

The Minimalist Microscope: How and Where Interface Principles Guide Acquisition

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1.0 Interfaces and Biology*

Linguistic theory has shifted focus to the question of interfaces: how do various modules of mind combine to produce language abilities, and therefore to enable language acquisition? Many have assumed that the relevance of interface interactions lessens the innate component. This essay proposes the opposite view: that a richer theory of innate structure is needed to construct interfaces. The innateness hypothesis predicts immediate recognition of theoretical principles, in particular where spontaneous utterances reflect principles that are not found in a target language. This overview shows that a good deal of that evidence exists. Because it is spontaneous and early, this evidence is arguably the singularly best support for linguistic theory and interface theory.

The argument here is an extension of classic reasoning, the original definition of the acquisition problem. Chomsky (1965) claimed that without innate constraints there was an overwhelming information explosion: too many ways to combine data and too many possible grammars given the tremendous ambiguity of the stimulus (poverty of stimulus argument). Innate constraints and the independence of modules (autonomy of syntax) serve to severely limit the set of possible alternatives—leaving still such a large number of possible grammars (even an infinite set in the 1965 conception) that uncovering the child's method to determine a language-particular grammar remains a challenge.

Others have argued (Tomasello, Tenenbaum among many) that innateness may not be necessary if we invoke a broader range of relevant abilities: general learning capacities and probabilistic analysis reduce the need for an innate component, while pragmatic and semantic analysis explain a number of syntactic generalizations. Those factors can be represented in the theory we advance here, but for them to argue against innate interfaces, they must account precisely for subtle and input-rare data like many forms of recursion.

What does a linguistic interface theory have to say? A conservative view, which I take to be consistent with Chomsky (2005, 2008) and Berwick and Chomsky (2008), is that an interface model *increases* the information explosion. If we seek to explain all these pragmatic and semantic ingredients of language, not just grammar, then a richer theory of constrained principles is needed, not a weaker one.

1.1 Interactions

It is important to observe that a constrained theory of Interfaces does not exhaust the possible interactions between language and various mental (and

physical) modules. While strong words may hasten our heartbeat, the connection between heart and grammar is indirect. Understanding the interaction sequences is a natural scientific goal, but one that needs to build upon a clear model of where interfaces are precise and biologically fixed. The distinction between interactions and interfaces may be important in the future.

Among the interfaces, I shall argue, the child uses pre-built avenues and restrictions upon how contextual information must fit open parameters in grammar (an important topic in semantics). By comparison, possible human interfaces among mental modules may not exist for all species. Hauser (2008) argues that interface “mismatches” are what restrict animals from combining all of their mental abilities.

1.2 Biological Analogies

Language ability has direct biological roots, so it is natural to look to biology for instructive hints about how to build an interface.

Independent modules: First we argue that the presence of a single particular principle of mental organization does not guarantee a single biological representation. Thus the principle of stereoscopy is crucial for both seeing and hearing, but all indications are that they are separately represented in the brain--- and the loss of stereoscopic ability in vision would not affect the use of two ears in hearing. Similarly we might, for instance, find that the notion of recursion has multiple independent representations in mental structure. Moreover it might be quite limited within each domain depending upon its interfaces with other modules. In general, biologically specific principles are not transferable among modules (although complex triggering connections could exist).

Speed: Grammar must meet the requirement of essentially automatic mental processing, which occurs in milliseconds and not minutes. Thus to use a classic example, a dog may instinctively solve a calculus problem when catching a stick, but the process is very different from a human with pencil and paper. Transfer is not possible in either direction.

Narrow Transfer: Modules allow transfer of information in fixed and narrow ways. If we typed on skin, it is unlikely that skin could rapidly carry to our minds the information imprinted upon it; while the information would in fact be present, skin is not designed to carry that kind of information. In eye-hand coordination we transfer information rapidly from eyes to mind to fingers to play the piano, shifting from a 3-dimensional visual scheme to a 3-dimensional scheme of muscle instructions again in milliseconds. The pathway must be inborn despite the fact that it is open to extensive refinement through instruction.

Links between Abstract Abilities are Specific and Innate: Organs in the body must all interface. The heart and lungs, like eyes and hands, are separate organs but both conspire to deliver oxygen to the blood. The interface link

between them is just as innate as the organs themselves. The tightest model is that of a key and a keyhole. The keyhole has the “concept” of a key built into it, while being physically its inverse.

Interfaces among language abilities should be the same. It is easily and often argued that certain inherent notions involved in structure-building reflect general abilities (categorization, hierarchy, and recursion) For instance, the linguistic notion of Merge seems, at first, to mean just “combine”, an ability which half our daily actions entail one way or another. The broader cognitive notion of Concatenation (Hornstein (2009)) may apply to many modules, but as we illustrate below, Merge carries a further requirement of Labeling, assigning a category to a phrase, which may be only required within language. While Labels are “categories” in a broad mental sense, their connection to Merge, creating asymmetrical structures is where we argue that interface specificity must be present. Children, we show, concatenate and label immediately.

2.0 Context Interfaces

There are three basic connections we must consider:

- (1) **Early Rich Inferences:** How does the child uses Context to infer hypotheses about structure to words and phrases in the acquisition?
- (2) **Confirmation:** How does the child uses Context to confirm grammatical hypotheses?
- (3) **Exclusion:** How does the child use grammar to exclude context?

