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Brass Tacks in Linguistic Theory

Innate Grammatical Principles

In the normal course of events, children manifest linguistic competence equivalent to that of adults in just a few years. Children can produce and understand novel sentences, they can judge that certain strings of words are true or false, and so on. Yet experience appears to dramatically underdetermine the competence children so rapidly achieve, even given optimistic assumptions about children's nonlinguistic capacities to extract information and form generalizations on the basis of statistical regularities in the input. These considerations underlie various (more specific) poverty of stimulus arguments for the innate specification of linguistic principles. But in our view, certain features of nativist arguments have not yet been fully appreciated. We focus here on three (related) kinds of poverty of stimulus argument, each of which has been supported by the findings of psycholinguistic investigations of child language.

The first argument hinges on the observation that children project beyond their experience in ways that their experience does not suggest. It is untendentious that children project beyond their experience, in the sense of acquiring a state of linguistic competence that they apply to novel constructions. The issue is *how* children project beyond their experience. That is, do children induce (or abduce) in the fashion of good scientists, on the basis of experience characterized in (more or less) observational terms; or do they project in more idiosyncratic and language-specific ways? To what degree is human language acquisition "data driven," and to what degree is it determined by the human genome? Clearly, experience matters. Typical children growing up in Tokyo achieve a state of linguistic competence that differs in some respects from the state achieved by typical children growing up in Topeka. According to the theory of universal grammar (UG), however, the differences between natural human languages—like English and Japanese, which any normal child can learn in the right context—are relatively small as compared with the differences between natural human languages and other logically coherent systems (equally compatible with the experience of human children) for associating signals with meanings. If so, this supports the nativists' contention that

children use their experience simply to determine which of the highly constrained natural human languages adults around them speak. Evidence in favor of the nativist perspective comes from experimental studies of child language showing that children's projections do not violate any core principles of universal grammar, even in cases where children might be tempted to violate such principles if they adopted general-purpose learning algorithms.

A second poverty of stimulus argument is based on the kinds of nonadult constructions children produce. Children appear to follow the natural seams (or parameters) of natural language, even when child language diverges from the local adult language. On an experience-dependent approach to language learning, the pattern of children's nonadult linguistic behavior would presumably look quite different from this. From a data-driven perspective, children's nonadult productions would be expected to be simply less "filled out" than those of adults in the same linguistic community. Children's productions would be adult-like, except that they would be missing certain words or word-endings, for example. The UG-based approach, by contrast, is consistent with the continuity assumption, which supposes that child and adult languages can differ only in limited ways—specifically in ways that adult languages can differ from each other. If so, children are expected to project beyond their experience in ways that are attested in natural languages. The nonadult linguistic behavior of children is not expected to match the input (as experience-based approaches to learning suggest); rather, the input is seen to guide children through an innately specified space of hypotheses made available by universal grammar. So children are free to adopt hypotheses that differ from those of local adults, as long as they can later be retracted using positive evidence, until they hit upon a grammar that is sufficiently like that of other speakers of the local language; at that point, language change is no longer initiated by the input (see Crain, 2002; Crain & Pietroski, 2001, 2002; Thornton, 1990).

A third argument is based on the gap—Chomsky (1986) speaks of a chasm—between a typical child's experience and the linguistic principles that govern children's competence. The key observation here is that linguistic principles unify and explain (superficially) disparate phenomena. We focus on this last kind of argument in the most detail, in order to show that children know specific contingent facts that apply to a wide range of constructions across different linguistic communities. Insofar as this aspect of linguistic competence is not plausibly a product of children's experience, it is presumably a product of their biological endowment. This raises further questions about how human biology gives rise to such knowledge. But in our view, these are precisely the questions that need to be asked.

Critics cannot insist that our shared biology cannot give rise to knowledge of specific contingent linguistic facts if the available evidence suggests that our shared biology does just this. The "contingencies" of human language may not be accidental, however. They may reflect deep facts about human biology (or underlying physical constraints on that biology), as it has emerged under various pressures, including, perhaps, evolutionary pressures imposed by the kinds of signals and meanings that primates can employ. One can view certain aspects of Chomsky's "minimalist program" as an invitation for nativists to ask just what aspects of language must be attributed to biology—and to start asking how our shared biology

might give rise to universal grammar without supposing that specific linguistic principles are biologically encoded as such; see Chomsky (1995, 2000). Perhaps a perspicuous characterization of what is innate will lead to a hypothesis about how (and why) human biology implements such constraints. But as Marr (1982) argued, one usually needs to know what is implemented before one can fruitfully speculate about implementation.

1   The Form of Linguistic Generalizations

One version of the poverty of stimulus argument proceeds from the following sort of observations. In simple sentences like (1), the reflexive pronoun *himself* is referentially dependent on another term, *Bill*, which appears nearby in the sentence. But in (2a–c), *himself* is anaphorically related to *John*, which is some distance away. This leaves open the possibility that (3a) is ambiguous. But adults know that (3a), like (3b), is unambiguous.

(1)   Bill washed himself.

(2)   a. John said to Bill that he wants to wash himself.

       b. John wants to shave Bill and wash himself.

       c. John said that he thinks he should wash himself.

(3)   a. John said that he thinks Bill should wash himself.

       b. John said that Bill washed himself.

By age two or three, normal children know how reflexive pronouns work. For example, they know that *himself* can*not* be anaphorically dependent on *John* in (3). But how could they infer this "negative" fact, about what (3a) can*not* mean, based on "positive" input? There is no general prohibition against ambiguity in natural language. So why don't children acquire a grammar that is more permissive than the adult grammar, according to which (3a) is ambiguous—in the way that (1) and (2) might suggest to an observer?

   One can speculate that, first, children notice that adults (almost?) never use constructions like (3b) while intending *himself* as a device for referring to the person picked out by the distant name, and second, this leads children to infer that (3a) and (3b) are both unambiguous. But learning the rule for reflexive pronouns in this way requires rather substantial cognitive resources, for recognizing adults' intended referents and keeping track of the word strings children encounter and the interpretations that are assigned to those strings. Such an account is possible, but it does not seem very plausible. For one thing, children's specific knowledge about linguistic expressions does not end with reflexive pronouns. They also know how ordinary pronouns work. In *Bill washed him*, the accusative pronoun cannot be referentially dependent on the name; but in *John wants to feed Bill and wash him*, the pronoun can be linked back to *Bill* (but not *John*). So how do children

(and adults) know that *John said that he thinks Bill should wash him* cannot be interpreted with the pronoun dependent on *Bill*? To complicate matters, children encounter sentences like *That man over there is him* (say, in response to a question about who John is). Therefore, a child can hardly assume that adults never intend to use *him* as a device for referring to someone picked out by a nearby expression. Linguistic principles, known as the binding theory, determine how pronouns can and cannot be interpreted. This component of UG governs the anaphoric relations among different kinds of noun phrases (e.g., Chomsky, 1981).

