# On the nature of Minimal Search

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## 1. Why study Search?

- Search applies everywhere.

- Structural dependencies all involve search, e.g.
  - (1) an adverb must **find** a verb to modify,
  - (2) an anaphor must **find** an antecedent,
  - (3) **EXT** economy: **find** structurally identical inscriptions, and
  - (4) $\text{INFL}_{\phi}$ **find** a θ-relevant item.

- Under the **SMT**, we want the simplest possible formulation of **Minimal Search (MS)**.
  - Simplicity for search would mean no comparisons between candidates, no rejections, no restarts, no multiple probing, cf. *Derivation by Phase* (*DbyP*) (Chomsky 2001), *see later*.

  - See also Section 10 below for Chomsky on "kinds of operational simplicity".

- Ideally, **find** in (1)–(4) above would use the "same" simplest algorithm.
  - (*Talk about variants later*.)

- To search means we're looking for something, i.e. search always has a *target*.
  - Also, search always has a *domain*. (*See section 3.*)

- Chomsky argues there are no exceptions, e.g. inputs to all **SBO**s, e.g. **Merge** and **FormSet** (*see last lecture*), also obey **MS**.

- The complexity of **Search**, i.e. in what it can find, directly affects the complexity of human language.

In other words, **MS** is a fundamental (sub-)operation that underpins nearly everything:

- *Right now, I don't see any reason why any operation should be exempt from **MS**.* (Chomsky, p.c.)

Of course, search of I-Language structures can be carried out in many possible ways, but the **Third Factor** limits the complexity of possible search operations.

**Optimal design case**: there is only one search, the simplest possible search (which is also the most efficient one, i.e. does not involve unnecessary operational complexity).

## 2. Background

**SMT** (*Strong Minimalist Thesis*): a reduction to only fundamental operations needed to **construct** and **parse** thought structures, *deep simplicity* motivated by evolutionary recency of human language and the slow (chemical) brain (**Third Factor**).

**construct**: **Merge** (External & Internal variants) and **FormSet**. Fundamentally, **Merge** is *asymmetric* structure-building and **FormSet** is *parallel* structure-building.

- **Pair Merge** needed anymore? *Probably not.*

**parse**: (structural) relations establish by search through I-Language structures, we suppose only **Minimal Search (MS)** is available for this.

**Merge**:
A mathematical core (*minimum necessary to build structure*), and
a language organ (**LSC**) variant *(includes θ-theory etc.*).

**Three Factors**: (Chomsky 2005)

- First, *genetic endowment*.
- Second, *experience*.
- **Third Factor**: computational efficiency imposed by biological limits, e.g. brain's 20W power consumption.
  - *To what extent is the human faculty of language **FL** an **optimal solution** to minimal design specifications, conditions that must be satisfied for language to be usable at all?* (Chomsky 2001)

Optimal case: what's most simple is also the most efficient.

## 3. MS and Merge

[**term-of**: recursively defined *subset* of a set.
Sometimes *reflexive* as well, e.g. formally, a set is a subset of itself.]

3.1. **MS** applied to **External Merge** (**EM**)

Search:

- domain: Workspace (**WS**),
- target: *WS item* (*twice*)

Formally: find X,Y ∈ **WS**, form {X, Y}

MS: can't search inside X (or Y), must stop at ***WS** item*.
*__EM'__: form {x, Y} st. x term-of X, X, Y ∈ WS, or
*__EM"__: form {x, y} st. x term-of X, y term-of Y, X,Y ∈ WS

LSC:
- *theta structures {X,Y}, where one member receives and the other assigns a theta role, an **LSC*** (Chomsky 2024)

2. **MS** applied to **Internal Merge** (**IM**)

Search domain: step 1) **WS**, step 2) **WS** item
Search target: step 1) ***WS** item*, step 2) term-of ***WS** item*
Formally: 1) find X ∈ **WS**, 2) find Y term-of X, form {X, Y}

MS: in step 1), can't search inside X
MS: in step 2), Y must be the highest occurrence of Y in X.
{**Y**, {..{Y..}}} (*we cannot tell structurally identical inscriptions apart*)

{$\mathbf{Y_\theta}$, {$Z_\theta$,..}} (θ-relevant Y and Z)
**Equidistance*, *e.g. wrt. specifiers* (Chomsky 1995)

**LSC**: in 2), target θ-relevant item.

## 4. Simplest Search = MS

***Simplest possible* notion of Search**:
look for something, find first matching item, terminate search. Minimal computation.