Initially common sense suggests that one uses a representation of Context and Events, picking out salient phenomena, to guess—often with error or imprecision--what a sentence or phrase refers to (whether a child or an L2 learner). This may indeed belong to an acquisition device that is largely discontinuous with the later use of context in grammar, where much of potentially relevant context must be blocked in order to communicate.

As soon as phrases are properly segmented, by hypothesis, grammar-based inferences determine what in context is utilized. For instance, Allen (2007) shows that salience in context may assist the child in identifying a missing subject. Still, it is the knowledge that a subject is missing which makes the child look for a salient object to fill a nounphrase and not a salient action. Thus, early on, grammar tells the child what to look for in context. (See Hyams (to appear) for a relevant summary of work on Null subjects.)

2.1 Context as Trigger

Second, trigger relations involve an important interface between syntax, semantics, and pragmatics. I have argued (Roeper (1982)) that children use a logical triple to confirm syntactic hypotheses, such as the passive transformation (see also Lebeaux (2000)):

- (4) [scene: John hits Bill] Sentence: “Bill was hit by John”

- a. pragmatic representation of context: Event of John hitting Bill
- b. semantic representation: hit requires AGENT and THEME
- c. syntactic representation: Object => moves to subject.

If the apparent subject is really the object, then the pragmatic semantic and syntactic hypotheses are all simultaneously confirmed. The pragmatic/contextual interface, what in biology is regarded as “triggering experience”, is a prerequisite here.

2.2 Including Context

How and where is grammar engaged in determining the relevance of context? Deixis is what first springs to mind, but it requires syntactic discrimination as well. In a situation like this:

(5) put your finger here [touch your nose]

most children will touch their own noses (though perhaps not autistic children) choosing to interpret here as a kind of mathematical variable (which is, perhaps crucially, a formal way of representing the notion of “mirror neurons”) allowing “here” to be in a semantically bound relation to a set of listeners. (“If you all put your fingers here, we can play the game”).

Syntax plays a role. If a Japanese visitor said:

(6) Here we put our shoes there, but there you put them here.

Then the sentence-initial here means “in this country” while the final, verbphrase-internal there refers to a spot near the Speaker. Origin (first) and Goal (second) are implicated in a sentence like:

(7) put the chair there here, and the one here there.

We do not know exactly when children master the syntax of deixis, but the ambiguous uses of here are in parental language and present early for children. From CHILDES Adam, just over 2yrs, we find at least (by a reasonable guess) locative, command, and presentational uses of here, both initially and finally: Adam01: “paper here”, “here doggie # here”, “here # Mommy”. Subtle syntactic constraints on here are present virtually from the outset.

2.3 Excluding Context

When exactly does context enter into the computation? Expletives, ubiquitous in parental speech, require the child to recognize that no contextual object is referred to (it's cold). Otherwise a child could search ever more microscopically, forever uncertain as to what object is referred to. That children understand expletives is reflected in their use of them: Adam 14: “it is nice outside”, Zoe: “it's nice having Kate around”. 4yr olds can even overgeneralize

them (“it’s sounding” (obscure noise) Roeper (corpus)). In general, contextual reference is allowed only after Discourse is composed and its connections are eliminated. In other words, the child must:

(7) Delay reference to Context

In fact, virtually every discourse contains some ellipsis that refers to previous sentences and not the physical context.¹ Children both succeed and fail to restore missing information from elided NP’s (and VP’s) (Roeper (2007)):

(8) **Success:**

Child : I drink it all up .
Child: give me some more. A lot.
Mother : I don't see any more.
CHI: yes you do.
Mother: mmhm.

Failure:

Mother: you want milk or juice?
Child: Milk...juice?
Mother: you can have one or the
 other but not both...
Child: huh?

In the first case, the child uses pronominal reference through discourse without introducing new contextual references successfully, but the second “one or the other but not both” has three reconstructions that seem to be baffling.

Nonetheless, many sentences allow an immediate use of Context:

(9) Look!



Do you want to eat some?

This context engages NP-ellipsis reconstruction where some => some cake.

Discourse subordinates this move to context, however, if we hear:

(10) I have some nails. Do you want to eat some __?

Here we are forced to reconstruct the anti-pragmatic NP: eat some [nails] even though a cake is present.

The constraint is even tighter. We must refer to the immediately available dominant NP in order to reconstruct the NP-ellipsis properly.

Thus if we have:

¹ Kamiloff-Smith (1981) as well argues that children cannot maintain pronominal reference, moving too quickly to context. Her contextual situations must be fairly complex. In pilot work Deanna Moore gave 10 3yr olds pictures of Grover playing baseball and BB playing basketball. And said “Grover is playing baseball. Is he playing basketball?” 90% said “no” although a contextual referent for “he” exists.

(11) “I just bought some cake.
Look here are some nails.
Do you want to eat some?”



We still anti-pragmatically reconstruct eat some nails although further back in the discourse we had a pragmatically acceptable nounphrase. Note that it is not “the last NP”, but the object argument of a verb that we reconstruct. If we said:

(12) “I found some nails on the floor. Do you want to eat some__?”