In attempting to characterize the knowledge that underlies the judgments in (1)–(3), linguists initially set aside issues about acquisition and its relation to experience, in order to look for a principle that explains a range of linguistic phenomena. In this quest, linguists (unlike children) elicited and considered judgments about what expressions can and cannot mean for adults; they conducted crosslinguistic research; and they looked for a principle that holds across human languages (and thus applies to many particular phenomena). Armed with a hypothesis about the operative linguistic principle, they then asked whether children could plausibly learn the principle that evidently characterizes adult competence. If not, the tentative conclusion is that the principle is not learned but is rather part of universal grammar. Or, more cautiously, the principle is due at least largely to human nature, as opposed to human experience. Such conclusions were bolstered when it was found that children adhered to the principle from an early age, because this compresses the learning problem, making it less plausible that all normal children encounter the data that would be needed on experience-based accounts.

This quick sketch of one poverty of stimulus argument illustrates several key points about such arguments. In particular, the much-discussed "logical problem of language acquisition" is not simply that the competence children achieve is underdetermined by their experience. This would be the case even if children induced linguistic principles from examples. Again, what impresses nativists is not the mere fact that children project beyond their experience but rather the fact that children project beyond their experience in ways that the input does not even suggest. Correlatively, the nativist is not just saying that children are born with a disposition to acquire a language. The nativist is saying that children are born with a disposition to acquire a natural human language; where the distinctive character of these human systems for associating signals with meanings are revealed by investigating what adults know and how that knowledge goes beyond the experience of typical children. Investigations of adult languages have revealed that there are universal grammatical principles, and experimental investigations of child language have found that these principles hold children's hypotheses in check. While universal grammar establishes boundaries on the space of hypotheses children can explore, children are free to explore this space as long as they do not exceed the boundaries. This observation forms the basis of the continuity assumption, to which we now turn.

2   The Continuity Assumption

The innate principles of universal grammar define a space of possible human languages for children to explore, under pressure from experience, until they

stabilize on a grammar that is equivalent to that of adults in the same linguistic community. This means that young children are free to "try out" constructions that are unattested in the local language, but only if those constructions are from a possible human language. (If the actual adult languages exhaust the relevant space of possibilities, then young children will only try out constructions attested in some adult language spoken somewhere.) At any given time, children will be speaking a possible human language, just not the language spoken around them. This is the continuity assumption: child languages can differ from the local adult language only in ways that adult languages can differ from each other. According to this assumption, the possible mismatches between child and adult language follow the natural seams (the so-called parameters) of human languages; children are not expected to violate any core principles of universal grammar, since language acquisition is constrained by those principles. If the continuity assumption is correct, one would expect children to exhibit constructions with features of adult languages found elsewhere on the globe, but not in the local language. If this expectation is confirmed, it provides dramatic support for nativists. Given an experience-dependent learning algorithm, one will be hard pressed to explain why children learning English produce constructions exhibited in (say) German, Japanese, or Italian but not in English. Obviously, everyone thinks there are examples of mismatches between child and adult language. But it is worth pausing to be clear about the form of the argument.

Given a data-driven perspective, one would expect children's nonadult linguistic constructions to simply be less articulated than those of adults. A child in the process of learning a (first) human language on the basis of experience would not yet display full linguistic competence in any human language; at best, such a child would have an imperfect grasp of the local language. If this is the position children find themselves in, one would expect them to gradually modify their deviant constructions, in response to environmental input. But where experience provides abundant evidence of statistical regularities, a data-driven learner should be faithful to the patterns in question (and in that sense "match" the input). So it is worth attending to the respects in which children diverge from adults, since attention to the details might reveal something about just how children project beyond their experience.

Several examples of children's nonadult productions support the continuity assumption, as opposed to a data-driven account of language acquisition. A parade case is the medial-Wh phenomenon first reported by Thornton (1990). The finding is that some English-speaking children produce Wh-questions that are attested in many languages but not in English. These children consistently introduce a copy of a bare Wh-phrase in their tensed long-distance Wh-questions, as in (4).

(4)   What do you think what that is?

In adult languages that allow such constructions (like Bavarian dialects of German), there is a prohibition against medial Wh-phrases with lexical content, as in (5).

(5)   *Which boy do you think which boy that is?

There is also a crosslinguistic prohibition against medial constructions in which the original extraction site (of the Wh-phrase) is inside an infinitival complement clause, as in (6). Accordingly, American children who freely produce questions like (4) refrain from producing questions like (5). And they refrain from producing ones like (6); they use adult-like questions such as (7) instead.

(6)   *Who do you want who to play with?

(7)   Who do you want to play with?

The fact that American children produce questions like (4), in the absence of evidence for medial constructions in English, is interesting. But the really important fact, from the nativists' perspective, is what such children don't say, as illustrated in (5) and (6). For children appear to be obeying the very constraints that adult speakers of other languages obey. Given a data-driven perspective, it is hard enough to explain why Bavarian children who hear examples like (4) learn that examples like (5) and (6) are impermissible in the local language.[1] But why do some American children achieve a state of (perhaps partial) linguistic competence with this character, which matches (in this respect) the linguistic competence of faraway adults? Such facts are unsurprising, however, given a nativist perspective that includes the continuity assumption. (See Crain & Pietroski, 2002, and Thornton, 2004, for detailed discussions of another example concerning American children whose nonadult use of *why*-questions seems to match the adult Italian use of *perche'*-questions; see Crain, 2002, for further examples.)

3   Deep Linguistic Principles

One goal of linguistic theory is to find principles that unify disparate linguistic phenomena. And as we have been stressing, the search for unifying principles is based only in part on what people say and the conversational contexts in which they say things. Just as important are facts about linguistic expressions that people don't use, and the meanings they do not assign to expressions they use. Moreover, human languages exhibit patterns at various levels of abstraction from what children hear. In addition to the various "construction patterns" that various languages exhibit—permissible ways of forming questions from declaratives, ways of extending sentences by means of relative clauses, and so on—there are generalizations (often characterized as constraints that hold crosslinguistically) across the patterns that careful observers of a particular language might note. As generalizations gradually emerge in linguistic analysis, therefore, their explanatory power is tested across languages, and against increasingly expanded sets of positive and negative data. Progress is difficult because the space of logically possible

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1. Moreover, the wh-phrases that children consistently avoid in questions like (5) and (7) are well-formed fragments of the local language; they appear in embedded questions: e.g., "He asked me *which boy that is.*" "I know *who to play with.*" Therefore, these questions could be formed by the kinds of "cut-and-paste" operations that experience-based approaches invoke to explain how complex constructions are formed by combining simple constructions (e.g., Goldberg, 2003; Tomasello, 2000).

grammatical principles is so immense. For it appears that many linguistic phenomena reflect contingent aspects of human psychology, which in turn may reflect demands imposed by the kinds of signals and meanings that human beings are able to process; and as yet little is known about these demands. Nevertheless, linguists have uncovered grammatical principles with broad empirical coverage and explanatory power.

