that early grammars across children can be quite distinct initially and only converge with development.

Across languages, differences in children's first steps into language are even more apparent. Bowerman & Choi's (Bowerman, 1996a, 1996b; Choi, 1997; Choi & Bowerman, 1991; Bowerman & Choi, 2001) work on the development of spatial relations in English versus Korean has made it clear that children learning each of those languages have early grammars that are more like those of the adults around them than they are to each other. These differences are apparent already by age two (Choi & Bowerman, 1991; Bowerman, 1996a, 1996b; Choi, 1997; Bowerman & Choi, 2001; Casasola, Wilbourn, & Yang, 2006; Choi, 2006; see also de León, 2001, Brown, 2001). Furthermore, about the same time as the child begins to use the spatial expressions available in the adult language, children's attention appears to be guided by that language (Choi, 2006), so that they stop paying attention to (at least some of the) distinctions not relevant to the input language. Furthermore, the structure of the language will influence the generalization of

spatial encoding beyond the first steps taken in the given language (Sinha, Thorseng, Hayashi, & Plunkett, 1994).

Similar findings have been reported for the expression of motion. Slobin and colleagues have closely examined children's description of motion events across languages, examining both verb-framed languages (in which Path is incorporated into the main verb, as in Spanish above) and satellite-framed languages (in which Path is expressed outside the main verb, as in English above). From the beginning, children generally use ways of referring to motion events that are fairly consistent with the language being learned (Choi & Bowerman, 1991; Berman & Slobin, 1994; Slobin, 1996b, 1997a). And, even beyond that, differences in languages in how paths of motion are expressed carry over to differences in how paths of vision are expressed: Even there children differ across languages, with those from satellite-framed languages expressing more complex Paths in relation to vision than those from verb-framed languages (Slobin, 2009). It should be noted that here (as elsewhere, see discussion below) children's patterns are not always identical to those of their adult counterparts. Hickmann & Hendriks (2006), for example, examined French-speaking children's use of motion verbs. French is a verb-framed language, with Path encoded in the main verb. Hickmann & Hendriks found that in some ways the French-speaking children's use of forms was unlike that of either French- or English-speaking adults, was in some ways like that of English-speaking adults, and was in other ways like that of French-speaking adults The authors suggest that one factor contributing to the patterns observed in the children's speech is the lexical knowledge. That is, the influence of the language input on children's syntactic and semantic patterns is modulated by their knowledge of the lexical items that instantiate those patterns.

Even in relation to nominal reference, one finds differences very early on in what children expect new nouns to refer to. Contrary to proposals suggesting that children automatically assume new words refer to whole objects (which would be a version of bootstrapping), children learning distinct languages appear to make inferences in line with the language they are learning. Thus, in relation to non-complex objects, Japanese-speaking children are more likely to interpret a new nominal form as referring to material makeup than English-speaking children (Imai & Gentner, 1997), and Korean-speaking children are more likely to

extend new words on the basis of function than English- or Spanish-speaking children (Gathercole & Min, 1997). In relation to arrays of objects that can be interpreted either as several single individuals or as collections, children who are acquiring Welsh are more likely than those acquiring English or Spanish to allow a new noun to refer to a collection (Gathercole, Thomas, & Evans, 2000). These differences are already apparent by 2 or 2 ½ years of age.

In the acquisition of morpho-syntactic systems such as the marking of aspect and tense, as noted above, cross-linguistic differences also appear apparent early. Weist (in press) points out how the tense-aspect structure of a language affects children's early linguistic abilities--e.g., Polish-speaking children use past tense imperfective verb forms relatively early; English-speaking children use past tense progressive forms relatively late; Inuktitut-speaking children use a prospective aspect suffix, *-si-*, to refer to the future, much earlier than is the norm in typical Indo-European languages. Li (2009), as we saw, argues similarly that Chinese-speaking children differ from the start from their English-speaking counterparts in how they use and extend aspect markers in their acquisition.