The answer continues to be nails, the argument of the verb find, and not eat some floor (which is buried in an adjunct PP). The pure context-cake choice, if made consistently, might suggest an undiagnosed disorder.² This kind of comprehension of ellipsis and binding is common in children’s readers and could easily be where a child goes astray. [See Roeper (2007)]

2.4 NP-ellipsis Data

There is abundant naturalistic data that children hear and use NP-ellipsis very early. Here is Adam 6-8, under three years:

(13) “I don’t [?] have some” “d(o) you [?] have some”. “Cromer have some?”
“have some # Mommy ?”

The strongest evidence of the Discourse-over-Context Principle requires anti-pragmatic circumstances. Goksun, Golinkoff, Hirsch-Pasek, and Roeper (to appear) gave children precisely such choices. Subjects: 18 3-year-olds:

(14) “John has socks” Can you find: “John wants to eat some.”



² One could make it sharper:

i) I found some nails near the cake. Do you want to eat some____
It should be nails again, but a child might go for the cake here.

Or: “Kate is cooking pancakes.” Can you find: “John wants some.” in contrast with: “John wants to”. Here the contrast is between NP-ellipsis (wants some pancakes) and VP-ellipsis (wants to cook pancakes). In both instances children were able to carry out NP-ellipsis and pick socks or pancakes: 3-year-olds pointed to the target anti-pragmatic action 77.78% of the time. Contextual reference is clearly syntactically controlled and not based on plausibility alone.

2.5 Complex NP Reconstruction: More to Learn

The abundant evidence that children reconstruct NP’s does not exhaust the interface challenge that they face. Context may invite a subtle division between parts of a reconstructed NP. Because the demand is intricate:

(15) Children may shift to Context too soon or too late

Thus they may reconstruct only part of an NP. Wijnen, Roeper & Van der Meulen, 2004 (see also Obdeijn (2005) investigated this contrast giving different pictures to different children with 28 American children; mean age 4:6yrs (range 40-69 month) and 47 Dutch children, mean age 3;6 yrs (range 28-57months)

(16) “Some kids are playing in the sandbox.

Are two upside down?”

Two => two [kids] [in the sandbox]



A	B	C
Correct = Only: two kids	[in the sandbox]	= A (kids in sandbox)
Argument	Adjunct	
Not: two [kids]		= B (kids <u>not</u> in sandbox)
Not: two [anybody or anything]		= C (adults)

We hypothesized that children might reconstruct the Argument without the Adjunct. (See follow-ups Wijnen et al (2008) and Hubert (2009)). The results were: 36% 3-4yr olds and 15% 4.9-5.7 allowed adults (C) to be reconstructed, apparently allowing a contextual interpretation without reconstructing any NP. The largest response, including children in the 5yr range was: 40% of 4yr olds allowed two kids anywhere, reconstructing the N but not the PP. In effect, they moved to context too soon. The conclusion is that children must learn to:

(17) Extend NounPhrase reconstruction to include NP and PP

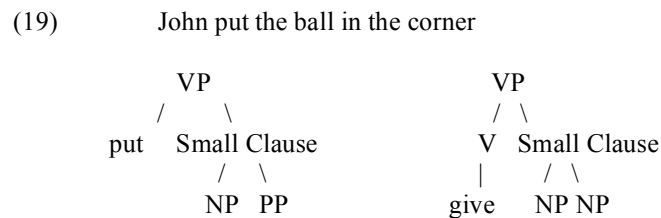
One can imagine instructive negative evidence that would reset the grammar of those who say “yes” to B: “No, those kids are not in the sandbox.” Use of a reduced NP is no surprise since languages vary in how much and when NP can be reconstructed. Languages like German, with morphology on adjectives, allow the equivalent of: “see truck. I want a big” where English requires “a big one”. This follows from Adj-Noun agreement variation across languages.

2.6 Parametric Variation in Ellipsis

To answer this question let us look at another domain where NP’s can be dropped. Huang (1982) distinguishes “hot” Asian languages that allow more reference to context than “cool” ones which do not. In English we allow objects to drop, usually with a generic meaning, but only in certain constructions:

- (18) John loves to buy, sell, and steal__
- *John likes to put__ on the shelf
- *John gives everyone __ at Christmas

This can be roughly described as a constraint requiring direct domination of an object by a verb. Constructions that have what is called a Small Clause making the connection indirect. Here are trees for put something on the shelf and give him something:



For our purposes we propose an informal version that may suit the child acquiring language:

- (20) **Interface Ellipsis Constraint:** Contextual Ellipsis applies to constituents under Direct Semantic Dominance (VP, DP)

The constraint captures both VP (don’t push) and DP ellipsis (I want some). In modern terms we can argue (extending Boeckx (2008):

- (21) Phase Version: A Phase-Head must dominate a Phase, only Phases (Phase-Head Complements) are context-deletable.

If it is a deep principle, then children may have access to it as an Initial State assumption, producing English.³ Early production evidence suggests that children are sensitive to the distinction. English allows cliticization for pronominals in cases like: “gimme that” ‘give’im that’⁴. Gimme involves clitic incorporation, as if it became a simple transitive verb like push while give’im seems to be primarily post-syntactic phonological incorporation. Under the hypothesis above, gimme allows direct domination of the verb while give-im engages a small clause blocking such domination.