Child language acquisition proceeds without the benefit of the vast array of (crosslinguistic and negative) data available to linguists, yet every normal three-year-old knows many, perhaps most, of the grammatical principles known by adults. And these principles include nontrivial generalizations that tie together clusters of apparently unrelated linguistic phenomena that are common to languages around the globe—and that turn out, upon close scrutiny, to be interestingly related. In the absence of an alternative account of the relevant generalizations and lacking a learning-theoretic account of how young children come to know them, we find it reasonable to conclude that humans are innately endowed with substantive universal principles of grammar, and that children can only acquire languages that conform to these principles.

There is another view of the relation between linguistic theory and the primary linguistic data available to children. For example, in a recent challenge to nativism, Pullum and Scholz (2002) argue that it is an open question "whether children learn what transformational/generative syntacticians think they learn." On their view, the evidence does not suffice to conclude that children are innately endowed with "specific contingent facts about natural languages." They contend that positive evidence alone could suffice for language learning, which could consist of shallow linguistic representations that are hypothesized and tested using the same kind of domain-general cognitive mechanisms that children use to learn about other (nonlinguistic) things.

We take up this recent challenge to nativism by (re)considering the extent to which linguistic theory needs to postulate abstract grammatical principles that explain "specific contingent facts about natural languages," including abstract principles that lie beyond the grasp of even intricate methods of statistical sampling. We concentrate on three likely candidates for innate linguistic knowledge: (1) the meanings of determiners, (2) the basic interpretation of disjunction, and (3) the structural configurations in which pronouns, negative polarity items, and the disjunction operator must appear, with respect to the linguistic expressions that license them.

3.1   What Determiners Can Mean

One specific contingent fact about natural languages is that determiner meanings are conservative (Barwise & Cooper, 1981) Determiners (Det) are quantificational words (or phrases)—like *every, no, some, most, both, three, seventeen, more than 9 but fewer than 20*—that can combine with a noun (or noun phrase [NP]) to form a grammatical unit, like *every boy*, which can in turn combine with a verb (or verb-phrase [VP]) to form a sentence, like *Every boy swam*.[2] In this respect, a determiner is like a transitive

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2. This is not to say that every expression that combines with a noun to form a grammatical unit is a determiner. Determiners have other properties, like not combining with verbs to form grammatical units.

verb, which combines with an "internal" argument to form a grammatical unit, which in turn combines with an "external" argument to form a sentence; though in the linear order of words, the external argument of a transitive verb comes first, while the external argument of a determiner comes last. There are various ways of characterizing the relevant semantic property of determiners. But let's say (for simplicity) that noun phrases and verb-phrases are semantically associated with sets of individuals, that a determiner expresses a binary relation between sets, and that such a relation is conservative iff: the internal set s bears relation R to the external set s' iff s bears R to s ∩ s'. Then the (perhaps improper) subset relation is conservative, since: s ⊆ s' iff s ⊆ (s ∩ s').

Consider again the example *Every boy swam*. Since the determiner *every* is conservative, the boys form a subset of the swimmers iff the boys form a subset of the boys who swam. But the converse relation of inclusion is not conservative, since it is false that: s ⊇ s' iff s ⊇ (s ∩ s'). It isn't a true biconditional that the boys include the swimmers iff the boys include the boys who swam. Trivially, the boys include the boys who swam; but it doesn't follow from this trivial truth that the boys include the swimmers. Intuitively, every F is G is true iff the Fs form a subset of the Gs. So, unsurprisingly, the following biconditional is sure to be true: every boy swam iff every boy is a boy who swam. Likewise, most boys swam iff most boys are boys who swam, and no boy swam iff no boys are boys who swam. Indeed, every natural language biconditional of this form is sure to be true: [(Det NP)(VP)] iff [(Det NP)(NP who VP)].

This is, upon reflection, a striking fact. No natural language determiner expresses the converse relation of inclusion.[3] Likewise, no natural language determiner expresses the relation of equinumerosity. But one can imagine a language in which *Equi boys swam* means that the boys are equinumerous with the swimmers. And in this language, the following biconditional would be false: Equi boys swam iff equi boys are boys who swam. (If every boy swam, then equi boys are boys who swam; but it doesn't follow that the boys are equinumerous with the swimmers.) This demonstrates that it is a contingent generalization that [(Det NP)(VP)] iff [(Det NP)(NP who VP)]. Of course, given what *every* means, it is a logical truth that every boy swam iff every boy is a boy who swam; and similarly for each natural language determiner. But it hardly follows that "logic alone" determines that determiners (individuated syntactically, as expressions with a certain *form*) have the precise semantic character that they do have, as a matter of fact. There are many (simple) nonconservative relations of the same logical type as actual determiner meanings, and there is no *logical* reason why determiners cannot indicate such relations (see e.g., Chierchia & McConnell-Ginet, 2000).

To underscore the point, it has been proposed that *Every boy is riding an elephant* is true—on a reading available to children (but not adults)—only if (1) every boy is riding an elephant *and* (2) every elephant is ridden by a boy (e.g., Drozd &

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3. There is a sense in which *Only boys swam* captures the converse of *Every boy swam*. But *only*, which can combine with just about anything, is not a determiner. Compare *He only seems nice* with **He every/no/ three seems nice* (see Herburger, 2000, for further discussion and defense). Notice also that *only* does not comply with the biconditional associated with conservativity. *Only boys are boys who dance* does not entail that only boys dance, since *Only boys are boys who dance* is a tautology, whereas *Only boys dance* is not.

van Loosbroek, 1998; Philip, 1995). If so, then children assign a nonconservative interpretation to the determiner *every*; in effect, the hypothesis is that children interpret *every* as though it meant what *equi* means in the imagined language (that no human adults speak). But if nonconservative determiner meanings are possible for children, and thus *not* ruled out by universal grammar, then one needs some other explanation for the absence of nonconservative determiner meanings in adult languages. If human children can operate with a determiner that expresses equi-numerosity, why don't adult languages contain such a determiner? If the human language system is compatible with some nonconservative determiners, shouldn't we expect to find the semantic converse of *every* in some adult languages? In short, there is a nonlogical "conservativity generalization" for adult languages. And if this generalization is not a reflection of universal grammar, it is hard to see what it is a reflection of. It would seem apparent then that there is a significant theoretical cost to hypothesizing that children assign nonconservative interpretations to determiners. (See sec. 4.1).