Furthermore, in the acquisition of word meaning, there does not seem to be a universal preference either for specific or general terms. It is not the case that children aim at a particular level of understanding of the world (whether at a specific or general level) and then either expand to a more general level or break that down into more specific reference. For example, de León (2001, 2009) reports that in Tzotzil, terms for eating, for falling, for space, and the like are not always acquired at either a specific or general level of abstraction. For example, of the several words for falling in Tzotzil, among the first verbs to be acquired are both the general verb *p'aj* 'fall from high' and several very specific verbs encoding manner of fall, angle of fall, and Figure/Ground contact. Children learn these and use them appropriately by age 2;0 (de León, 2009). Similarly, Narasimhan & Brown (2009) report on the acquisition of terms for containment in Hindi and Tzeltal and find no preference in either direction for specific or general terms. They report that in Hindi, children learn the most general form, *mE* 'in', early (and they use it in a general, not a specific fashion), while in Tzeltal, the early words include both one of the general forms, *och* 'enter', and many of the specific forms, such as *ch'ik* 'insert between parallel long thing things', *lut* 'insert tightly between', and *tik'* 'insert into container' (while yet another general form,

y-util 'its-inside', is not acquired until much later). De León (2009) comments, "early lexical learning is guided by the *particular* intersection of linguistic and cognitive factors in the native language. The different weights these factors have in the learning task is particular to the language being learned" (p. 91).

For prediction set 2, then, the data reveal little support for a position positing that language is learned by mapping linguistic structures directly onto universally developing cognitive structures. The data reveal that children learning different languages must be guided from the beginning, at least in part, by the language they are learning. The extent to which that guidance is independent from cognitive knowledge and the extent to which it may interact with cognitive knowledge, even if it doesn't build directly on such knowledge, will be addressed below.

Prediction set 3: Timing of cognitive developments

The previous two sections indicate that (1) language is not directly mapped onto pre-developed cognitive notions, and (2) children acquiring different languages are guided from the beginning by the language they are learning. As discussed in the introduction, these findings suggest either that language development and cognitive development are independent from one another or that language development and cognitive development interact in development. In the former case, it is possible--nay, probable--that cognitive developments may still proceed in a uniform order and at a universal pace in children. In the latter case, however, there is a strong possibility that children's developing cognitive knowledge will be affected by language development.

The possibilities for this set of predictions have been much less extensively studied than those for the previous two sets. However, there is some evidence available pointing toward interaction effects, not total independence. With regard to prediction set 3 and the timing of cognitive developments, there is some evidence indicating that cognitive abilities do not emerge in identical fashion across language groups. In fact, the emergence of cognitive notions appears, at least in some cases, to be directly tied with the emergence of the language related to the linguistic expression of those notions.

A seminal study was carried out by Gopnik & Choi (1990), who provided one of the earliest elegant demonstrations that the language children are learning-- English, French, or Korean -- may provide a guide for the cognitive abilities they develop and the order in which those cognitive skills emerge. These researchers followed the emergence of linguistic and cognitive abilities in children aged around 17 months over a period of 6 months. For linguistic development, they examined the children's use of language concerning disappearance and language concerning success and failure, and the occurrence and timing of a naming spurt; for cognitive development, they examined potentially related cognitive abilities for object-permanence [tested by observing children's reactions to the "disappearance" of an object, e.g., under a blanket], means-ends [tested by observing children's use of one object (e.g., a string) to obtain another (a toy on a table too far to reach)], and categorization [tested by having the child spontaneously sort objects of two kinds].

In relation to object permanence/disappearance and means-ends/success-failure, in the linguistic realm, Korean children used many more verbs than English-speaking and French-speaking children. And, interestingly, the Korean-speaking children all developed means-ends knowledge before object permanence, while English-speaking children were mixed half and half as to which of these developed first. With regard to both of these areas, the cognitive abilities were closely linked in time with the development of the related linguistic abilities (at a gap of 10 to 14 days). (The gap between un-related cognitive and linguistic abilities (e.g., disappearance and means-ends abilities) was much longer, 28 to 69 days.) (I will return to this below.)

