The Language Faculty

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A review essay on the human visual system can safely presuppose that there is such a system, with homologs in other species, and get on with describing what scientists have learned about how retinal images lead to detailed and informative representations of distal scenes. Discussions of the language faculty are more controversial from the outset. It is not obvious what the alleged faculty does, or whether its operations are specific to language. Indeed, it is not clear what language is, or what languages are. So at least initially, it is hard to say what would make a cognitive system specifically linguistic. Nonetheless, while other animals can communicate to some degree, children go though what seems to be a special kind of linguistic metamorphosis. So in this chapter, we focus on some remarkable facts about how children acquire languages, as a way of gaining insight in this domain. Our conclusion is that humans have a language faculty—a cognitive system that supports the acquisition and use of certain languages—with several core properties. This faculty is apparently governed by principles that are logically contingent, specific to human language, and innately determined. Moreover, at least some of these principles are grammatically pervasive. They are manifested in diverse constructions, and they unify linguistic phenomena that are superficially unrelated.[1]

Every biologically normal child acquires thousands of words and a capacity to understand endlessly many complex expressions, given an ordinary and relatively brief course of experience. Indeed, a child can easily acquire more than one language—e.g., Japanese and Mohawk, or English and ASL. As we discuss below, these languages respect certain logically contingent constraints, and each such language is acquirable for the most part by the age of three. This

suggests that human children come into the world prepared to acquire languages of a certain sort, much as caterpillars are born ready to acquire the traits of butterflies, after a suitable period of growth. Of course, speakers of Japanese and Mohawk differ saliently, in ways that depend on experience. But across the languages that children naturally acquire, there are commonalities that reflect experience-independent aspects of human cognition that seem to be specific to language acquisition. Children may also employ more general capacities when formulating and testing generalizations; acquisition of a language like English is a presumably a complex phenomenon, arising from the interaction of various cognitive systems. But this phenomenon, not manifested in birds or bees or chimpanzees, requires something distinctive that lets human children acquire and use the languages they do.

1. Procedural Matters

We begin with some observations and terminology used by Chomsky (1957, 1965, 1986) and others to motivate a three-part idea. First, children acquire *procedures* for associating signals—like the sounds of spoken English, or the signs of ASL—with concepts or other interpretations. Second, these procedures, often called I-languages, respect substantive *constraints* on how signals can be associated with interpretations. Third, in many respects acquiring an I-language is *not* a process of generalizing from experience, if only because a child's experience often provides no basis for the relevant generalizations. Instead of basing generalizations on experience, children employ an innately determined procedure that *projects* I-languages in response to their experience. One can think of the language faculty as the biological system that somehow implements this "metaprocedure" that projects procedures for associating human linguistic signals with interpretations. As we will stress, if one wants to know which aspects of

human languages are determined by mental architecture that is specific to human language acquisition, one must consider the best candidates for principles that govern the I-languages acquired by children. And this requires, in turn, attention to both linguistic theory and psycholinguistic experiments.

We don't want to argue about what counts as a language. So let's say, overgenerously, that a language is anything that associates signals of some kind with interpretations of some kind. And let's say that an expression of a language associates a signal (type) with an interpretation (type), allowing for indirect associations. An expression might pair a given sound with a dog, a property, or a concept. And a complex sound might be paired with a complex concept via some compositional instruction. This allows for various conceptions of what languages are: *sets* of expressions; *procedures* or algorithms for generating expressions; physical *implementations* of such procedures; classes of similar sets/procedures/implementations; and so forth. But in any case, one can focus on "finite-yet-unbounded" languages that have infinitely many complex expressions that can be characterized recursively. Such languages can associate endlessly many signals with interpretations, and endlessly many interpretations with signals.

Let a *naturally acquirable human language* (Naturahl) be a finite-yet-unbounded language with two further properties: its signals are overt sounds or signs; and it can be acquired by a biologically normal human child, given an ordinary course of human experience. For reasons that will become clear, we want to assume as little as possible about the relevant interpretations. (Though one might well take them to be mental representations of some kind.) In what follows, we ignore the relatively minor variations in Naturahls that can be used to form a linguistic community of mutual intelligibility. Dialects of English can differ, as can the idiolects

of neighbors. But let's idealize and say that common language-names, like 'English' and 'French', signify Naturahls that are acquired and shared by many speakers.

Any biologically normal human child can acquire any Naturahl, given an ordinary course of experience with users of that language. And different children, who undergo different courses of experience, can acquire the same language. This leaves room for many views about what the acquisition device is. But some aspect of human infant cognition supports the acquisition of implemented *procedures* for associating sounds/signs with interpretations. In acquiring a Naturahl, a child acquires a capacity to understand novel expressions and express novel thoughts. This capacity requires something like an algorithm that determines how complex sounds are associated with complex interpretations in endlessly many cases. The language faculty is posited as providing a procedure for acquiring such algorithms; see Chomsky (1957), Lasnik (1999).