3.2   *Disjunction Is Inclusive-or*

We claim that a second contingent fact, known by speakers of natural language, is that natural language disjunction is inclusive-*or* (as in classical logic); see Horn (1989) for references to researchers who argue that natural language disjunction is exclusive-*or*. Let the ampersand and wedge have their usual meanings, so that *P* & *Q* is true iff both *P* and *Q* are true, while *P* v *Q* is false iff both *P* and *Q* are false; and let's say that *P* X-*or* *Q* is true iff (*P* v *Q*) & not(*P* & *Q*), with X-*or* thus corresponding to exclusive disjunction. Then we endorse the view that the English word *or* corresponds semantically to *v*, as opposed to X-*or*; pragmatics is responsible for appearances to the contrary in examples like *You can have cake or (you can have) ice cream* (see Chierchia & McConnell-Ginet, 2000; Grice, 1975). One can certainly imagine a language with a sentential connective that sounds like *or* but corresponds semantically to X-*or*. Indeed, from a data-driven perspective, one might well expect children to conclude (at least for a while) that English is such a language. For the vast majority of children's experience suggests that *or* is used to indicate exclusive disjunction. Nonetheless, children as young as two appear to know that *or*-statements have a basically inclusive meaning. If this is correct, it ends up providing a double argument for nativism. For not only does it suggest that children essentially ignore the abundant evidence suggesting that *or* expresses exclusive disjunction, it raises the question of how children determine the relevant pragmatic implicatures in the right situations. And, as we shall show, the details suggest that children are (without learning) sensitive to quite subtle grammatical properties of sentences.

It is an obvious—but upon reflection, theoretically interesting—fact that English *or*-statements conform to DeMorgan's law for (classical inclusive) disjunction. It is a logical truth that not(*P* v *Q*) iff (not-*P* & not-*Q*); whereas it isn't a logical truth that not(*P* X-*or* *Q*) iff (not-*P* & not-*Q*). More specifically, not(*P* v *Q*) entails (not-*P* & not-*Q*), while not(*P* X-*or* *Q*) does not entail (not-*P* & not-*Q*). And in English, *You shouldn't kick the dog or pull his tail* pretty clearly entails that you shouldn't kick the

dog *and* you shouldn't pull his tail. Likewise, *Luisa doesn't want beans or rice* entails that Luisa doesn't want beans *and* doesn't want rice.[4] One can imagine languages in which the disjunction operator has the different semantic character of X-*or*: In such languages, the sentence that sounds just like *You shouldn't kick the dog or pull his tail* would be understood as an instruction to refrain from doing just one or the other (but it's okay to kick the dog and pull his tail).[5] No natural human language works like this. And it is a striking fact that children evidently "know" this at a remarkably early age. That is, without instruction and in apparent disregard for any evidence suggesting that English *or* is exclusive, children interpret negated *or*-statements as having conjunctive entailments.

Notice that even if young children have a tacit grasp of DeMorgan's law, in the sense of knowing (innately?) that not(*P v Q*) entails (not-*P* & not-*Q*), this does not yet explain what they know about English *or*-statements. For any such "logical" knowledge would have to be combined with a conjecture about how children learn *which* logical operator the natural language expression *or* is associated with, that is, inclusive or exclusive disjunction. Of course, if inclusive disjunction is the only available candidate for the meaning of *or*, then children's immediate grasp of DeMorgan's law might suffice to explain how they interpret negated disjunctions. But if there is just one available candidate for the meaning of *or*, there is no learning to be done, which is hardly an embarrassment for nativists (though in-teresting facts about pragmatic implicatures remain). But it turns out that children know much more about how *or* contributes to the meanings of complex expres-sions: the DeMorgan facts are just the tip of an iceberg, and the relevant gener-alization concerning what children know about the extended class of statements with disjunction appears to track other logically contingent features of natural language, such as the linguistic environments that permit negative polarity items, and constraints on the anaphoric relations of different kinds of noun phrases. Taken together, these features form the basis for abstract generalizations that children apparently know as early as they can be tested. We now describe these other features of the abstract generalizations.

3.3 Downward Entailment

We said that the DeMorgan facts are just the tip of an iceberg. To expose more of it, notice that in English, disjunctive claims have conjunctive entailments in many contexts that (at least from the observable surface) do not appear to involve ne-gation. Consider (8)–(10).

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4. A related point is that the following biconditional is sure to be true: *P* or *Q* iff [(*P* or *Q*) or *Q*]. But this wouldn't be so if *or* expressed exclusive disjunction. And note, reminiscent of conservativity, that the following biconditionals are also sure to be true: *P* and *Q* iff [(*P* and *Q*) and *Q*]; *P* if *Q* iff [(*P* if *Q*) if *Q*].
5. The discussion presupposes that disjunction appears in the scope of negation, as suggested by the brackets in the logical notation. We discuss later how the logical notion of scope is related to structural properties of natural language sentences.

(8)   Chris goes to the gym before linguists or philosophers arrive.

(9)   Every linguist or philosopher admires Chomsky.

(10)   If a linguist or philosopher arrives, Chris leaves.

If (8) is true, Chris goes to the gym before the linguists arrive *and* Chris goes to the gym before the philosophers arrive; similarly for (9) and (10). By contrast, (11)–(13) do not have conjunctive entailments.

(11)   Chris goes to the gym after linguists or philosophers arrive.

(12)   Every linguist admires Chomsky or Fodor.

(13)   If Chris arrives, a linguist or philosopher leaves.

A comparison of (8) and (11) shows that linguistic expressions with clearly related meanings (*before* v. *after*) have divergent semantic properties. The contrast between (9) and (12) is even more striking. A disjunctive internal (NP) argument of the determiner *every* creates a conjunctive entailment, as in (9); while a disjunctive external (VP) argument, as in (12), does not create a conjunctive entailment. On the contrary, an utterance of (12) is naturally heard as conveying the pragmatic (and thus defeasible) implicature—that it's false that every linguist admires Chomsky *and* Fodor. Similarly, disjunction in the antecedent consequent clause of a conditional statement creates a conjunctive entailment, as in (10), but disjunction in the consequent clause does not; (13) is naturally understood as implicating that at least sometimes when Chris arrives, it's false that both a linguist and a philosopher leave. We return to this point presently. For now, it suffices to note that disjunctive claims have conjunctive entailments in some but not all grammatical contexts, and that mere knowledge of DeMorgan's Law does not provide knowledge of which contexts do and which do not have conjunctive entailments.