With regard to categorization and the naming spurt, the Korean children were <u>much</u> delayed relative to the English-speaking children. The English-speaking children all developed the cognitive skill of categorization (and the related linguistic naming spurt) about the same time as object permanence; furthermore, about half of the English speakers developed means-ends knowledge about the same time as the other two cognitive abilities, while half developed this ability later. For the Korean children, categorization (and the related linguistic naming spurt) developed much later than object permanence and means-ends abilities. In fact, two of the 5

Korean subjects did not develop categorization (or a naming spurt) even by the time the study ended.[6]

Gopnik & Choi remark that these results are likely due to the much higher percentage of verbs in the input and in the output for Korean-speaking children than for English-speaking children: "The relatively lesser importance of nouns in Korean may lead the children to pay less attention to this area of language and so to pay less attention to the kinds of object-categorization that are encoded by nouns" (p. 212). They add, "We already know that children attack different cognitive problems in different orders and at least part of their decision about which problems to attack first may be influenced by linguistic input. Moreover, linguistic clues might facilitate certain cognitive developments even if those developments could, in principle, be attained independently of language" (p. 213).

Other research is also suggestive. Weist (in press) points out that work by Peterson & Rideout (1998) showed that talking about a medical emergency affected later recall in children: 2-year-old children had better recall of a medical emergency involving a trip to the emergency room up to two years later if they could talk about the experience in an interview at the time. Later work by Peterson and colleagues supports this finding: In a study of 2- to 13-year-olds' memory of a medical emergency, Peterson (1999) found that an extra interview one year between the event and two years later helped younger children recall the hospital visit and helped all children's accurate recall of the hospital visit (less memorable than the injury itself, which was less affected by interviews). Peterson, Pardy, Tizzard-Drover, & Warren (2005) similarly found that 3- to 13-year-olds who were not interviewed about an emergency until a year later had less accurate recall of the hospital visit than those who had been. Furthermore, children whose parents have an elaborative style when talking with their child about that child's medical emergency have better memories of the hospital treatment than those whose parents are less elaborative (Peterson, Sales, Rees, & Fivush, 2007). Although these studies do not have to do with the timing of cognitive abilities per se, they do suggest that language provides a boost for memory, particularly of less memorable events, and especially in younger children.

[6] See footnote XX in chapter XXX questioning the reality of the 'naming spurt' in general.

On the other hand, linguistic differences do not always seem to lead to cognitive differences. Weist, Lyytinen, Wysocka, & Atanassova (1997) examined cognitive and linguistic developments in Polish- and Finnish-speaking children, specifically with regard to concepts of time and space. The structure of Polish, they reasoned, might facilitate temporal knowledge: The linguistic mapping shows a one-to-one correspondence with temporal concepts, in that tense morphology is separate from aspect morphology, and there is an invariant way to encode past tense. The structure of Finnish, on the other hand, might facilitate spatial knowledge, in that that language has at least six cases used to express distinct spatial concepts. On tasks probing temporal concepts, these predictions did not hold; the Polish children's performance did not exceed that of the Finnish children. On tasks probing spatial concepts, however, the Finnish children did indeed outperform their Polish peers. In a follow-up study, however, Weist, Atanassova, Wysocka, & Pawlak (1999)) failed to find an interaction of conceptual development by language group.

These studies are suggestive. Cognitive knowledge or abilities do not necessarily appear at different times across groups, even if the linguistic systems they are learning treat the related linguistic expression of similar concepts in dramatically distinct fashion. However, in some cases, they do in fact appear to be timed differently, and the difference in timing appears to be related to differences in the related linguistic developments.