Therefore we predict that gimme can allow context-deletion while give-im cannot. A cursory study produces these results. 73/375 instances of gimme in CHILDES had no object (“gimme that” but also “gimme” “no gimme” “I said gimme” “Mommy gimme” etc) while 0/72 cases of “give him” had a missing object (“give him dog food”, “Mom give him a kiss” “don’t give him no dinner” “I can give him one of mine”). This shows that syntactic principles govern the contextual interface immediately.

2.7 Conclusion

Interface Context Constraints play several roles in triggering grammar.

(1) It provides an initial inferential basis to determine the Topic of utterances, (2) it allows confirmation of changes in grammar on the acquisition path, and (3) it is engaged in the acquisition of refined principles of context-sensitive rules for ellipsis which are unfailingly subordinate to Discourse-binding of missing and pronominal information (Delay reference to Context). Stating those restrictions is an important unfinished task. Nonetheless, steps on the acquisition path evidently involve the extension of syntactic principles, not their replacement.

3.0 Interface Constraints within Syntax

Do “general” abilities include grammar? Are these actually grammatical:

- (22) Merge (= “combine”)
 Phrase structure (= make a hierarchy)
 Movement (=change order of sequence)
 Recursion (= self-reference)

Each of these abilities have fixed links, so they are not just general abilities:

³ Asian languages, under this view, would require a subtler definition of deletion domains, but this is only a superficial view See work on Argument Deletion by Keiko Murasugi (2008) and Mamoru Saito (2008)

⁴ I became sensitive to the double object restriction in English on deletion when a visitor from Japan said to me “let me give you” handing me something without saying “let me give you this”.

- (23) Merge + Labels with dominance
 Hierarchy + Labels ordered by subcategorization
 Movement + Intervention Barriers, Minimal moveable Features
 Recursion + Specific Nodes: Language variation exists

If these links are real and innate, they should arise spontaneously in acquisition.
 What does the evidence say?

Merge and Label In general, the reported instances of early two word utterances appear to exhibit the property of asymmetric merge where one item is projected to dominate the other⁵, that is, Merge requires a Label, minimally a word that carries category features (NP, VP, AP) as in:

- (24) a) house b) boat
 / \ / \
 boat house house boat => (a) = a house, and (b) = a boat

And labeling operates recursively:

- (25) handle
 / \
 / handle
 elephant / \
 box \
 / \ \
 ice box handle

There is room for experimentation here to determine that children do assign Labels, and when they do it recursively (What is a coffee-maker-maker?).⁶
 Typical two-word utterances show asymmetry of some kind:

- (26) agent-action "baby eat" verb-object "pick glove"
 agent-loc "baby highchair" possessive-obj "mommy sock"
 verb-goal "throw daddy"

Bowerman (1981) reports the general absence of conjoined elements like

⁵ Data complexities do occur. In addition to idioms (bread and butter), it may be unclear if there is a pause between words hence a two-word phrase is not built. Thus a child might say "Mommy...Daddy...help" appearing to give a conjoined utterance.

⁶ See Snyder (1995) and Snyder and Roeper (2003) for discussion of parametric factors in the emergence of compound that separate Germanic and Romance in their connections to recursion. See Roeper (2007) for more experimental suggestions.

50% of the children chose (B), as if the second every were a copy of the first [(x) => every girl is holding a balloon] just like Negative Concord is treated as a single negation. The significance of a bias toward Operators in young children should play a larger role in our conception of their mental preferences.

It is not impossible that animals might have a primitive form of this ability as well. Suppose one were to teach some species a word for blue and a word for coat and a word for hat and them present them in this sequence: blue coat hat with a choice of objects:

(29) blue coat, red hat, blue hat, green hat, orange hat,

and see if they point to or give you: a blue coat and a red hat, or a blue coat and a blue hat. In other words, would they treat the modifier blue as applying to a set rather than an adjacent symbol.⁷ This early bias deserves more empirical and formal attention, but we move now to the important question of recursion and the semantic/pragmatic interface.

4.0 Recursion, Concatenation, and Interface Semantics

The most elementary form of recursion occurs when Merge has applied twice and therefore must be present in any grammar where phrases beyond two words occur. This fact provides the primary justification for the famous claim by Hauser, Chomsky, and Fitch, (2002) that recursion is a distinctive property of human grammar. A more challenging question is how children first represent and then acquire recursion where it is language specific.

4.1 Concatenation

The first thing to be observed is a strong child bias toward conjunction, which can be seen as a form of Concatenation and is often represented with multiple branches under a single node. It leads to the kind of concatenative conjunctions that every parent has heard:

(30) Sentence: “and I came home and I had a snack and it was candy and...
Adjective: “it was big and fun and scary”

It is notable that while these are acceptable adult sentences, there is no strict interpretive sequence that is enforced. Consider this contrast:

(31) John, his father, and his friend came
[=his friend and his father and John came]

where three separate sentences are implied whose sequence is arbitrary from an interpretive perspective. By contrast possessive sequences:

⁷ Thanks to Tecumseh Fitch and Marc Hauser for discussion of this possibility.

(32) John's father's friend came \neq John's friend's father came

require us to interpret each possessive inside the other recursively.

4.2 Periodic Interpretation

This interpretive difference is at the heart of the challenge to a child. The core is this: possessive, adjective, compound, and sentence recursion are all language-particular and involve an interpretive interface. This claim is not remote from intuitive experience: recursive possessives “feel” more taxing than conjoined phrases.