There is, however, a generalization here. Negated contexts are a special case of downward-entailing contexts, which can be characterized as contexts that license inferences from claims about things to claims about subsets of those things. For example, if Noam didn't buy a car, it follows that he didn't buy an Italian car.[6] Using this diagnostic of downward-entailing contexts, we see that the contexts in (8)–(10), where *or* had conjunctive entailments, were also downward-entailing (DE) contexts. This is illustrated in (14)–(16).

(14)   a. Chris sang before the linguists danced.

b. Chris sang before the tall linguists danced.

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6. Without negation, the entailment goes the other way: if Noam bought an Italian car, he bought a car.

(15)   a. Every linguist admires Chomsky.

     b. Every tall linguist admires Chomsky.

(16)   a. If a linguist arrives, Chris leaves.

     b. If a tall linguist arrives, Chris leaves.

In each case, the first claim entails the second. By contrast, *or* is not in a DE context in (11)–(13). For example, if every linguist is a singer, it doesn't follow that every linguist is a tall singer.

    If young children apparently know these facts, then this would bolster the hypothesis that children know that English *or* is inclusive. For suppose that every linguist exclusive-*or* (*X-or*) philosopher admires Chomsky; that is, every individual z such that z is a linguist *X-or* z is a philosopher is an individual who admires Chomsky. It doesn't yet follow that every linguist admires Chomsky. Perhaps someone who is both a linguist and a philosopher doesn't admire Chomsky. (It's unlikely, but possible.) That is, exclusive disjunction doesn't create a conjunctive entailment in the first (NP) of the universal quantifier. Likewise, suppose Chris arrived before every individual z such that z is tall *X-or* z is a singer. It doesn't follow that Chris arrived before every z such that z is tall. The exclusive disjunctive claim leaves open the possibility that tall singers arrived before Chris. One can imagine a language in which this is how the entailments work for sentences with a connective that sounds like *or*. But English isn't such a language, and young children evidently know this—again, despite evidence suggesting otherwise.

    Of course, given that English *or* is inclusive and that the first argument of *every* is a DE context, it follows that sentence (3) has the relevant conjunctive entailment. But it isn't a matter of logic that English *or* is inclusive. Neither is it a matter of logic that the first argument of the determiner pronounced *every* is a DE context, any more than it is a matter of logic that this determiner has a conservative meaning. Once the child knows that the word pronounced *every* is a determiner— a kind of second-order predicate (satisfying certain semantic restrictions) that takes an internal and an external argument—associated with the subset relation, the child is in a position to know that *Every boy swam* is true iff the boys form a subset of the swimmers (and that *Every tall boy swam* is true iff the tall boys form a subset of the swimmers). It doesn't take much more to know that the internal argument of *every* is a DE context. For if $s \subseteq s'$, and $s'' \subseteq s$, then $s'' \subseteq s'$. But the question is how the child comes to have all this knowledge about *every* (and what it means), and similarly for all the other expressions that create DE contexts.[7]

    If the only linguistic generalizations concerning DE contexts concerned patterns of entailment, the point would be of interest but not yet a clear argument for linguistic nativism (as opposed to a version of empiricism that allows for innate logical concepts

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7. A further complication is the overlap in meaning between *every* and other expressions, e.g., *lots of*. Whenever every boy swam, presumably lots of boys swam. But *lots of* is not DE: *Lots of boys swam* does not entail that lots of tall boys swam.

and some corresponding innate knowledge of logic). But, as we have already noted and now want to stress, adults and children know that *or*-statements have exclusive pragmatic implications in non-DE contexts. In such contexts, the use of *or* implies "not both" but does not entail it. To take an example, the truth-conditional content of a sentence with *or*, such as (17a), is taken to be that in (17b). That is, (17a) is true in a variety of different situations, including ones in which Geraldo is drinking and driving. However, disjunction triggers an implicature in ordinary contexts, such that sentence (17a) implicates (17c). Intuitively, the implicature stems from the fact that if a speaker uses *or* to describe a situation, then she does not plausibly intend *and*. If this were the intended interpretation, then a more cooperative description of the situation is a sentence like (17d), where *or* is replaced by *and*.

(17)   a. Geraldo is drinking or driving.

b. $\text{drinking}(g) \lor \text{driving}(g)$

c. $\neg\,[\text{drinking}(g) \land \text{driving}(g)]$

d. Geraldo is drinking and driving.

This is, in effect, to treat *or*-statements in ordinary contexts as having a "secondary meaning" corresponding to X-*or*, but one that can also be characterized in terms of inclusive-*or*, negation, and conjunction: (P v Q) & not(P & Q). But the reverse is also imaginable. That is, one can imagine a language in which the sentential connective pronounced *or* expresses exclusive disjunction as its "basic meaning" and *or*-statements in DE contexts have a secondary meaning characterized as follows: not(not-P & not-Q). The negation of this secondary meaning would be: not-P & not-Q. So a speaker of such a language would know that *Don't kick the dog or pull his tail* does not semantically entail that (just) kicking the dog is disallowed but that an utterance of this sentence pragmatically implicates that both actions are disallowed. This isn't how English works.[8] But how do children come to know this at an early age?

3.4   *Negative Polarity Items*

Another much-discussed phenomenon is that so-called negative polarity items (NPIs)—expressions like *ever*, as in *I wouldn't ever lie to* you—are licensed in DE contexts. For example, *ever* can appear in the first (NP) but not the second (VP) argument of *every* as indicated in (18)–(19).

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8. Pragmatic implications are cancelable. One can say *He sang or danced, and he may have done both*. And there are pragmatic contexts that suspend implicatures. If you bet that Chris will sing or dance, you win if Chris does both; and if you promise to sing or dance, and do both, you keep your word. But it is a contradiction to say *He didn't kick the dog or pull his tail, but he may have done both*. Likewise, if the sign says *No parking or loitering*, you can't beat the ticket by saying that you parked and loitered: laws depend on primary meanings and not pragmatic implicatures.

(18)   Every linguist who ever met Chomsky admires him.

(19)   *Every linguist ever met Chomsky.

By contrast, *ever* can appear in both arguments of *no* and in neither argument of *some*, as indicated in (20)–(23).

(20)   No linguist who ever met Chomsky admires him.

(21)   No linguist ever met Chomsky.

(22)   *Some linguist who ever met Chomsky admires him.

(23)   *Some linguist ever met Chomsky.

And both arguments of *no* are DE contexts, while neither argument of *some* is a DE context. (If no linguist sang, then it follows that no tall linguist sang well. But if some linguist sang, it doesn't follow that some tall linguist sang; nor does it follow that some linguist sang well.)