Prediction set 4: Timing of linguistic development relative to cognitive development

The last set of predictions concerns the relative timing of developments in the linguistic and cognitive realms. If linguistic and cognitive developments occur independently, again, there is no reason why the linguistic and cognitive advances should occur in step with each other. If the two interact in development, on the other hand, we could expect close links in the timing of developments in the two realms.

On the one hand, there is evidence that at least in some cases, developments in the two are closely tied in time. As noted above, in the Gopnik & Choi (1990) study, there was a very striking link in timing in the development of the related linguistic and cognitive developments having to do with object permanence/disappearance, means-ends/success-failure, and categorization/a word spurt for all three language groups of children. First, the gaps between

the related developments were much shorter (for object permanence/disappearance and means-ends/success-failure words an average of 10 to 14 days) than between unrelated cognitive and linguistic developments (28 to 69 days), and, in fact, more striking, "at least half the children solved the cognitive tasks and acquired the related linguistic developments in the same session" (p. 206). So the timing of the related developments was closely linked.

Secondly, it is important to note that the timing was not always in a single direction. The "gap" between the cognitive and linguistic developments that Gopnik & Choi discuss could have been in either direction, but at least "some children acquired the linguistic developments before they solved the cognitive tasks" (p. 206). The very close relationship between the timing of the related cognitive and linguistic developments, in all three groups of children, plus the fact that categorization, alongside a naming spurt, was considerably delayed in the Korean-speaking children suggests, according to Gopnik & Choi, a strong, interactive, relationship between linguistic and cognitive developments.

Similarly, in her work on children's early development of spatial terms and concepts of spatial relations, Choi reports a link in time between the acquisition of the linguistic forms for expressing spatial relations and infants' attentional behavior. Under the age of 29 months, children from both English- and Korean-speaking environments show attention to both containment and tight- versus loose-fit situations (McDonough, Choi, & Mandler, 2003). Choi (2006) asked at what point the linguistic system being learned affects (i.e., diminishes) infants' sensitivity to potential spatial contrasts that are not encoded in their language. She exposed English-learning babies at 18, 24, 29, and 36 months (and Korean babies at 29 and 36 months) to the Korean-relevant category distinction of tight-IN versus loose-IN. She found that English babies at 18 and 24 months were sensitive to the relative fit dichotomy. However, at 29 and 36 months, this sensitivity was weakened: Infants were still sensitive to a category of tight-IN, but not to one for loose-IN. (Korean children at 29 and 36 months, in contrast, retained attention to both tight fit and loose fit.) Importantly, the English-learning babies' sensitivity at the higher ages was related to whether or not they already used the English word *in* and to infants' vocabularies. Those who produced *in* or had a high vocabulary level showed much less sensitivity to the difference between tight-IN and loose-IN than those who did not yet produce *in*

or had a low vocabulary level. This very close timing between the language children are learning and their attentional preferences mirrors long-standing work in the realm of phonology that shows a similar progression: initial sensitivity to phonetic contrasts that may not be relevant to the language being learned, followed by a later insensitivity to those phonetic differences that are not phonologically distinguished in the language being learned (Werker & Tees, 1984).

In the realm of temporal and aspect systems, Weist and colleagues (Weist et al., 1997; Weist et al., 1999; Weist, 2008, in press) found that children learning Polish, Finnish, and English showed consistently high correlations between linguistic and cognitive abilities. Weist (in press) proposes that their data show that children are "conceptually ready" for the challenges that language acquisition will bring. The conceptual readiness includes infant memory for past events and infants' use of distance and direction information in spatial orientation. With regard to space and time, even very young children are ready to communicate "mono-referential" relations--for time, the location of events relative to speech time; for space, the location of an object relative to a referent object. During the preschool phase, temporal and spatial systems become more complex; children become capable of understanding and expressing "bi-referential" relations. Weist (in press) remarks, "As language acquisition progresses into more complex ways of locating events in time and objects in space, the capacity to think about temporal and spatial representation also changes. Furthermore, the developments in the spatial and temporal domains run parallel" (p. 25). And, as children get older, "Higher-order thinking in space and time co-varies with the emergence of complex spatial and temporal language systems" (p. 28).