**EM** brings structural relation ***sister-of***:
In {X, Y}, X and Y, inputs to EM, are sisters.

**IM** brings structural relation ***term-of***:
In {..{X,..}} = Y, X and Y inputs to IM, X is a (proper) term of Y

EM + IM brings composite structural relation: ***term of sister*** (**c-command**)

Mathematically, *term of sister*:
1. a. {{X, Y}, {U, {V, W}}} has c-command relations:
   b. (X, Y) and (Y, X),
   (U, V), (U,W),
   (V, W) and (W, V) (6 total)

Merge of **Z** to (1a) results in (2a):
2. a. {**Z**, {{X, Y}, {U, {V, W}}}} adds c-command relations:
   b. (Z, X), (Z, Y), (Z, U), (Z, V), (Z, W) (5 new relations)

**MS** is efficient: do not (pre-)compute all possible c-command relations.

**MS** is limited by Phase boundaries? (Strong *Third Factor*). No, except perhaps in **EXT**.

- **EXT** operates top-down (only ?) layer-by-layer. (*Details in a later lecture*.)

More complex notions that are ruled out because they're too (computationally) expensive.

We should distinguish between:

- Design Principle – *costless* (or rather, cost paid upfront – by evolution) vs.
- Filter – a *cost incurred each time used*.

**Sorting, i.e. search with comparison**:
e.g. find two candidates, compare, select "best" one. (**Optimality Theory*)

**Multi/partial-probing**:
e.g. $T_{\phi}$ probes EXPL (incomplete-ϕ) and R-expr (complete-ϕ) (**DbyP*)

3. *a. there is likely to arrive a man*
   *b.* $\{T_{\phi}, \{v, \{likely, \{EXPL, \{v, \{arrive_{\theta}, man_{a}\}\}\}\}\}\}$
   *c.* relations: $(T_{\phi}, EXPL)$ $(T_{\phi}, man_{a})$

I'd question whether EXPL even needs to be part of the **WS** to begin with.

**SMT Parser**: concept of an initial **WS** populated by θ-relevant heads plus selectors (functional and lexical). Surface subject is by **EXT**.

- A minimal **WS** should contains no extraneous θ-relevant or unselected items, e.g. **who John saw Mary*.
- **WS** should also contain all necessary items for convergence, e.g. missing θ-relevant in **John saw*.
- For parsing, initial **WS** is partial. (*To be explained in a future lecture*.)

**Non-determinism**:
e.g. {..{X, Y}..}, (distinct) X & Y both possible targets. Maybe there are no such configurations. Suppose I-Language is organized so **MS** never encounters non-determinism.

4. a. *a rose is a rose* (Moro)
   b. $\{INFL_{\phi}, \{be, \{rose_{a}, rose_{a}\}\}\}$ (*apparent non-determinism*)

- *we have to* [*distinguish substantive-predicative*]*, perhaps resorting to the categorization in terms of ±substantive, ±predicative that we've discussed.* (Chomsky, p.c.)

Asymmetry (Moro 2017):

5. a. John considers a picture of the wall (to be) the cause of the riot
   b. John considers the cause of the riot *(to be) a picture of the wall

**Basic θ-configurations**

- *If the propositional core of language keeps to binary theta structures, there will be no n-ary theta structures for n>2. In particular, complex VPs such as double- object constructions will have internal structure, as commonly assumed.* (Chomsky 2024)

We assume θ-configurations are basic/universal.
Each functional head v, R, Appl may introduce a single θ-relevant item.