It is useful to follow Chomsky (1986) in applying an extensional/intensional distinction—regarding mappings from inputs to outputs—to the study of Naturahls and the faculty that lets children acquire these languages. Consider the set of ordered pairs <x, y> such that x is a whole number, and y is the positive square root of $x^2 - 2x + 1$. This infinite set, { ... (−2, 3), (−1, 2), (0, 1), (1, 0), (2, 1) ... }, is a function-in-extension. And this set/function can be finitely characterized in many ways: $F(x) = {}^{+}\sqrt{(x^2 - 2x + 1)}$; $F(x) = |x - 1|$; etc. Each such characterization specifies a way of computing a value given an argument. Indeed, each of these algorithms computes the *same* function-in-extension. So the distinct algorithms can be viewed as (coextensive) functions-in-intension; see Frege (1892), Church (1956). Using this analogy,

Chomsky contrasts E-languages with I-languages. An E-language is a set of signal-interpretation pairs, whereas an I-language is a way of associating signals with interpretations.

The I-languages that children acquire are biologically *implementable*, since they are actually implemented in human biology. This obvious truth is a potential source of theoretical constraint: only implementable algorithms can be I-languages (Naturahls) that children can acquire.[2] And as Chomsky and others have stressed, one can adopt this perspective without overworking the analogy with intensions. A function has a unique value for each argument, but Naturahls admit the possibility of ambiguity. A sound might be homophonously associated with more than one interpretation. Moreover, while competent speakers of English hear (1) as somehow defective, they still hear it as having the interpretation of (2), *and not* the interpretation of (3); see Higginbotham (1985).

(1) *The child seems sleeping

(2) The child seems to be sleeping

(3) The child seems sleepy

The asterisk indicates that there is something wrong with using (1) to express a thought. But this does not preclude understanding (1), which is not incomprehensible word salad like (4).

(4) *Be seems child to sleeping the

Such examples challenge the idea that Naturahls can be described, in any theoretically interesting way, as E-languages. Since (1) is defective, the corresponding signal-interpretation pair is not an element of any set/E-language that is plausibly the set of English expressions. Yet when a child acquires English, the algorithm/procedure/I-language acquired associates the sound of (1) with an interpretation, though one that can be signaled “better” with (2). This I-language

may fail to determine *any* set/E-language that can be identified with English. So if the goal is to explain how children acquire Naturahls, and how adults can interpret the sounds of such languages, the theoretical descriptions should be in I-language terms. From this perspective, the human faculty for language is a biologically implemented device for acquiring I-languages.

2. Constrained Homophony

In what follows, we present several reasons for thinking there is such a faculty, implemented somehow in ways determined by the human genome and how it unfolds in embryology. We focus mainly on the fact that children acquire procedures that associate sounds with interpretations in ways that permit lots of ambiguity, while also imposing exacting limits on how ambiguous strings of words can be. In short, ambiguity is ubiquitous but highly constrained in Naturahls. To the extent that constraints on linguistic ambiguity are not due to other cognitive systems, these constraints can reveal features of the posited faculty. And specifically linguistic constraints on ambiguity are good candidates for innate specification, since it is so unlikely that children *learn* that word interpretations *cannot* be combined in ways that would yield more ambiguity than adults permit. To do what children do, given their experience, they need a faculty that projects I-languages in distinctive ways that are largely independent of experience.

To illustrate, let's begin with the string of words in (5). This string of words can be understood in either of the two ways indicated with (5a) and (5b).

(5) The man called the woman from Paris

(5a) The man called the woman, and the woman was from Paris

(5b) The man called the woman, and the call was from Paris

In this sense, (5) is a homophone like ‘bank’ or ‘bear’. But (5) is homophonous even holding fixed the interpretations associated with the word-sounds. Here, the ambiguity is said to be structural, in that ‘from Paris’ can be understood as modifying the noun ‘woman’ or the verb (phrase) ‘called (the woman)’. But the string of words in (5) *cannot* be understood in a third way.

(5c) #The man called the woman, and the man was from Paris

Note that (5c) can be used to express a coherent thought, which could easily be constructed from concepts indicated with the words in (5), in a way that parallels an intuitive subject-predicate division: the man is an individual x such that x called the woman, and x is from Paris.[3] Yet the word-string in (5) cannot be have the interpretation of (5c). So (5) is *two-but-not-three* ways ambiguous. We can invent a language in which string (5) has all three readings, or just one. But acquiring English, as opposed to some such invented language, is a matter of acquiring a procedure that is permissive in treating (5) as ambiguous and yet restrictive in a specific way.

This point is pervasive. Given any string of words that has at least one interpretation (in some Naturahl), that string will be *n-but-not-n+1* ways ambiguous, where *n* may be 0. Even unambiguous strings can be interesting, because pairs of superficially similar strings can be unambiguous in different ways. Borrowing a famous example from Chomsky, (6) can only be understood as in (6a), even though the relation of (6) to (6b) seems no less direct than the relation of (6) to (6a). By contrast, (7) can only be understood as in (7b).

(6) John is eager to please

(6a) John is eager that he please us

(6b) #John is eager that we please him

(7) John is easy to please

(7a) #It is easy for John to please us

(7b) It is easy for us to please John

These observations invite the following suggestion: in both (6) and (7), ‘please’ takes a covert subject and a covert object; though because ‘eager’ and ‘easy’ differ semantically, ‘eager’ takes a (nonpleonastic) subject that is also understood as the subject of ‘please’, while ‘easy’ can take a pleonastic subject (‘It’) or a subject that is understood as the object of ‘please’. Explaining these facts will require interacting assumptions about how ‘eager’ and ‘easy’ are related to the concepts they indicate, and how words can be combined in Naturahls. But whatever the details, it is hard to see how children could figure out what (6) and (7) *cannot* mean without help from a faculty that is largely responsible for these facts—which go unnoticed by most speakers, and which remain puzzling even for trained linguists with access to lots of data.