Here is a summary of major known recursion contrasts:

- (33) a. Compounds: Germanic languages \Rightarrow recursion
Romance languages \Rightarrow no (recursive)
- b. Possessives: English \Rightarrow recursive possessives (Saxon Genitive)
German \Rightarrow no recursive possessives
- c. Adjectives: English \Rightarrow recursive prenominal adjectives
no recursive post-nominal adjectives
French \Rightarrow no recursive prenominal adjectives
recursive post-nominal adjectives
- d. Serial verbs: Bantu recursion
English no recursion
- e. PP recursion: English \Rightarrow recursion
Not present if a language has incorporated prepositions.
- f. Clausal recursion: Germanic, Romance
Sign Language, Piraha (disputed) \Rightarrow no recursion

It is crucial to note that in non-recursive languages a single instance can occur without recursion. Thus in German one can say Maria's Haus but not *Maria's Freundin's Haus. It follows that a child must not generate recursion from a single example but must experience recursion directly (or some different trigger), as argued by Snyder and Roeper (2003, 2004).

We can ask which of many models (rewrite rules, tag grammar, X-bar theory) best captures the acquisition path? Our evidence suggests that a shift from Direct to Indirect recursion is linked to a major interface:

(34) Direct Recursion: AP \Rightarrow A (and AP)

This rule of conjunction applies to any category N, V, P or S.

(35) Indirect recursion: NP \Rightarrow N (PP)
PP \Rightarrow P (NP)

DP \Rightarrow (Poss)NP

Poss => DP 's

Indirect recursion creates a perpetual loop. In principle the recursion could be arbitrarily deep and the system might therefore be “unaware” that a category repeats itself. If we are correct, then we must make the system “aware” of recursion in such a way that it produces a challenge for a child, and is experienced by the adult.

Chomsky (2005, 2008) argues that Phases are syntactic and interpretive:

(36) Strong Minimalist Thesis (SMT): “Transfer...hands Syntactic Object to the semantic component, which maps it to the Conceptual-Intentional interface. Call these SOs *phases*. Thus the Strong Minimalist Thesis entails that computation of expressions must be restricted to a single cyclic/compositional process with phases.” Chomsky (2005).

Boeckx (2008) argues for what we can call the Phase Alternation Constraint:

(37) “Interpretation must occur in alternating sequence:
Transfer takes place every other time Merge applies yields the following pattern: Phase- Non-phase - Phase - Non-Phase”

This is produced by a Phase-Head taking a Phase-complement which is transferred. In effect then we have a pattern like:

(38) [NP POSS] [NP POSS] [NP POSS] =>

which reveals why Indirect recursion captures an Interpretive Interface, and how grammatical recursion is embedded in a Specific way among abstract representations as we discussed at the outset.

4.3 The Acquisition Corollary

A central hypothesis now comes into play: Children require an interface experience in order to master recursion and in each instance (a) they initially prefer conjunction, and (b) they resist the recursive interpretation. Essentially, direct recursion without periodic phase interpretation is easy, while transfer to interpretation under recursion provides, we will see, computational difficulty. Let us look at each acquisition path:

4.4 Possessives

(39) **No Poss: Stage 1** (Galasso (2003):

Me: I want me bottle. Where me Q-car? That me car. (2;6-2;8)

You: No you train. It's you pen. It's you kite. (3;2)

Him: I want to go in him house. Him bike is broken.

Lexical Poss:

Mine: Mine banana. Mine bottle. Mine car. Mine apple. Mine pasta (2;4)

Single Poss: Jensen and Thornton (2007) [whose hat is that]
“Mrs. Wood’s” (2.7)

However resistance to recursion is evident (more in Roeper (2007)):

Stage 2: MOTHER: What's Daddy's Daddy's name?
SARAH: uh.
MOTHER: What's Daddy's Daddy's name?
SARAH: uh.
MOTHER: What is it? What'd I tell you? Arthur!
SARAH: Arthur! Dat my cousin.
MOTHER: Oh no, not your cousin Arthur. Grampy's name is Arthur.
Daddy's Daddy's name is Arthur.
SARAH: (very deliberately) No, dat my cousin.
MOTHER: Oh. What's your cousin's Mumma's name?
What's Arthur's Mumma's name?
And what's Bam-Bam's daddy's name?
SARAH: Uh, Bam-Bam!
MOTHER: No, what's Bam-Bam's daddy's name?
SARAH: Fred!
MOTHER: No, Barney. [See Roeper (2007, more examples)]

Experimental evidence also reveals an evasion of recursion. Gentile (2003) asked 11 3-5yr old children to: “Show me Cookie Monster’s sister’s picture” with three pictures before them:

(40) 1. Cookie Monster 2. Cookie Monster and his sister 3. his sister

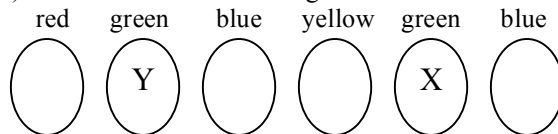
while only 12% of 5yr olds did not choose (3), 35% of 3-4 yr olds choose (2) which is equivalent to the conjoined reading: Cookie Monster’s and sister’s picture. Finally children get it: “What's Toto's girl's name?” (5yr old)

4.5 Adjectives

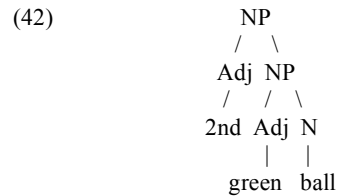
Children’s first adjectives receive a concatenative, conjoined reading although “and” is not present, as these data (Gu (2008)) reveal: (Adam 2. 3] “I sleepy tired” “you big tired” “I funny little boy” Only at a later age are there intersective adjectives: [Adam 3.4] “he got a new little big trailer” (small version of a big trailer). It does not mean “little and big trailer”.