6. a. $\{v, \{R_\theta, IA\}\}$ (unaccusative)
   b. $\{EA, \{v_\theta, R\}\}$ (unergative)
   c. $\{EA, \{v_\theta, \{R_\theta, IA\}\}\}$ (transitive)
   d. $\{EA, \{v_\theta, \{IA_1, \{Appl_\theta, \{R_\theta, IA_2\}\}\}\}\}$ (ditransitive: high applicative)
   e. $\{EA, \{v_\theta, \{IA_1, \{R_\theta, Appl_\theta,, IA_2\}\}\}\}$ (ditransitive: low applicative)

(Possibility to not introduce EA in (6c–e) if v instead of $v_\theta$.)
Binary Merge ensures arguments (EA/IA) are always asymmetric wrt. **MS**.

Merge is θ-aware (and *selection-aware*). Build (6a–e) efficiently, e.g. no

7. *$\{EA, \{R_\theta, \{v_\theta, IA\}\}\}$

Assume **INT** can directly decode/read θ-configurations: no need for (earlier) θ-assignment operation.

Then we should assume **MS** can also efficiently decode these structures, i.e. whatever mechanism available to **INT** for this purpose is also available to **MS**. (*see also Appendix*).

**Where are the results of MS stored?**

Relations computed by **MS** on I-Language structures must be stored somewhere.

Relations must be accessible for processes downstream from Merge computation:

(i) semantic interpretation (*dependencies*), and
(ii) **EXT** (*pronounce which occurrences and where*?).

Not stored in **Merge** structure (or **WS**): no room for it (or labels).
Not stored in the Workspace

- because we assume all **WS** objects are "1st class citizens" subject to **Merge**.

Assume **WS** computation is complete when *only* a single **WS** object is left.

For convergence, *all* **WS** objects must be used, can't have **MS** relations hanging around.

**Example**: XP will be assembled in a sub-**WS** for {XP, YP}, XP = **EA** and YP = vP.

8. [The man I knew] found the artifact

The sub-**WS** vanishes once complete, i.e. structure built is now integrated into the "main" **WS**.

## 5. MS and INFL$_\phi$

3. MS for INFL$_\phi$
Transitioning from the proposition to the clausal domain involves Merge of INFL (and C). INFL$_\phi$ triggers search for a θ-relevant item. Only search possible is **MS**.

9. a. {INFL$_\phi$, {EA, {v$_\theta$, {R$_\theta$, IA}}}}
   b. ϕ-relation (INFL$_\phi$, EA)

In (7a), EA is found, IA is never seen. See (6a–b,d–e) for other cases.

At INFL$_\phi$ **EXT**, verb agreement obtains and a range of (language-particular) spell-out options are possible for the found item, e.g. in English:

| | | |
|---|---|---|
| 10. a. | He$_\phi$ *repair/repairs$_\phi$ the cars | (left edge INFL; EA Agree) |
| b. | Many soldiers$_\phi$ *has/have$_\phi$ arrived | (left edge INFL; IA Agree) |
| c. | There *has/have$_\phi$ arrived many soldiers$_\phi$ | (no edge spellout; IA Agree) |
| d. | We should do this again, said$_\phi$ John$_\phi$ | (right edge INFL) |
| e. | In the distance stands$_\phi$ a mountain range$_\phi$ | (no edge spellout; EA Agree) |
| f. | In this cave was$_\phi$ found an ancient artifact$_\phi$ | (no edge spellout; IA Agree) |
| g. | There entered$_\phi$ the room a strange man$_\phi$ | (right edge of INFL: TEC) |
| h. | There hit$_\phi$ the stands a new journal$_\phi$ | *ditto*. Kayne in (Chomsky, 2001) |

(8c,g–h) EXPL insertion. (Not available for all languages.)
(8d) quotative inversion.
(8f–g) locative inversion.
(8d,g–h) right edge of INFL$_\phi$P spellout. (Spanish has subject-verb inversion.)

> *Since SPEC-INFL is not at the phase level, it is not accessed at later phases. Therefore, it need not to be boxed. And it shouldn't be, since unlike boxed elements, SPEC-INFL is accessible to other operations (Agree, Labelling, Anaphora)* (Chomsky 2024)

(Chomsky 1999) on **EXT**(?):

(10) a. There is likely to be a proof discovered
b. I expected there to be a proof discovered

> *Observe that [...(10)...] appear problematic because of raising of a proof from DO of discover. There are reasons to suppose that the actual structure at this stage is the expected there to be [discovered a proof] as in similar languages, the preferred English construction a proof [discovered t] being formed outside the system we are now considering. I will assume so, leaving the issue to the side here.*

(Chomsky 2021) notes that there are semantic, i.e. non-stylistic, effects, if argument spellout is at the left edge of INFL.