It is striking that speakers *agree* about many such unambiguities, once they are prompted to reflection. Repeatedly, and despite considerable variation in experience, children in English-speaking countries grow up to be adults for whom (6-7) are unambiguous in the particular ways that these strings are unambiguous for other competent speakers of English. One can speculate that this regularity of acquisition is, somehow, a by-product of a general learning mechanism applied to the sound-interpretation pairs that any normal child acquiring English will encounter. But absent at least a sketch of a proposal, such speculations are implausible, given that Naturahls allow for lots of ambiguity. For it is hard to learn from experience that a string *cannot* have an additional (coherent and composable) interpretation.

Indeed, a string of words can have an interpretation that seems crazy, compared with an equally composable interpretation that the string cannot have. Consider (9), which must be understood as the bizarre question (10), as opposed to the more reasonable question (11).

(9) Was the boy who fed the waffles fed the horses?

(10) Yes-or-No: the boy who fed the waffles was fed the horses?

(11) #Yes-or-No: the boy who was fed the waffles fed the horses?

In (9), the auxiliary verb ‘Was’ is construed as related to ‘fed’ in the *main* clause, corresponding to the bizarre passive phrase ‘was fed the horses’ in (10)—as opposed to ‘fed’ in the *relative* clause, corresponding to the more expected passive ‘was fed the waffles’ in (11); compare (12).

(12) Was the boy who fed the horses fed the waffles?

Even if one knows that the boy fed the horses, and that he was fed the waffles, (9) remains perversely unambiguous. And this is not because Naturahls abhor ambiguity.

Still, one wants to know if “negative” facts concerning the absence of readings are restricted to the I-languages of adults. For if so, one might suspect that some kind of experience-dependent learning procedure—as opposed to an innate faculty largely responsible for linguistic metamorphoses in human children—plays a major explanatory role in accounting for the emergence of such facts in human languages. So it is important to know the ages at which children recognize various kinds of nonambiguity. And at least in many cases, children seem to be fully competent (adult-like) speakers in these respects by the age of three. If this is correct, it considerably narrows the window of opportunity for learning, thereby bolstering the case for an innate and substantive acquisition faculty. We end this section with one cluster of examples, though the literature contains many others.[4]

Young children know that pronouns like ‘he’ and ‘him’ can have deictic or anaphoric interpretations, and that pronouns like ‘himself’ must be understood as anaphoric. But more interestingly, they know that certain anaphoric interpretations are impossible. In (13), the antecedent of ‘himself’ must be ‘Grover’, and the antecedent of ‘he’ cannot be ‘Grover’. These

facts can be represented as in (14), ignoring deictic readings, with coindexing indicating anaphoric dependence.

(13) Kermit said he thinks Grover should wash himself

(14) Kermit$_1$ said he$_{1/*2}$ thinks Grover$_2$ should wash himself$_{*1/2}$

Likewise, in (15) the antecedent of 'him' cannot be 'Grover'.

(15) Kermit$_1$ said he$_{1/*2}$ thinks Grover$_2$ should wash him$_{1/*2}$

Attending to many such examples might suggest a generalization: an antecedent for 'himself' must be associated with a "nearby" referential expression, perhaps within the smallest sentential clause containing the pronoun, while 'he' and 'him' cannot take a nearby antecedent. One can test this hypothesis by presenting speakers with unusual constructions like (16) and (17). But as indicated, the facts suggest a subtler generalization.

(16) Kermit$_1$ expected to feed Grover$_2$ and wash himself$_{1/*2}$

(17) Kermit$_1$ expected to feed Grover$_2$ and wash him$_{1*/2}$

In (16-17), the possibilities for 'him' and 'himself' *reverse* the possibilities in (14-15). Linguists can use such data to revise their theories. But it seems unlikely that all children who acquire English *encounter and use* such data in determining how pronouns can/cannot be understood. Yet 3-year-olds know which interpretations are available for examples like (14-17). This suggests that children never consider superficially simpler algorithms for interpreting pronouns.

To be sure, young children cannot just report that a string of words fails to have a certain reading. But in suitably constructed experiments, their behavior reveals an I-language that is adult-like with regard to which interpretations are allowed and which are not allowed. By age three, children are adept at saying whether a puppet has correctly or incorrectly described a

scenario that has just been played out. If the puppet uses an ambiguous string that is true on a salient reading, but false on another reading, children (like adults) say the puppet was right. Other things equal, children say the puppet was wrong only when they understand the sentence as being false on each relevant reading. By constructing scenarios appropriately, one can have the puppet say something that is *false* on every interpretation available for adults but *true* on a logically possible interpretation that would be especially *salient* if it were available. If children consistently say the puppet is wrong in such cases, this is evidence that children do not assign the "extra" interpretation to the string. And if children consistently demonstrate adult-like competence in appreciating but not overgenerating ambiguities, this is evidence that the I-languages of children are adult-like in this respect. (See Crain and Thornton [1998].)

As an illustration, we consider one study involving examples like (18-20).

(18) The Ninja Turtle$_1$ danced while he$_{1/2}$ ate pizza.