Experimental evidence reveals the same pattern found with possessives: children revert to conjoined readings. Matthei (1981) showed 3-4 year old children this array of balls and said (C. Chomsky suggestion):

(41) “show me the second green ball”



More than 50% of 3-4yr olds chose (Y) instead of (X), giving a conjoined reading “second and green ball”. The structure they needed was essentially indirect, second [green ball], not directly modifying another adjective as in crystal-clear water, which is notably non-recursive:



See Hubert (forthcoming)) for German preference for Direct recursion.

4.6 Prepositional Phrases

There is initial naturalistic evidence that children will treat PP's conjunctively and resist recursion (Gu (2008)):

- (43) Father: Up in the shelf in the closet
 Child: yeah
 Father: can you say that
 Child: up in the shelf in the closet
 Father: very good, up in the shelf in the closet in the kitchen, can you say that
 Child: yeah, up in the # up in the # what
 Father: up in the shelf in the closet in the kitchen
 Child: up in the shelf in the # what
 Father: closet
 Child: in the closet in the kitchen
 Father: in the jar up in the shelf? can you say that?
 Child: I can't
 Father: you can
 Child: in the jar # say in the jar
 Child: up in the shelf in the jar in the closet in the kitchen

Note that the PP's are now conjoined (in the shelf and in the jar), rather than recursively embedded (the shelf is not in the jar). Experimental work is needed.

4.7 Serial Verbs

Bantu languages allow recursive serial verbs:

- (44) Kofi [**fringi** a tiki [**fadon** [**naki** Amba]]]. (Baker (2001), Sebba (1987))
 Kofi **throw** the stick **fall hit** Amba
 “Kofi threw the stick down at Amba (and hit her).”

English, with a limited set of verbs, has two-verb cases: come sing. go work. help build. 3-verb expressions can be constructed.: John will go help Mary cook. However, like German, they are captured by a conjunctive interpretation: ‘John will go and he will help and Mary will cook’.

In a case study of Naomi (1.1-5.1yrs) 47/8,843 maternal were like “come look at the picture”. Naomi produced zero examples of 3-term serial verbs. Adone (1994), however, studying acquisition of a serial verb language finds spontaneous examples of 3 and 4 verb constructions by children, which are over-generalizations of what adults allow: Make look fall (Leffa 5;6)

(45) Sa lisyen pe fer letur pye dibwa pe gete kot bul in tonbe [Leffa 5.6]
this dog prog make around tree wood prog look where ball asp fall
 ‘This dog is going around the tree checking where the ball fell.’

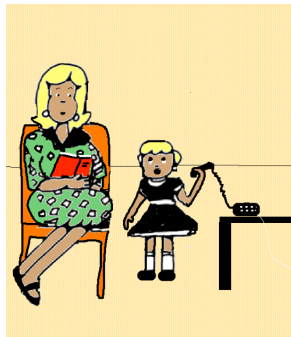
These results support the view that children must hear and experience recursive examples before they use them.

4.8 Sentential Complements

Parents are familiar with endless conjoined relative clauses like: “this is the toy that I like that I got for Xmas that has six wheels...”. In addition tail recursion is a common feature of nursery rhymes whose hidden goal may be promoting recursion: “This is the cow that tossed the dog that worried the cat that chased the rat...”, but when do children exhibit real sentence recursion? A 6 word sentence with 3 clauses seems childlike: “Mom said you said I did it” but do they occur? Adam 28, around 4yrs, says many subordinated sentences like “Urs(u)la said I can throw it away”—such clauses are easily generated as single adjuncts. Real recursive subordination only begins around 5yrs: Adam 37: “I thought you said the animals gonna have space”.

Experimentally Hobbs, Hollebrandse, deVilliers, and Roeper (2008) with 18 children (6;3 – 6;11, avg: 6;9) have shown that they have no difficulty giving single complement answers for situations with sentences like: “Dad is talking to Billy about moving his tools. Dad tells Billy that Jane said that hammers are too heavy. What did Jane say?” Children easily respond “hammers are too heavy”.

However when the higher verb is needed to make sense of the question, implying recursive subordination, correct answers fall off sharply.



(46) ”Jane talks to mom. She is having a fight with Billy on the phone. Jane tells mom that Billy said that all sisters are stupid. What did Jane tell mom?”

Single: [said] “that all sisters are stupid”

Recursive:

[tell Mom]“that Billy said that all sisters are stupid.”