    Again, it may be that, given what negative polarity items mean, there is something semantically amiss with using them in non-DE contexts; though while there is something amiss with overt contradictions like *He is both tall and not tall*, they don't "sound bad" in the same way that (19), (22), and (23) do.[9] But even if knowing what negative polarity items and determiners mean would somehow determine which argument positions license such items (and similarly for other DE contexts), this just highlights the striking fact that children know what words like *any* and *ever* mean. And it's not enough to just say, for each expression in the "logical" vocabulary, that a child will know the relevant inferences once the child knows what the expression means. On the assumption that lexical meanings (together with some composition rules) determine entailment relations, knowledge of meaning (and perhaps a little logic) will presumably suffice for knowledge of entailment relations. But for just this reason, one wants to know how knowledge of meaning is achieved. And if there are (logically contingent) generalizations across the meanings of natural language expressions, that calls for explanation.

    From a data-driven perspective, this poses the perhaps unanswerable question of how children learn all the (perhaps lexical) semantic facts in question on the basis of experience. Our view is rather that children effectively assume that natural languages contain determiners (all of which are conservative), that some argument positions of determiners create DE contexts, and that such contexts are grammatically significant. From this perspective, the child's task is "simply" to figure out which
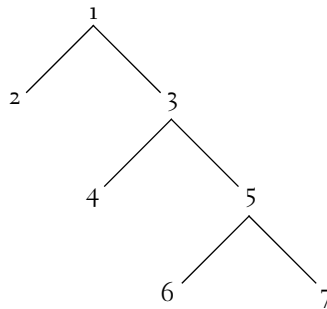
9. And see Ludlow (2002) for an argument that negative polarity licensing should be explained in structural/grammatical terms.

adult words are determiners, and which sounds go with which of the determiner meanings countenanced by universal grammar. As we noted earlier, such nativist conclusions raise (hard) questions about how human biology could give rise to a universal grammar with this particular character. But in our view, these are the questions linguists are stuck with. At this point, it's no good insisting that some (yet to be specified) learning account will reveal that what we regard as "assumptions" are really "conclusions" based on experience. For our point is not that blaming unknown biological mechanisms is somehow better than blaming unknown learning mechanisms. It is rather that the available evidence strongly suggests that child experience is just too thin to be the basis for the logically contingent features of natural languages. Like it or not, detailed study reveals that human linguistic competence has a distinctive character that is not due to the environment in which it develops. (In this respect, human linguistic competence is like every other biologically based capacity that has been studied.)

Still, it is a persistent idea that knowledge—and in particular, knowledge of language—is the product of experience and a little logic. So we want to mention a third range of facts known by children that runs across the other phenomena we have been discussing—and cuts across them in a logically contingent way.

3.5   *The Structural Property of C-Command*

The facts under consideration are governed by the structural notion of c-command, which plays a central role in linguistic theory. If we think of phrase markers as trees (in the mathematical sense) with nodes (partially) ordered so that one can speak of the "ancestors" of any given node (except the root), we can provide a simple characterization of c-command: one node c-commands another if the immediate ancestor of the first is an ancestor of the second.[10] In the following tree, node 2 c-commands each of 3–7; node 3 c-commands 2; node 4 c-commands 5–7; and so on.

10. There may be empirical reasons for introducing slightly different definitions. But this one will do for present purposes.

This structural notion figures in the description and explanation of many phenomena. For example, the negative adverb *never* creates a DE context, which licenses the negative polarity item *any*, as in (24).[11]

(24)   The man who laughed never expected to find any dogs at the party.

But what is the extent of the DE context created? As (25) illustrates, it is nothing so simple as the string of words that follow the adverb.

(25)   *The man who never laughed expected to find any dogs at the party.

Rather, the negative polarity item must be c-commanded by *never*. In (24), *never* c-commands *to find any dogs at the party*; in (25), *never* c-commands only the verb *laughed* (see Fromkin et al., 2000, ch. 4).[12] It is customary to describe this fact, known by children, by saying that the "scope" of a licenser is the expression it c-commands. In our view, this importation of logical terminology is appropriate. The expression c-commanded by *never*, in each sentence, is relevantly like the expression surrounded by brackets in a formal language with expressions of the form *never* [. . .]. But this analogy—or if you like, the fact that the logical notion of scope is implemented in natural language by the structural notion of c-command (see Hornstein, 1984)—hardly shows that the natural language generalization (NPIs must be c-commanded by a suitable licenser) is not logically contingent.

One could try to formulate a more shallow generalization, not based on c-command, but in terms of linear order. One possibility, similar in kind to representations that Pullum and Scholz seem to endorse, would be something along the lines of (26), where (26a) illustrates a construction type in which *some*, but not *any*, are permitted; by contrast, (26b) is a construction type in which both *some* and *any* are permitted.

(26)   a. . . . never + V + V + NP + P + some

       b. . . . V + never + NP + P + some/any

Of course, one is left to wonder how children know to keep records of this sort, as opposed to others. It seems implausible, to say the least, that children are recording everything they hear and searching for every possible pattern. But even setting such issues aside, the proposal that c-command is the relevant structural relationship for the licensing of NPIs has much to recommend it, as opposed to the

11. We restrict attention, in this discussion, to any on its "true universal" as opposed to "free choice" uses of *any* (see, e.g., Horn, 2000; Kadmon & Landman, 1993; Ladusaw, 1996).
12. While some linguists seem to use the licensing of NPIs as a diagnostic of c-command, its precise definition and the level of representation at which it applies (d-structure, s-structure, LF, semantic representation) is the subject of considerable debate (see, e.g., the essays in Horn & Kato, 2000).

construction-type approach advocated by Pullum and Scholz. For the c-command account has independent support from other linguistic constructions. We will mention two.

A structural constraint, based on c-command, is operative in the interpretation of disjunction. To illustrate, because the negative adverb *never* does not c-command disjunction in (27a), an exclusive-*or* reading is available, on which the girl under consideration may have received just one thing—a coin or a jewel. By contrast, the conjunctive interpretation of disjunction is enforced in (27b) because the negative adverb *never* c-commands disjunction—the girl did not receive a coin, and she did not receive a jewel.

(27)   a. The girl who never went to sleep received a coin or a jewel.

       b. The girl who stayed awake never received a coin or a jewel.

Continuing in the same vein, the same structural notion that determines the extent of DE contexts is also germane to the interpretation of pronouns. To take a familiar kind of example, in (28), the pronoun cannot be referentially dependent on the referring expression *The Ninja Turtle*; whereas this relationship is possible in (29). And in (30), the reflexive pronoun *himself* must be referentially dependent on *the father of the Ninja Turtle* (but not *Grover* or *the Ninja Turtle*)

(28)   He said the Ninja Turtle has the best smile.

(29)   As he was leaving, the Ninja Turtle smiled.

(30)   Grover said the father of the Ninja Turtle fed himself.