(19) While he$_{1/2}$ ate pizza, the Ninja Turtle$_1$ danced

(20) He$_1$ danced while the Ninja Turtle$_{*1/2}$ ate pizza.

Note that in (20), 'He' cannot take 'the Ninja Turtle' as its antecedent. Crain and McKee (1985) began their investigation of children's knowledge of this constraint, by first showing that children do not rule out anaphoric relations between pronouns and potential antecedents in examples like (19). Such strings were presented in two contexts. For example, in one context the Ninja Turtle was dancing and eating pizza; in a second context, another salient male character was eating pizza while the Ninja Turtle was dancing. Children accepted (19) in both contexts about two-thirds of the time. This established a baseline for how often children permit anaphoric relations absent a linguistic constraint.

The same children then tested on sentences like (20). The crucial contexts corresponded to the illicit referential dependence—e.g., a situation in which the Ninja Turtle was dancing and eating pizza, but another salient male character refused to dance. If children respect a constraint *prohibiting* anaphora in (20), one would expect them to *reject* (20) as a description of this situation. But if children permit an anaphoric link between 'He' and 'the Ninja Turtle', one would expect them to accept the sentence about two-thirds of the time, as they did in response to (19). In fact, children overall (average age 4;2) *rejected* examples like (20) 88% of the time in these contexts. Even the youngest children (n=7, average age 3;1) rejected examples like (20) 79% of the time. This strongly suggests that, by age 3, children already respect the relevant constraint on anaphoric relations.[5]

As we indicated at the outset, another property of the human faculty for language is its conformity to "deep" principles that unify phenomena that, on the surface, appear to be unrelated. For example, Chomsky (1981) argues that the same constraint against coreference manifested in (20)—repeated below—is related to the striking contrast between (21) and (22).

(20) He_1 danced while the Ninja $Turtle_{*1/2}$ ate pizza.

(21) Who did he say Luisa had criticized

for which x: he said Luisa had criticized x

(22) Who said he had criticized Luisa

for which x: x said x had criticized Luisa

The pronoun 'he' (21) must be used to refer to a single male individual. But the pronoun can be interpreted as bound in (22), where it is anaphorically linked to 'Who.' As Chomsky (1981) also points out, the contrasts in (18-20) and in (21-22) are also related to the contrast illustrated in

(23) and (24). Again, the pronoun ‘he’ must be used deictically in (23). But in (24), ‘he’ can be bound by the quantificational expression ‘everybody’.

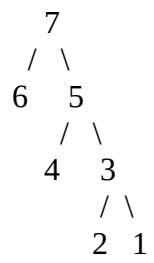
(23) He said Luisa had criticized everyone

for every x: he said Luisa had criticized x

(24) Everybody said he had criticized Luisa

for every x: x said x had criticized Luisa

These facts about the licensing of anaphoric relations are in turn unified by the structural notion of c-command: anaphors/variables are c-commanded by their antecedents/binders. Think of phrase markers as sets of points partially ordered by a dominance relation. Then at least to a first approximation, one node c-commands another iff every node that dominates the first dominates the second. In the following tree, node 6 c-commands each of 1-5; 4 c-commands 1-3; 1 and 2 c-command each other.



This structural notion figures in the description and explanation of *many* linguistic phenomena, including those illustrated with (6-24). And experimental studies reveal childrens’ sensitivity to relations of c-command; see below. This makes sense *if* children have a language faculty that plays two roles: first, it leads children to hear strings like (6-24) as structured expressions whose constituents exhibit such relations; and second, it treats these relations as semantically important, in a way that severely constrains how children can associate the syntactic

structures with interpretations. To the extent that domain general learning mechanisms fail to detect the abstract structural property of c-command, or fail to treat this property as interpretively relevant in the right ways, these mechanisms fail to provide a unified account of the various phenomena tied together by c-command and the corresponding facts about acquisition.

In which case, the conclusion invited is that the relevant structures and constraints are somehow imposed by a human faculty for language. Of course, this is only the start of an explanation. One wants to know how human biology implements such a faculty and what, exactly, is implemented. But ignorance on this score is no argument that the constraints are, despite evidence to the contrary, somehow acquired in response to experience.[6]

3. Patterns in patterns

We assume that the language faculty is not a mere hodgepodge of constraints that happen to be enforced by the biological mechanisms children use to associate signals with interpretations. If current theories sometimes make it look this way, that is because linguists do not yet know what the *basic* operations of the language faculty are, or how these operations interact to yield what may seem to be a disparate assortment of constraints. Put another way, if children have a distinctively human and specifically linguistic faculty of language, it presumably employs a small number of basic operations that manifest in various ways (e.g., as constraints stated in terms of c-command).[7] In this section we further illustrate the more general point, beginning with some humble observations about logical connectives and quantificational words.

Before children are three, they know that the sound of ‘or’ signifies *inclusive* disjunction (Crain and Khlentzos 2008; see also Chierchia, Gusati, Gualmini, Meroni and Crain 2004; Crain, Gualmini and Meroni 2000; Crain, Goro and Thornton 2006). To be explicit, let the ampersand

and wedge have their usual meanings: '*P & Q*' is true iff both '*P*' and '*Q*' are true; '*P v Q*' is false iff both '*P*' and '*Q*' are false. Then '*v*' signifies inclusive disjunction. Let '°' signify exclusive disjunction: '*P* ° *Q*' is true iff '*P v Q*' is true and '*P* & *Q*' is false. Examples like (29), as naturally used by speakers of English, might initially invite the idea that (the sound of) 'or' has the exclusive interpretation of '°'.