Results: 23% irrelevant 34% single, 33% recursive

The experiment is designed to make the single clause answer improbable: Billy's sister saying that all sisters are stupid. Nevertheless, 1/3 gave the "Single" answer. Only 1/3 of the 6yr olds were able to produce the recursive complement in repeating the story. The next experiment in the series elicited spontaneous recursive statements in the late 6yr old range: "because he thinks she thinks they are selling them" [6.10]. Sentential recursion is clearly resisted by children which suggests that the first forms of apparent complementation are adjuncts (see deVilliers et al (2007), Sowalsky, Hacquard, and Roeper (2009)).

4.9 Discourse Recursion and Recursion as Metaphor

Recursion has origins in mathematical logic and philosophy and has important instantiations in computer science. It is widely assumed that it is a basic property of the mind and therefore its role in language is derivative. We argue, to repeat, that under a tight interface theory, its role in language is biologically specified and therefore bears only a metaphorical relation to other possible forms of recursion.

If "recursion" were a general property of mind, then there should be no difficulty with discourse recursion. In many cases, however, it is impossible, with discourse binding only the initial clause (the earth is flat) (Joshi (2007)):

- (47) The earth is flat. John doesn't think so. Mary doesn't think so.
= Mary doesn't think the earth is flat
=/= Mary doesn't think John doesn't think the earth is flat.

In other environments, it is difficult with three (impossible with four) as Hobbs et al show in the next experiment, which is built to make discourse recursion seem natural:

- (48) Jimmy and his sister live next to a bridge. The bridge is broken.
Jimmy knows that.
His sister doesn't think that.

We then asked either question (A) or (B) with sample answers following:

- (49) A. Will his sister warn Jimmy? Why? ("yes, because she is nice")
B. Will his sister cross the bridge? Why? ("No, she knows it's broken")

50% of the answers gave a single embedding answer and 50% gave irrelevant answers. None gave recursive answers. Likewise 12/13 adults did not give recursive construals. It is computationally, though not conceptually, more difficult. If we collapse two sentences, the same story becomes easy again:

- (50) Jimmy did not think that the bridge was broken.
His sister knew that. [=Jimmy did not know that the bridge was broken]

Now we must ask exactly why discourse recursion is more difficult. Consider how open and situation-sensitive discourse binding can be:

- (51) John was very funny in saying that a democrat could not win while
Susan said he could. Mary liked that.
that = a) that = whole sentence
b) a democrat could win.
c) Susan said a democrat could win.

The large range of possible interpretations of “that” include the metaphorical equivalent of recursive propositions (c and a). Thus the difficulty with discourse is that it allows too many readings and relies on substantive factors to choose, including knowledge of people (what Mary usually likes). Hollebrandse and Roeper (2007) propose that embedded propositions, by contrast, have another property: Propositional Exclusivity. Because recursive embedded propositions have fixed scope and opacity relations, they have an interpretive precision that enables efficient reasoning and communication. (Mary like that John was funny in saying that a democrat could not win while Susan said he could.)

It is important, from a moral and ethical view, to realize that the kind of complex situation-comprehension (carried by “that” above) may be a part of a child’s non-linguistic comprehension abilities before he has the syntactic equipment to express those intricate ideas (Sowalsky (2008)).

4.10 Summary

The evidence across a wide range of constructions shows that while Direct recursion, with conjunction readings, is easy, indirect recursion proves difficult. An interface model that requires simultaneous syntactic and semantic computation before a Final Phase provides an explanation within a minimalist conception of Alternating Phase/Non-phase sequences. Our analysis fulfills another natural promise of linguistic theory: if UG is part of inborn biology, then spontaneous acquisition data should provide direct support for the theory. The existence of Assymmetric Merge and the Strong Minimalist Hypothesis are both supported.

A comment is warranted about our method. Like linguistic theory, which uses both strong and rather flimsy intuitions, we have adduced data that is both robust and minute, naturalistic and experimental. The diversity of sources is a strength and the style of argumentation resembles biology, paleontology, and physics in the expectation that deep general principles will be expressed in subtle, remote, diverse and seemingly unstable data.

5.0 Pragmatic Extension of the Strong Minimalist Hypothesis

How far does the Strong Minimalist Thesis go? There are Final Phase interpretive properties (like intonation) which operate over a larger domain than Phase-based interpretation. Long-distance movement suggests that questions should not receive an intermediate interpretation by Phases. Here we find that the Phase has two traces and must carry an open variable to a higher phase to obey the SMT.

- (52) What did John guess [t the number was t]
[t the number was t] = Phase

It is clear that what must take scope over guess and was. Therefore only in the Final Phase would it be interpreted, but the SMT requires Phase-based interpretation of [t the number was t]. Therefore one must leave a hole in the Phase-based interpretation which is filled later in the derivation. Lasnik et al (2005) captures this anomaly as follows as essentially “exceptional”:

- (53) “The specifier of the head of PH (‘phase edge’) belongs to the next higher phase PH₂, for the purpose of Transfer only when it involves wh-phrases in intermediate COMP positions (p. 249)” (Lasnik et al (2005), see also Rizzi (2006) on Criterial Freezing).

Given this exceptionality, let us propose that:

- (54) Strict SMT requires full interpretation of each Phase.
Children shift to Context (early) and consistent with a strict SMT.

Both intuitional and acquisition evidence are relevant, but we take the spontaneous nature of the acquisition evidence to be more important.