11. a. *There* is *a* flaw in my argument/bottle
    b. *A flaw is in my argument
    c. A flaw is in my bottle
    d. {{INFL$_{\phi}$, {v, {R, IA$_{\phi}$}}}, in my argument/bottle}

*there*-existentials generally signal new information, which interacts with *definiteness* (Milsark 1974).

12. a. *there* arose *a*/**the* storm
    b. *a*/*the* storm arose (last night)

This kind of information will be coded differently depending on particular language, which suggests this also belong to EXT (*directly signaling C-I interface*).

Chinese has no expletive *there*; instead, signal is encoded via word order variation (Wu 2020, *citing earlier work*).

13. a. 老师 来了
        teacher come.PERF (old)
        '*the* teacher came'
    b. 来了 一个 老师
       come.PERF one.CLF teacher (new) cf. *那个老师 / that.CLF teacher
       '*there* came *a* teacher'

In Spanish, the presence of impersonal verb *haber* (*have*) signals the *there*-existential:

14. a. *un* policía está aquí / *hay* *un* policía aquí (Tubens, p.c.)
        a policeman is here there.is a policeman here
        'a policeman is here' / 'there is a policeman here'
    b. (**había*) surgió *una* tormenta
        there.was arose a storm
        'a storm arose'

## 6. MS and Modification

The adverb *carefully* seeks a verb in (15a) (Chomsky, 2021). Sentence is structurally ambiguous.

15. a. the mechanic who fixed the car *carefully* packed his tools
    b. relation (carefully, fix), right edge vP spellout, or
    c. relation (carefully, pack), left edge vP spellout

**MS** applies to compute relations (9b–c) from (10a–b), respectively.

16. a. {mechanic, {$v_\theta$, {*carefully*, {$fix_\theta$, car}}}}, or
    b. {mechanic who …, {$v_\theta$, {*carefully*, {$pack_\theta$, his tools}}}}

(16a–b) can also be spelled out as unambiguous (17a–b), respectively.

17. a. the mechanic who *carefully* fixed the car packed his tools
    b. the mechanic who fixed the car packed his tools *carefully*

Note 1: adverb *carefully* appears in a sub-**WS** in (16a), but in the main/matrix **WS** in (16b).
Note 2: structures (16a–b) assume θ-theory has primacy. {$R_\theta$, IA} must be built first.

Adverbs (seeking verbs) are not part of θ-Merge, but **MS** still generally applies to **WS Merge** (Note: no **Pair Merge**).

## 7. MS and EXT

**Economy of spellout applies at EXT**
This also involves **MS** within a Phase, e.g. for c-commanded identical inscriptions, only the highest occurrence is pronounced.

In (18a) below, Phase = **{** … **}**, see fn.30 in (Chomsky 2024).
(TNS, as part of v, not shown.)

18. a. {$INFL_\phi$, {John, **{**$v_\theta$, {$see_\theta$, John}**}**} ⊨ *John saw John*, not *John saw*
    b. {$INFL_\phi$, {v, {arrive, John}}} ⊨ *John arrived*
    c. {$INFL_\phi$, {most people, {$v_\theta$, {try, {v, {honest, most people}}}}}} ⊨ *Most people try to be honest*

For (18c), copy relation (most people, ~~most people~~) computed by **MS** and used at **EXT**.

## 8. MS and FormSet

- *The only other permissible relation is unbounded set, with the **SBO** FormSet (**FS**)* (Chomsky 2024)

What's different about the fundamental *Structure Building Operation* (**SBO**) **FS**, cf. Merge? **Answer**: they have different conditions for formation and use, no overlap.