(29) You may have cake or ice cream

But (30) is *not* understood as an instruction to refrain from an exclusive disjunction.

(30) Don't kick the dog or pull its tail

Contexts of negation—and as we'll see, 'downward entailing' contexts more generally—strongly suggest that for adults, the sound of 'or' is associated with the inclusive interpretation of '*v*'. Intuitions to the contrary, prompted by examples like (29), can be diagnosed as reflections of pragmatic implicatures as in Grice (1975). And this familiar point about adult comprehension raises questions about acquisition.

One can imagine a language with a sentential connective that sounds like 'or', yet has the interpretation of '°'. Indeed, utterances of sentences like (29) might well confirm the hypothesis that English is such a language for any children who considered this hypothesis without yet encountering enough disconfirming examples like (30).[8] Nonetheless, as noted above, young children know that 'or' has an inclusive meaning. In an illustrative and ongoing long-term study of four 2-year-olds, we have presented children with negated disjunctions, and recorded their responses (behavioral and verbal). On a typical trial in one condition, children were shown three dogs: a white dog, a brown one and a black one. Kermit the Frog, who was being manipulated by the experimenter, indicated that he wanted to play. The experimenter held

up the three dogs, and Kermit said, 'I don't want to play with the white dog or the brown dog'. If children understand 'or' as inclusive disjunction, then one expects them to consistently give Kermit the black dog—as opposed to sometimes giving Kermit the white and brown dogs. (Negating an exclusive disjunction would signify that Kermit didn't want *just one* of the white and brown dogs.) Responses are adult-like, as expected.

In another condition, negated disjunctions were used in Wh-questions like 'Who doesn't have A or B?' On a typical trial, various characters were introduced: some with yo-yo's, some with sponge balls, and some with strawberries. The question posed to children might be 'Who doesn't have a yo-yo or a sponge ball?' One of the youngest children, at age 2;3, consistently responded in conformity with the conjunctive entailment—identifying characters who failed to have a yo-yo *and* failed to have a sponge ball—beginning on the very first trial. Other children produced consistent adult-like responses later than this. But all four children demonstrated knowledge that negated disjunctions yield conjunctive entailments by age 2;10.

The transcripts of parental input suggest that children get little evidence that disjunction is inclusive. The vast majority of the input is consistent with an exclusive interpretation. So if this interpretation were possible, in human languages, many children should adopt it. Yet 2-year-olds have already concluded that the disjunction-word in English has the inclusive meaning of '*v*'. This is already striking. Moreover, given this conclusion, children must treat 'or'-statements in *unnegated* contexts like (29) as having a more restrictive "secondary" interpretation: $(P \vee Q) \ \& \ \text{not}(P \ \& \ Q)$. So they seem to be *presupposing* some kind of semantics/pragmatics distinction in their understanding of 'or'-statements. And they seem to presuppose that the core meaning for a disjunction-word is inclusive.

One can imagine a different linguistic scheme in which 'or' has the exclusive meaning of '°', and *negated* statements have a more restricted secondary meaning: not(P ° Q) & not(*P* & *Q*). A speaker of such a language would know that (30) fails to semantically entail that (just) kicking the dog is disallowed, while also knowing that an utterance of this sentence pragmatically implicates that each of the two actions is disallowed. But this isn't how English works.[9] Children know this: secondary implications are associated with unnegated (or more generally, not downwardly entailing) grammatical contexts. And this has wider implications.

For adult speakers of English, "Ted didn't order sushi or pasta" has a conjunctive entailment: Ted didn't order sushi, *and* Ted didn't order pasta. We doubt that children note such facts and use them to acquire English. But in any case, evidence of an inclusive meaning for disjunction-words seems to be even poorer in other languages. For example, adult speakers of Japanese do not judge (31) to have conjunctive entailment. Rather, adult speakers of Japanese hear (31) as the claim that Ted didn't order sushi *or* Ted didn't order pasta (not-S *v* not-P).

(31) *Ted ga sushi ka pasuta o tanomanakatta*.
Ted NOM sushi or past ACC order-NEG-PAST
'it's sushi or pasta that Ted did not order (but I don't know which)'

Yet in contrast to adults, Japanese-speaking children interpret disjunction in simple negative sentences as having conjunctive implications, like English-speakers (young and old). Using a Truth Value Judgment Task, Goro and Akiba (2004) tested thirty Japanese-speaking children (mean age 5;3) as well as a control group of Japanese-speaking adults. On a typical trial, subjects were asked to judge whether or not (31) was an accurate description of a situation in which Ted had eaten sushi but not pasta. Japanese-speaking adults uniformly accepted the target sentences,

whereas the overwhelming majority of Japanese-speaking children consistently rejected them. To repeat, Japanese-speaking children interpreted negated disjunctions as licensing conjunctive entailments, whereas local adults do not. This is further evidence that across languages, children understand disjunction-words inclusively, despite experience that invites exclusive interpretation.

This raises the question of why Japanese adults hear (31) as they do. But once again, we think the answer lies with nonobvious grammatical structure projected by the language faculty, as opposed to learning from experience. Adults understand (31) with the disjunction operator 'ka' having scope over the negation, despite surface appearances. In this respect, 'ka' in (31) is like 'some' in (32), on the reading which *doesn't* imply that Ted didn't eat *any* kangaroo.