One standard explanation for the prohibition against referential dependence in (28) is that a pronoun cannot be referentially dependent on a referring expression that it c-commands. In (29), the pronoun does not c-command *the Ninja Turtle*, so anaphoric relations are permitted. In addition, reflexive pronouns must be referentially dependent on a "local" antecedent that c-commands it, as (30) illustrates.

3.6   *Summary*

Evidence from experimental investigations of child language suggests that young children grasp the distributional facts about NPI licensing, the interpretive facts about disjunction, and the interpretive facts about pronouns, as soon as they can be tested, that is, by age two or three. And this calls for explanation, presumably in terms of some biologically imposed constraint on the space of alternatives children consider in the course of acquiring a natural language. Even if children were meticulous record-keepers, there is no reason we can think of to suppose that, on a learning-theoretic account, children would notice that the very same linguistic environments require the conjunctive interpretation of disjunction. On the other hand, if these phenomena follow from syntactic and semantic principles that

children have under their belts from the earliest stages of language development, then there should be no stage at which children know that some linguistic expression permits *any* but does not also require the conjunctive interpretation of disjunction. Similarly, they should know that c-command constrains these phenomena, as well as the anaphoric relations among different kinds of noun phrases. In the absence of an account of how children attain the specific linguistic knowledge underlying these different phenomena, we are left to infer that innate syntactic and semantic principles guide children as they navigate through their linguistic experience to discover where NPIs are permitted, and where to interpret disjunction as inclusive-*or*, and where to tolerate an exclusive-*or* reading, and where to tolerate coreference.

As we noted earlier, logic alone does not dictate that scope is implemented by c-command in natural language. But there may be opponents of linguistic nativism who would not object to the hypothesis that human minds do indeed implement structural hierarchies in terms of trees (nodes and ancestors), with the result that c-command is a "natural" implementation of the logician's notion of scope. One might even speculate that this is due to the fact that the language system interfaces (somehow) with a general system of inferencing, for which the notion of scope is important. But even if this is correct, one wants to know why children treat the relation of negative polarity items to their licensers as relevantly like the relation of a variable to the quantifier that binds it. Why should children view the relation of a negative polarity item to its licenser as an instance of scope, understood as a logical notion, if the relevant notion of scope comes from (innate) knowledge of how variables are related to quantifiers? One can speculate that the NPI/licenser relation is relevantly like the variable-quantifier relation. But if this speculation is correct, it just raises another poverty of stimulus challenge: how do children come to understand negative polarity constructions as instances of variable-binding, given their limited experience?[13]

Extending the argument, one also wants to know why children treat the relation of a pronoun to its antecedent as relevantly similar to variable-quantifier and NPI/licenser relations. This question remains, even if we assume that (because of simplicity, or some such constraint) children would not introduce a second notion of scope without severe experiential pressure. To repeat an earlier example, children know that in (30) *the Ninja Turtle* cannot be the antecedent of *himself*.

(30)   Grover said that the father of the Ninja Turtle fed himself.

One can describe this fact by saying that the pronoun is not in the scope of *the Ninja Turtle*, with scope implemented as c-command. But how does the child know that scope is what matters here? Many theorists have held that the pronoun/

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13. And one should not discount the possibility, which we won't explore here, that the logician's notion of scope is a theoretical extension of c-command, a notion we implicitly grasp prior to any knowledge of logic. If this is correct, then viewing c-command as a natural-language implementation of scope gets things backward.

antecedent is indeed relevantly like the variable/quantifier relation; and while the jury is still out on the details, we have no doubt that some version of this suggestion will prove correct. But we see no reason for thinking that children abstract the relevant generalization from their experience. Rather, it seems that independently of experience, children are disposed to treat variable/quantifier, pronoun/antecedent, and NPI/licenser relations as instances of linguistic relations governed by c-command. One wants to know the source of this disposition. What is it about the human language system that leads children to group together phenomena whose surface manifestations do not suggest an underlying unity? In our view, this is the question to ask. (And one does not answer it by stipulating that the various relations are all instances of "scope.") The unity does not seem to be a by-product of generalizing, in some language-independent way, from a typical child's experience. It is rather a by-product of the mental system, whose contours remain largely shrouded, that makes it possible for humans to associate signals with meanings in the distinctive way that comes naturally to human children.

4   Children's Emerging Linguistic Competence

This section summarizes some of the recent research relevant to this discussion of how children attain mastery of linguistic knowledge in the absence of decisive evidence in the input. Except where noted, the findings we report were gathered over the past few years in interviews with three- to six-year-old children at the Center for Young Children at the University of Maryland. (This research was conducted in collaboration with Luisa Meroni, Amanda Gardner, and Beth Rabbin.)

4.1   *Constraints on Pronominal Reference*

Children's knowledge of constraints of pronominal reference have been studied extensively for the past 20 years. For discussion of individual principles, see Crain and McKee (1985), and Crain and Thornton (1998) (for principle C); Thornton and Wexler (1999) (for principle B), and Chien and Wexler (1990) (for principle A).

4.2   *The Universal Quantifier: Past Mistakes*

Different investigations of sentences with the universal quantifier *every* have led to qualitatively different conclusions about children's linguistic knowledge. One line of research has uncovered systematic nonadult responses by even school-age children (e.g., Drozd & van Loosbroek, 1998; Philip, 1995). In certain experimental conditions, for example, young children sometimes reject (31) as an accurate description of a picture in which every boy is riding a donkey if there is an "extra" donkey, that is, one that is not ridden by a boy. For adults, the sentence is true despite the "extra" donkey. When these children are asked to explain why they reject (31), they often point to the "extra" donkey as the reason. It is as if these children think the question is asking about the symmetry between boys and donkeys. This response is therefore referred to as the symmetrical response.

(31) Every boy is riding a donkey.

Research that evoked the symmetrical response from (some) children typically used pictures, and perhaps brief verbal comments about what was depicted in them. Using a different experimental technique, the truth-value judgment task, Crain et al. (1996) found that children consistently produced adult-like affirmative responses to sentences like (31). In a truth-value judgment task, one experimenter acts out a short story in front of the child and a puppet, using props and toys. The story constitutes the context against which the child judges the target sentences. Following a story, the target sentence is uttered by the puppet, which is manipulated by a second experimenter (Crain & Thornton, 1998).

The Crain et al. study also adopted a specific feature of research design, which they call the condition of plausible dissent. This condition involved the introduction of another animal in the context for (31), for example, an elephant—in addition to the "extra" donkey (see Crain et al., 1996; Freeman et al., 1982). It was made clear to children that the boys could have ridden the elephant, though in the end they all decided to ride donkeys. There is considerable independent evidence that providing a different possible outcome in the experimental context significantly reduces children's uncertainty about the question being asked of them; this feature of the design satisfies the felicity conditions associated with tasks that require a decision about whether a sentence matches the context or not (see Guasti & Chierchia, 2000). The intuition is that it is felicitous to ask if every boy is riding a donkey in situations in which the outcome is in doubt at some point in the story. Since the symmetrical response failed to emerge in the truth-value judgment task, Crain et al. suggest that children's nonadult behavior in previous research may have been due to the failure of researchers to satisfy the felicity conditions associated with the target sentences, in particular the condition of plausible dissent. This rescues the claim that the meaning of the determiner *every* is conservative.