On the other hand, alongside such evidence of close relationship in the timing of linguistic and conceptual advances in children, there are also innumerable examples of cases of an asynchrony in the developments in these two realms. First, children can show early acquisition of linguistic structures long before they are able to associate those structures with adult-like usage/meaning. As noted above, Shirai and Miyata's (2006) examination of the early acquisition of the past tense marker -*ta* in four Japanese-speaking children's speech revealed that they all showed productive use of this morpheme long before appropriate use of the form for deictic past. They concluded that a child's syntactically or morphologically 'correct' use of a form does not necessarily entail full understanding of the conceptual underpinnings associated with

that form. Narasimhan & Brown (2009) report that in the acquisition of the Hindi expression *mE* 'in', non-spatial uses are frequent in the input, but the young children they studied didn't use *mE* for non-spatial uses. Gathercole (2009) examined children's usage of a variety of scalar expressions up to age 6, and she reports that children begin using linguistic forms like *too X*, *catch up with*, *as X as* long before they use them for encoding relative position on an ascending scale.

Even more puzzling are cases when children clearly have available some aspects of conceptual knowledge, but they fail to make use of those conceptual aspects in their use of (what in the adult language are) related language. All of the items discussed above indicating early infant cognition that does not get attached to relevant linguistic forms fall into this category--e.g., early appreciation of objects versus substances does not immediately or automatically carry over to children's early acquisition of mass/count language; early knowledge of number does not automatically get connected with the acquisition of numbers, even small numbers (*two*). In a study of children's extension of new words on the basis of common material makeup and function, Gathercole & Whitfield (2001) observed that children were often intensely interested in those material-associated functions but then extended new words on the basis of shape.

These studies together suggest a mixed answer--in some ways the data reveal clear interaction between language and cognition; in other ways the data reveal clear independence, at least at initial stages.

INTEGRATION

These studies together provide a complex picture of the relation between language and cognition. The combined data suggest:

1. Initial steps to language development and cognitive development can be taken independently. Studies of infant cognition make it clear that at least some cognitive abilities are present or emerge during the first year of life, independent from language. Studies of children's first steps into language make it clear that at least some linguistic abilities emerge on the basis of the child's processing of the input and developing networks of forms within the linguistic system itself. That linguistic development takes shape according to structures in the input, so that children acquiring distinct systems look more like the adults around them than they do to each other.

2. At the same time, the semantic elements that a child associates with the linguistic forms s/he is learning are clearly limited on the outside by what the child is "conceptually ready" to associate with them. Before children are capable of a bi-referential systems, they treat temporal and spatial linguistic forms as expressing mono-referential relations. Before children have any concept of relative locations of items along the same scale, they use scalar forms as if they express non-scalar notions. Prelinguistic infants seem to develop a proto-concept of canonical sense of containment, so if their language does have a single morpheme to express containment, the acquisition of that morpheme "takes off" from that canonical sense (Sinha *et al.*, 1994).

3. With time and experience, the child draws the cognitive and linguistic systems together. This process appears to involve a continual interweaving of cognitive and linguistic elements (as it does phonological, morphological, semantic, and syntactic elements--see examples in Bowerman, 1982a; Karmiloff-Smith, 1992; Gathercole, 2006, 2009; Li, 2009). As connections are made, a complex web is woven. Later restructuring of forms that may have been in the child's speech for years is common (Bowerman, 1982b; Karmiloff-Smith, 1992; Gathercole, 2009). Carey provides at least one suggestion of how the two realms eventually get linked--through a process that she terms "bootstrapping" (distinct from the "semantic bootstrapping" discussed above)--a process whereby knowledge in one area is brought into knowledge in another realm, and the two become linked in an interactive network:

> Bootstrapping capitalizes on our ability to learn sets of symbols and the relations among them directly, independently of any meaning assigned to them in terms of antecedently interpreted mental representations. These external symbols then serve as placeholders, to be filled in with richer and richer meanings. The processes that fill the placeholders create mappings between previously separate systems of representation, drawing on the human capacity for analogical reasoning and inductive inference. The power of the resulting system of concepts derives from the combination and integration of previously distinct representational systems. (Carey, 2004, p. 66)

4. As the linguistic and cognitive realms become intertwined, they mutually affect one another. Language can provide two important factors that help to structure cognition: (1) Language

specifies the "boundaries" of categories and "fixes" the focus, and (2) language influences attention.

With regards to the first, as noted by Hampton (2007), the world does not provide the lines dividing categories. Language provides information on where the boundaries should be placed. This is the case in relation to spatial relations, in relation to temporal and aspectual categories, in relation to individual lexicalized categories, and so forth. (See interesting work on bilinguals in this regard, indicating some convergence of the boundaries imposed by their two languages, e.g., Malt & Sloman, 2003; Malt, Sloman, & Gennari, 2003; Gathercole & Moawad, under review.)

Furthermore, the way in which events and objects can be construed is very flexible. Croft (2009) discusses how even within a given language, scalar adjustment in the use of a form can affect the conceptualization of the event in terms of a fine-grained versus coarse-grained interpretation. Thus, for example, *hikes* can be taken as encoding a coarse-grained interpretation of the activity across time (being interpreted as "habitual"), whereas *is hiking* can be taken as encoding a fine-grained interpretation of the activity across time (being interpreted as ongoing activity). Similarly, construal operations allow alternative ways to construe the structure of an object--e.g., for *hair*: "*a hair* profiles a single ('uniplex'—Talmy[, 1985]) object whereas *hair* profiles a plural ('multiplex') collection" (Croft, 2009:156). Within a language, we can continually adjust the conceptualization. But across languages, it may well be that languages differ in the type of conceptualization that is preferred/more frequent/dominant, so that one construal may take precedence. So whereas *hikes* in English is taken as coarse-grained, in Spanish the equivalent present tense form can be taken as fine-grained, in reference to an ongoing activity. While English may prefer the multiplex use of *hair*, Spanish appears more neutral, allowing both the uniplex and multiplex interpretations about equally.

Children need to learn the construals and focus that are relevant to their language. This includes whether one talks about things like eating, falling, containment in general terms or specific terms. The scalar adjustment is "set" by the language. It includes whether one distinguishes trajectory paths from endpoint paths (Choi, 2009). It includes whether one treats

arrays that come in multiples as individuals or collections. It includes whether one highlights manners or paths in motion events.

With regard to the second, the effect of language on attention, Choi's and others' work shows that language affects children's and adults' attention in relation to new instances. Choi's (2009) data suggest that Manner/Cause (Satellite-framed) languages appear to lead to greater sensitivity to causal element of events, as well as possibly more attention to changes of state. In contrast, speakers of path languages appear to pay more attention to trajectory of motion. Furthermore, the dominant pattern used in a language with motion verbs also affects paths of vision, and speakers' conceptualization of paths of vision (Slobin, 2009). If nothing else, language provides, in Slobin's (1996a) terms, a way of "thinking for speaking".

In conclusion, it is only through this extensive pursuit over the last decades of meticulous work exploring in depth the relationship between language and cognitive development that we have arrived at a fairly clear determination that the two must in fact interact in development. The four logically possible positions considered here, and the four sets of predictions concerning the timing and relationship of linguistic and cognitive developments in children, lead uncontrovertibly to this conclusion. Further work in the area is beginning to examine in much greater detail and with greater precision the precise relationship between language and cognition by the use of new methods such as eye tracking, ERPs, and by the increasing focus on these issues in the case of bilingual and bimodal populations. Such work promises to provide stimulating new insights into these questions in the future.

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