Observe that if the wh-word is not moved, then a second reading is present, whose importance is never addressed:

- (55) John guessed what the number was. (say, estimate, state...)
= made a guess or = guessed correctly

Verbs that disallow true complements and require opacity do not allow such clauses:

- (56) *John thought what Bill ate (compare: John said what Bill ate)

This is predictable under the strict SMT if a phonologically realized what triggers a Default UG interpretation, which is pragmatically taken to be “true”.⁸

⁸ Quotation is not meant to imply that truth is relative, but to distinguish our use of the term from its role in Model Theoretic Semantics. See (Hinzen 2006).

recognized by children, will wh-interpretation be delayed and children move to the adult grammar.

In sum, children obey the SMT against the adult grammar when they map the *trace* all the way to the pragmatic determination of truth. When the most “sophisticated” representations correspond to the tiniest spontaneous details of acquisition evidence, it is stronger independent support for the minimalist version of UG than intuitions.

6.0 Language Disorders

Not only the presence of grammatical features, but their absence is a source of insight. If UG properly describes grammar, then some language disorders should be describable in those terms. Whether the disorder reveals an absence of a fundamental ability or an external system interferes with UG in a subtle way, the child’s output may entail a grammatical description. Van der Lely (2003) claims that disorders occur at the grammatical level, while Chomsky and Berwick (2008) argue that only external computational factors are involved. In either case the diagnosis and remediation need to identify the phenomenon clearly.

The DELV test offers a wide spectrum of application of UG principles to language disorders. In this essay we focus on one central claim: the absence of “variable” interpretation. The notion of variable is broadly present in lexical items (every, all, who, some, nobody) that engage the notion of a set. Various syntactic configurations maintain or suppress it--a large topic in semantics.

There is consistent evidence that both who and every are not fully understood initially and failure to understand them may persist as a disorder into the school years (See Roeper (2007) for discussion of a connection between them). This claim captures this important and long-lasting disorder:

(60) Children do not project quantification properly.

We consider here evidence on wh- words and double wh-words that is derived from the Diagnostic Evaluation of Language Disorders (DELV (2005)) test and background work. Schulz, Roeper, Pearson and Reckling (2006) show that children, especially those with disorders give a singleton answer where wh-words require an exhaustive set: they point to just one person. Children given a variety of pictures like the following in English and German (supported by further ongoing work in Dutch, Polish, Romani and other European languages).

(61) child-ball child child-ball child child-ball child
Who has a ball?

115 German and English children from 4;0 - 7;11yrs were involved. Among 4yr olds: 79% of English-speaking children give a singleton readings, and 52% of German children. While some speakers allow a singleton reading for single wh-, double wh-expressions **require pairing** and exhaustivity:

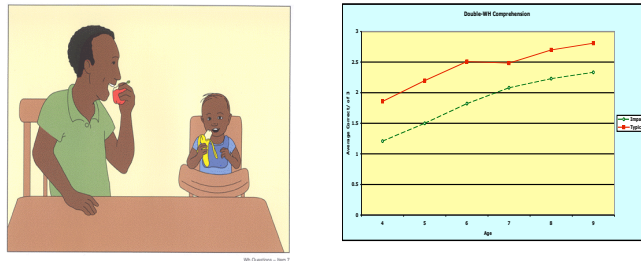
(62) Who ate what?

Adult: [Dad ate an apple and baby ate a banana]

How did she play what?

Adult: [she plays the piano with her hands and drums with her feet]

1450 children were involved and the results comparing normal and disordered children 4-9 yrs show persistent large deficits: Red =typical, Green =Disordered:



Typical non-paired answers: “Dad ate banana” or “hands and feet”.

Exploring the detailed acquisition path of all quantifiers, particularly those that involve distributive (every) as well as collective (all) readings is of primary importance for understanding disorders and the challenge of language in primary school. (e.g. Merchant and deVilliers (2006) show every is produced late.)

7.0 Conclusions

This survey has aimed to connect refined details of minimalist theory to comparable acquisition facts. We have argued that fundamental features of the biological explanation of automatic mental behavior (Speed, Narrow Transfer, Independence of Principles in each module, and Specified Interfaces) characterize language. The primary claim is that apparently abstract and general abilities are innate because they have specific interfaces.

Two examples of specified interfaces have been addressed: how grammar controls reference to context in a variety of ways under the general principle: Delay Reference to Context.

Second the hypothesis has been reviewed that an elementary contrast between Direct recursion, which does not require periodic interpretation, and Indirect Recursion, which is constrained by a theory of Alternating Phase-interpretation, captures the acquisition path for every language specific domain (excluding the fundamental form of recursion involves in Merge).

We reviewed a range of structures including possessives, adjectives, PP's, compounds, and sentential complements, each of which exhibits a shift from conjoined interpretations to intersective ones. If true, this may be the primary axis of growth in language acquisition. It entails the major shift from lexically based representations to abstract rule-based representations.

Linguistic theory provides the refined hypotheses that enable us to focus where detailed work needs to be done. Virtually every structure needs careful experimental and naturalistic investigation to make the microscopic acquisition paths really clear. We have every reason to expect that they will resemble the dominant microscopic models of biology. In sum, acquisition evidence constitutes an unparalleled basis for the demonstration or modification of the claims of linguistic theory.

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