(32) Ted did**n't** eat **some** kangaroo.

*Possible Meaning: There is **some** kangaroo that Ted did**n't** eat*

On the indicated reading, 'some' is a positive polarity item (PPI), interpreted as having scope over a negation in the same clause.[10] But negation in a higher clause still takes scope over a PPI. In (33), the negation clearly has widest scope.

(33) You did**n't** convince me that Ted ate **some** kangaroo.

*Mandatory Meaning: You did**n't** convince me that Ted ate **any** kangaroo.*

So if the Japanese disjunction-word 'ka' is a positive polarity item (for adults), then 'ka' should generate a conjunctive entailment in sentences with negation in a higher clause, as in (34).

(34) *Gen ga Ted ga sushi ka pasuta o tanomu no o minakatta*

Gen NOM Ted NOM sushi or pasta ACC order-Prt Nmlzr ACC see-NEG-PAST

(Prt: Present, Nmlzr: Nominalizer)

'Gen didn't see Ted order sushi or pasta'

And this is the case. In both Japanese and English (like all other languages, as far as we know), disjunction-words in the scope of negation generate conjunctive entailments. But as ‘ka’ reveals, this generalization can be obscured in the simple constructions that are likely sources of data for children. The generalization may be “manifest” only in structurally complex examples like (34).

It is *very* unlikely, however, that children acquiring Japanese infer that ‘ka’ signifies inclusive disjunction based on exposure to sentences like (34). Such sentences are too exotic to ensure that every language learner is exposed to sufficiently many to guarantee convergence on the local adult grammar. So it seems that Japanese children understand ‘ka’ as inclusive disjunction, despite input from parents who treat ‘ka’ as a PPI in simple negative sentences. Human language acquisition is, for whatever reasons, constrained in this way. And this has cascading effects for other aspects of interpretation. In the next section, we develop this point to illustrate how appeal to an innate language faculty can help explain why apparently disparate phenomena are not acquired separately.

4. Related Generalizations

As noted by medieval logicians, quantificational expressions like ‘every’, ‘some’ and ‘no’—which combine with a predicate like ‘dog’ to form a phrase that can combine with a predicate like ‘barked’ to form a sentence—can be characterized in terms of the inferences they license between pairs of predicates such that one is (known to be) more restrictive than the other. Consider ‘dog’ and ‘brown dog’. If some brown dog barked, then some dog barked. The direction of inference is from the more restrictive to the less restrictive predicate. Likewise, if some dog barked loudly, then some dog barked. The inference is from the more restrictive ‘barked loudly’ to the less restrictive ‘barked’.

Replacing ‘some’ with ‘no’ inverts this pattern: if no dog barked, then no brown dog barked. Interestingly, ‘every’ is like ‘no’ with regard to the first predicate, and like ‘some’ with regard to the second predicate: if every dog barked, then every brown dog barked; and if every dog barked loudly, then every dog barked. So ‘every’ is said to be *downward entailing* in its first (nominal) argument position, while ‘no’ is downward entailing in both argument positions. Children know such facts.[11] But even more interestingly, their acquisition of Naturahls respects correlations between other linguistic properties.

One phenomenon correlated with “downward entailingness” involves so-called negative polarity items like ‘ever’ and ‘any.’ Negative polarity items (NPIs) are licensed in downward entailing contexts, as illustrated in (35), with the first predicates in bold.

(35) No/Every **cow that ever ate a vegetable** became ill

(36) No **cow that became ill** ever ate a vegetable

(37) *Some **cow that ever became ill** ate a vegetable

(38) *Some/Every **cow that became ill** ever ate a vegetable

A second phenomenon involves the interpretation of disjunction-words. Consider (39) and (40).

(39) Every **cow that ate broccoli or asparagus** became ill

(40) Every **cow that became ill** ate broccoli or asparagus

In (39), the disjunction is in the downward entailing argument of *every*, and there is a conjunctive implication: every cow that ate broccoli became ill, *and* every cow that ate asparagus became ill. In (40), the disjunction is not in a downward entailing argument, and there is no conjunctive implication.

This trio of facts—concerning direction of inference, NPI licensing, and the implicational effect of disjunction—presumably has a common source. But one can imagine language acquirers who figure this out late, if at all, after passing through stages at which only one or two of the generalizations are respected. To the extent that domain general learning mechanisms allow for this kind of "partial" knowledge of linguistic constraints, such mechanisms are unlike children. (Compare the earlier remarks about c-command; see also Marcus [1998].)

Using Truth Value Judgment tasks, several studies have shown that children have an adult-like understanding of disjunction in scope of 'every.' In one study, by Gualmini, Meroni and Crain (2003), 4- and 5-year-old children consistently accepted (41) as a description of a situation in which none of the women bought bananas, but the same children rejected (42) in a scenario in which women who bought eggs received a basket, but women who bought bananas didn't.

(41) Every **woman** bought eggs or bananas

(42) Every **woman who bought eggs or bananas** got a basket.

This asymmetry in responses reveals children's knowledge of the corresponding asymmetry in the argument positions of 'every': downward entailing *only* with respect to the first (nominal) argument position. Such experiments also confirm that children understand 'or' inclusively. And this connects with the fact that 'or' is often pragmatically associated with an exclusive-disjunction implicature—but *not* in downward entailing environments.