4.3   *Downward Entailment in Child Language*

Previous research has shown that children as young as four have mastered one of the linguistic phenomena associated with downward-entailing linguistic expressions, namely, the licensing of the negative polarity item *any* (O'Leary & Crain, 1994). In a recent study, we tried to find out, further, if children know another property of downward-entailing linguistic expressions—that they license the conjunctive interpretation of disjunction. The construction we used was negation, and the experimental technique of choice was the truth-value judgment task. On one trial, a story was acted out about some pirates who were looking for treasure in an Indian camp, where a jewel and a golden necklace were hidden. At the end of the story, none of the pirates had found the jewel, but one pirate had found the golden necklace. Children were then asked to judge the truth or falsity of Kermit the Frog's assertion in (32).

(32)   None of the pirates found the necklace or the jewel.

(33) a. None of the pirates found the necklace *and*
              none of the pirates found the jewel.
       b. None of the pirates found the necklace *or*
              none of the pirates found the jewel.

Children who know that negation gives rise to the conjunctive interpretation of disjunction should interpret (32) as (33a). Therefore, they should reject (32) in the context under consideration. By contrast, children who lack such knowledge could interpret (32) as equivalent to (33b), and could accept it (since it is true that none of the pirates found the jewel). The finding was that children consistently rejected the test sentences.

4.4   *An Asymmetrical Universal Quantifier*

As we indicated in section 4.1, previous researchers have reached the conclusion that children and adults assign different semantic representations to sentences with the universal quantifier *every* (Drozd & van Loosbroek, 1998; Philip, 1995). A common assumption in these accounts is that children fail to distinguish between the internal argument (NP) and the external argument (VP) of the determiner *every*. We conducted a study to determine if children know one semantic property that distinguishes between these arguments, the interpretation of disjunction. As we discussed, the truth conditions associated with exclusive-*or* are available in the external argument of *every*, but disjunction has conjunctive entailments in the internal argument. We used the truth-value judgment task to investigate children's interpretation of disjunction in the internal and in the external arguments of the determiner *every*. In one study, two groups of three- to six-year-old children were interviewed in the different conditions illustrated in (34)–(35). To satisfy the felicity conditions for (34), there was a Smurf who did not choose an apple or a jewel in the situation, but every Smurf who did choose an apple or a banana received a jewel, making the sentence true on the conjunctive interpretation of disjunction. There was also an "extra" jewel in the context. In the situation for (35), there was a character in addition to the Smurfs, and there was a highly salient "extra" apple and an "extra" banana. In the story corresponding to (35), every Smurf chose both an apple and a banana; this makes (35) true, but infelicitous, due to the implicature of exclusivity that is associated with disjunction in non-downward-entailing linguistic contexts, such as the external argument of the determiner *every*.

(34)   Every Smurf who chose an apple or a banana got a jewel.

(35)   Every Smurf chose an apple or a banana.

The group of child subjects who heard sentences like (34) accepted them over 90 percent of the time. The second group of children, who heard sentences like (35), accepted them only half of the time; and, in rejecting them, these children pointed out the improper use of disjunction (i.e., they indicated that "and" should have been used). No children pointed to the extra apple or banana.

Two previous studies assessed the truth conditions children associate with the internal and external arguments of the universal quantifier. One assessed children's knowledge that the truth conditions associated with exclusive-*or* are available in the external argument of *every*, as in (36), and a second study assessed children's knowledge that disjunction has conjunctive entailments in the internal argument of *every*, as in (37).

(36)   Every lady bought an egg *or* a banana.

(37)   Every lady who bought an egg *or* a banana got a basket.

The first of these studies was by Boster and Crain (1994), who showed that children correctly accept the exclusive-or interpretation of disjunction in the external argument of the determiner *every*, as in (36). The second study, by Gualmini, Meroni, and Crain (2003) found that disjunction is assigned the conjunctive entailments by children in sentences like (37). Children were presented with sentences like (37) in a context in which only the girls who had bought an egg received a basket. The child subjects rejected the test sentences over 90 percent of the time, showing mastery of the semantic property of downward entailment.

These results are unexpected under the account on which children lack knowledge of the semantic properties of the universal quantifier *every*, including the fact that it is downward entailing in its internal argument but upward entailing in its external argument. The findings add further support for the proposal by Crain and colleagues—that children's nonadult linguistic behavior in earlier work was an experimental artifact: children produce adult-like behavior when attention is paid to the felicity of the target sentences in experimental tasks.

4.5   The Structural Property of C-Command in Child Language

As we observed, for a downward-entailing operator to have scope over a linguistic expression, it must c-command that expression. To determine if child language is subject to the c-command constraint, we conducted an experiment using the Truth-value Judgment task (Crain & Thornton, 1998). The children who participated in the experiment were divided in two groups. Group 1 children encountered sentences in which negation c-commanded the disjunction operator, whereas group 2 children encountered sentences in which c-command did not hold. The experiment draws upon the observation that the disjunction operator *or* receives "conjunctive" interpretation when it occurs in the scope of a downward-entailing operator, but not if it is simply preceded by a downward-entailing operator. To illustrate, on one trial, children were told a story about two girls who had both lost a tooth and were waiting for the Tooth Fairy to come. One girl went to sleep, but the second girl decided to stay awake to see what the Tooth Fairy looked like. At this point, the puppet (Merlin the magician) made a prediction. Group 1 children heard (38) and group 2 children heard (39).

(38)   The girl that stayed up late will not get a dime or a jewel.

(39)   The girl that didn't go to sleep will get a dime or a jewel.

Then the story resumed, and the Tooth Fairy rewarded the girl who was sleeping with both a dime and a jewel but only gave a jewel to the girl who had not gone to sleep. For adults, (38) is equivalent to (40) and therefore false in the context under consideration. By contrast, (39) is equivalent to (41) and is therefore true in the context.

(40)   The girl that stayed up late will not get a dime *and*
       the girl that stayed up late will not get a jewel.

(41)   The girl that didn't go to sleep will get a dime *or*
       the girl that didn't go to sleep will get a jewel.

The main finding was that children in group 1 rejected sentences like (38) more than three-quarters of the time, whereas children in group 2 accepted sentences like (39) 90 percent of the time. The results lead us to conclude that children know that c-command is a necessary condition in creating downward-entailing contexts.