For FS, the minimal assumptions (Fong & Oishi 2025):

(i) Members must be a coherent set of WS objects
(ii) Members must obey some parallelism requirement for INT
(iii) **MS** into FormSet, all members must be treated alike

MS applies to FS inputs just like in the case of EM, i.e. inputs must be objects, not sub-objects of the WS.

(19b) and (19c) below are *coherent* WS objects, both are vP θ-configurations.
FS applied to (19b–c) produces (19d), also a WS object. (Notation: FS object **{**…**}**.)
Merge of INFL triggers MS. Following (iii) above, MS finds the identical inscription *John* in both members.

19. a. John arrived *and* met Bill
    b. {v, {arrive, John}}
    c. {John, {v*, {meet, Bill}}}
    d. **{**{v, {arrive, John}}, {John, {v*, {meet, Bill}}}**}**
    e. {INFL$_{\phi}$, **{**{v, {arrive, John}}, {John, {v*, {meet, Bill}}}**}**}

Economy of spellout applies for (19e), lower occurrences of *John* are not pronounced.

When MS cannot operate identically across members, as in the case of (20b), the derivation crashes.

20. a. John arrived and Sally met Bill
    b. *{INFL$_{\phi}$, **{**{v, {arrive, John}}, {Sally, {v*, {meet, Bill}}}**}**}
    c. **{**{C, {INFL$_{\phi}$, {v, {arrive, John}}}}, {C, {INFL$_{\phi}$, {Sally, {v*, {meet, Bill}}}}}**}**

Instead, (20a) is derived via (20c).

Note in the case of *serial verbs constructions* (**SVC**s), e.g. in Japanese or Chinese, independent clausal structure, as in (20a), is impossible.

- These are monoclausal constructions with verbs that *must* share (some) argument structure.

In (21a) below, the two SVC verbs are transitive, sharing both arguments.

21. a. Ken-ga Miki-o home-tatae-ta
       K.-NOM M.-ACC admire-praise-PST
       'Ken greatly admired Miki'
    b. {EA, {v$_{\theta}$, {**{**admire$_{\theta}$, praise$_{\theta}$**}**, IA}}}

In (21b), **EM** of **IA** invokes **MS** for each FS member, a predicate, to find the identical inscription *Miki* (= IA) in the WS.

Note that EM of *Ken* (=EA) does not involve FS.

It is also possible that SVC verbs have independent IAs. For example, in (22a), the verbs *nomu* (*drink*) and *aruku* (*walk*) have independent IAs, *sake* (*alcohol*) and *yoru no mati*, respectively, but share EA *Ken*. In (22b), MS finds each IA independently prior to FS.

22. a. Ken-ga yoru-no mati-o sake-o nomi-arui-ta
K.-NOM night-GEN town-ACC alcohol-ACC drink-walk-PST
'Ken went bar-hopping at night'
b. {EA, {$v_\theta$, **{**{drink$_\theta$, *sake*}, {walk$_\theta$, *yoru-no mati*}**}**}}

[Note: Japanese examples (21a) and (22a) above taken from unpublished joint work with J. Ginsburg, H. Terada & M. Matsumoto.]

Assuming Chinese *qu* (go) and *gen* (follow) are both SVC verbs that share an **EA** in example (23a), the corresponding structure is given in (23b).

23. a. Zhangsan zhunbei gen ni qu (Huang, 1989)
张三 准备 跟 你 去
*prepare follow you go*
'Z. plans to go with you'
b. {EA, {$v_\theta$, **{**go, {follow$_\theta$, IA}**}**}}

## 9. A second form of MS

**My claim is that there is another MS predicted by SMT.**

Recall that **IM** brings relation term-of and **EM** brings relations sister-of (*for free*).

- *Relations are binary. The simplest ones are sisterhood and term-of, the domains of EM and IM, respectively*. (Chomsky 2024)

A (multi-valued) function is an input-to-output mapping of a relation.
(Top-down) **MS** is functional composition, i.e. Y = term-of(sister-of(X)).

Sister-of is symmetric, but term-of isn't.
Define, if X term-of Y, Y term$^{-1}$-of X.

Bottom-up **MS** is just Y = sister-of(term$^{-1}$-of(X)).
Of course, term$^{-1}$-of is just *dominates*.