A domain general learning procedure might let children to learn the environments in which NPIs *can* appear. But again, acquiring the constraint on where such expressions *cannot* appear is another matter. And unless such a procedure takes advantage of whatever deep

property unites the various phenomena related to downward entailment, there is no reason to expect such a mechanism to yield acquisition of an I-language that relates NPIs to contexts in which disjunction-words have conjunctive implications, and restricts NPIs from appearing in contexts in which disjunction-words lack conjunctive implications.

We conclude this section with one last point about disjunction, and how its interpretation is related to c-command. The point is simple, theoretically, but striking from the perspective of acquisition, since it seems so unlikely that a child would ever "find" the generalization. As illustrated in (43-46), a disjunction-word generates a conjunctive entailment only if c-commanded by a downward entailing expression.

(43) The news that Bush won did**n't** surprise Karl **or** Jeb

(44) The news that Bush did**n't** win surprised Karl **or** Jeb

(45) The news that Bush won did**n't** surprise any of the justices

(46) *The news that Bush did**n't** win surprised any of the justices

In (43) but not (44), negation c-commands disjunction; and in (43) but not (44), there is a conjunctive entailment. Indeed, in (44) there is an exclusive pragmatic implicature. Likewise, the NPI 'any' is licensed in (45) but not (46).

In a study of 5-year-olds, Gualmini and Crain (2005) had a puppet use sentences like (47) or (48), as a description of a story about two girls who had each lost a tooth.

(47) The girl who stayed up late did **not** get a dime **or** a jewel.

(48) The girl who did **not** go to bed got a dime **or** a jewel.

Disjunction resides in the scope of 'not' in (47). But in (48), 'not' is embedded in a relative clause, and so fails to have scope over 'or'. This difference in structure results in a difference in

interpretation. For both adults and children, (47) has a conjunctive entailment, while (48) does not. In the story, one girl went to sleep, but one girl stayed up to see the tooth fairy. The girl who was asleep received both a dime and a jewel from the tooth fairy, but the girl who had stayed awake was only given a jewel. At the end of the story, 87% of children presented with (47) accepted the sentence. By contrast, 92% of children presented with (48) *rejected* the sentence, on the grounds that the girl who stayed up late had only received a jewel.

For these children, (47) has a conjunctive entailment. This requires sensitivity to the fact in (47), 'not' c-commands 'or', which signals inclusive disjunction. This is a lot to learn, all at once. But such facts are unsurprising if children have a language faculty that leaves them with no other interpretive options. But if children are born able to adopt other linguistic options, and must somehow learn that these options happen not to be exploited in English, then the rapid convergence on adult grammar is very surprising indeed.

5. Limited Variation

Given a human faculty for language, one expects many aspects of adult grammar to be determined independent of experience and manifested at an early age. From a theorerical perspective, innate linguistic principles define a space of possible human languages: a space the child explores, influenced by her environment, until she stabilizes on a grammar equivalent to that of adults in her linguistic community. Languages outsisde this space will go "untried." But correlatively, at any stage of acquisition, children are employing a possible state of the language faculty (a possible I-language), just not the one being used by local adults. So even if the known adult grammars constitute only some of the possible human grammars, one expects to find children trying out grammars with features found in adult languages elsewhere on the globe.

If this expectation is confirmed, it provides dramatic support for a human language faculty that determines the linguistic options available to children. We conclude this chapter by briefly noting an example of children acquiring an I-language that diverges from those of local adults. For even if such cases are in some sense unusual, they provide vivid evidence of children projecting I-language in accordance with constraints imposed by their language faculty and in the absence of relevant experience.[12]

Using an elicited production task, Thornton (1990) evoked wh-questions from three- and four-year-old children. Thornton found that about one-third of the 3-4 year-old children (of English-speaking parents) she interviewed consistently inserted an 'extra' Wh-word in their long-distance questions, as illustrated in (49).

(49) What do you think what's in the box?

For example, a child might use (49) repeatedly when prompted to inquire after a certain puppet's views concerning the contents of the box. (The experimenter always says 'Ask him what he thinks is in the box', with only one occurrence of 'what'.) But interestingly, children who diverge from adult usage in this way do *not* produce utterances like (50) or (51).

(50) Which smurf do you think *which smurf* is wearing roller skates?

(51) Who do you want *who* to win?

This suggests that the children in question have an I-language that lets them form questions with a "medial wh-word" subject to a constraint. And this suggestion is bolstered by the fact that many adults have such an I-language. For example, (52) is acceptable in Bavarian; see McDaniel (1986). But (53), with a medial wh-*phrase,* is defective.

(52) Wer glaubst du wer nach Hause geht?

Who do you think who goes home

(53) *Wessen Buch glaubst du *wessen Buch* Hans liest?

Whose book do you think *whose book* Hans is reading?

Likewise, one cannot have a medial subject of an infinitive. In a question like (54), the question word appears only once.

(54) Wen versucht Hans anzurufen?

Who is Hans trying to call?

The contrasts in (52-54) raise questions about how children who acquire medial-wh languages figure out when *not* to use a medial wh-expression. But even if children could learn the relevant constraints, given experience with those who use a medial-wh language, it seems impossible for children to learn a constraint on a construction that does not exist in the local adult language.

Instead, it seems that language faculty makes it possible to acquire an I-language that permits questions with a medial-wh, even if one does not encounter such questions. Yet whatever I-language one acquires, that way of associating signals with interpretations is subject to whatever constraints the language faculty imposes on these procedures. And for whatever reason, expressions like (50-51) and (53) are verboten. From this perspective, it is not surprising that when American children use a medial-wh, they are governed by the same constraints as Bavarian children. But if one does not assume that children everywhere are projecting I-languages in accordance with constraints imposed a distinctive faculty, it is quite surprising that children who use (49) *don't* use (50) or (51), even when prompted to do so. For further examples, see Thornton (1996), Crain and Thornton (1998), Crain, Gualmini and Pietroski (2005).

6. Conclusion

We have tried to illustrate, with examples that may have some independent interest for philosophers, that humans have a faculty for acquiring procedures (I-languages) that associate linguistic signals with interpretations in constrained ways; where these constraints are not reflections of more general constraints on thought and/or the experience that leads children to acquire a particular procedure. The constraints, which are at far remove from ordinary perception, govern superficially disparate constructions. And yet they are respected by young children. As Chomsky and many others have long argued, this suggests that language acquisition is made possible by a distinctive human faculty for generating I-languages.

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Notes

[1] There are many other ways of organizing this kind of discussion. See, for example, Chomsky (1981, 1986), Fodor (1983), Hornstein and Lightfoot (1981), Pinker (1994), Hauser, Chomsky, and Fitch (2002), Collins (2004), Jenkins (2005), Pinker and Jackendoff (2005), Reinhart (2006). Our primary aim is to illustrate several kinds of arguments, which in our view remain unrebutted, for positing a substantive language faculty; though cf. Cowie (1999), Elman, Bates, et.al. (1996), Pullum and Scholz (2002). Given space constraints, we focus on facts concerning the relation of syntax to semantics. (For relevant discussions of phonology, see Dresher [2005] and Halle [2002]). We have also tried to abstract away from various debates, among those who assume a substantive language faculty, concerning its nature and the best vocabulary for describing it. While such debates often reveal facts that bolster the case presented here, we want to avoid the impression that arguments in this domain always rely on a particular and tendentious theoretical perspective.

2. For Chomsky, 'I-' has further connotations. He takes I-languages to be *idiolectic*—as opposed to public/conventional languages that a speaker might grasp only imperfectly (cf. Dummett [1986])—and *internalistic*, as opposed to languages that are individuated (externalistically) with reference to things in the mind/language-independent world (cf. Burge [1989]). See George (1989) for further discussion and distinctions.

[3] That is, the man is both one who called the woman *and one who is* from Texas. Compare (5b), according to which the man called the woman who is from Paris. Similar points apply to 'The cook saw the thief with binoculars'.

4. See, e.g., Crain (1991); Crain and Pietroski (2001, 2002); Crain and Thornton (1998, 2006); Guasti (2002); Goodluck (1991); Pietroski and Crain (2005).

[5] In experiments of this kind, children almost never reject sentences 100% of time. A "noise" rate of about 10% is standard and hardly surprising. When children are confused by a question, they are more likely to say 'yes' than 'no'. Thus, 90% rejection is very good evidence that children understand the puppet's claim as wrong on any salient reading.

[6] Much discussed "poverty of stimulus arguments"—for recent reviews, see Crain and Pietroski (2001), Laurence and Margolis (2001), and the replies to Pullum and Scholz (2002)—can reveal that the facts to be explained have their source in a substantive language faculty, whose nature remains unclear, as opposed to general learning mechanisms whose nature remains unclear.

7. In terms of the evolutionary time scale and underlying biology, the difference between humans and our nearest primate cousins is small. So somehow, a small and recent change had dramatic effects; see Hauser, Chomsky, and Fitch (2002), Hornstein and Pietroski (forthcoming).

[8] If one starts with *concept* of inclusive disjunction, constructing a concept of inclusive disjunction to associate with 'or' would not be hard, compared with children's other cognitive accomplishments. And even if exclusive interpretations are implicatures, they must represented somehow, raising the question of children don't associate directly/semantically associate such representations with 'or'. See Chierchia and McConnell-Ginet (2000) for introductory discussion that bridges Grice (1975) to relevant literature in linguistics.

[9] For example, pragmatic implications are cancelable. One can say 'He sang or danced, and he may have done both' without contradiction. And if you bet that Chris will sing or dance, you win if Chris does both. (Likewise, if you promise to sing or dance, you keep your word if you do

both.) But it is a contradiction to say ‘He didn't kick the dog or pull his tail, but he may have done both’. And if the sign says ‘No parking or loitering’, you can't beat the ticket by saying that you parked and loitered.

[10] See Szabolci (2002) for discussion of PPIs, building on a traditional discussion (see note 11) of *negative* polarity items (see Ladusaw [1996] and Ludlow [2002]).

[11] See Crain, Gualmini, and Pietroski (2005) for discussion of experiments; and see note 10.

[12] In cases of creolization, children acquire I-languages that have the grammatical properties any ordinary Naturahl, despite experiences with adults who use a pidgin language that lacks many of these properties. This shows that children can project an I-language that is not already implemented in their linguistic community; and such projection cannot be a species of *learning* in any traditional sense. But discussion of creoles would take us too far afield. Here, we offer an example closer to home of children projecting a fine I-language not implemented by any adults.