Exactly what we need for anaphors, which generally seek a closest antecedent.
Generally, we seem to have a need for both top-down and bottom-up **MS**.

So-called *each*-insertion (Chomsky 1973):

24. a. The men *each* hated the *other*

b. *Each* of the men hated the *other*
c. The men hated *each other*
d. *The men hated the *other*

MS: *each* must quantify over *men*, *other* seeks *each*.
Relation (*each*, *men*) is found by top-down MS and (each, other) by bottom-up MS (at INT) for interpretation purposes.

25. a. {$INFL_{\phi}$, {*each*, {*men*, {$v_{\theta}$, {$hate_{\theta}$, *other*}}}}}
b. {$INFL_{\phi}$, {{*each*, {of, *men*}}, {$v_{\theta}$, {$hate_{\theta}$, *other*}}}}

[We employ the color *green* to indicate where bottom-up search will be triggered, and *blue* for top-down.]

26. a. *Neither* of the men hated the *other*
b. *Neither* man hated the *other*
c. ??*Neither* man *each* hated the *other*

Following (Chomsky 2021), raising to object (of *expect*) of the embedded subject:

27. a. The *candidates* *each* expected the *other* to win
b. The *candidates* expected *each other* to win

28. a. {$INFL_{\phi}$, {*each*, {*candidates*, {$v_{\theta}$, {*other*, {$expect_{\theta}$, ...}}}}}}
b. {$INFL_{\phi}$, {*candidates*, {$v_{\theta}$, {*each other*, {$expect_{\theta}$, ...}}}}}

Search is always targeted, search initiated by *other* skips the NP *candidates* in (22a).

Does bottom-up MS go beyond the local clause?

- *anaphora is not generally restricted by PIC* (Chomsky 2024: fn.29)

(Chomsky 2024) θ- and clausal configurations:

29. a. [which pictures of each other] did Mary think they hope Bill likes? (*adapted*)
b. θ: {Mary, {$v_{\theta}$, {think, {they, {$v_{\theta}$, {hope, {Bill, {$v_{\theta}$, {$like_{\theta}$, wpeo}}}}}}}}} (Search in θ)
c. C: {$C_Q$, {..., {$v_{\theta}$, {think, {C, {$INFL_{\phi}$, {..., {$v_{\theta}$, {hope, {C, {$INFL_{\phi}$, {..., {$v_{\theta}$, {$like_{\theta}$, wpeo}}}}}}}}}}}}} (Search in C)
d. {$C_Q$, {Mary, {$v_{\theta}$, {think, {C, {$INFL_{\phi}$, {they, {$v_{\theta}$, {hope, {C, {$INFL_{\phi}$, {Bill, {$v_{\theta}$, {$like_{\theta}$, wpeo}}}}}}}}}}}}} (*combined*)

EXT: $C_Q$; anaphor: upward search to *they* (target: plural noun)
Other clausal heads, e.g. Topic, Rel (*relativization*): *search can find relevant item* ...

Lower object is not subject to raising to matrix object.

30. a. The candidates expected to defeat *each other*
b. The candidates *each* expected to defeat the *other*

*Other* specifically targets *each*, and *each other* targets the nearest θ-relevant binder.

31. a. The men *each* expected the soldier to shoot the *other*
    b. *The men expected the soldier to shoot *each other*

32. a. The men *each* saw John's pictures of the *other*
    b. *The men saw John's pictures of *each other*

33. The men *each* believed and expected the sniper to try to target the *other*

## 10. Operational Simplicity and Optimal Design

Useful here to recall the discussion/summary in Minimalist Inquiries (**MI**) (Chomsky 1999).

> ***Good design conditions*** *would lead us to expect that simpler operations are preferred to more complex ones.*

There are four kinds of operational simplicity (for optimal design):

1. Simple operations preempt more complex ones.
2. Search space is limited (locality).
3. One-time access to language properties (no **DM**).
4. Computation is locally determined (no look-ahead).

On point 2:

> *(52a) [Merge must] find syntactic objects to which [it] apply.*
>
> *Condition (52a) is optimally satisfied if Op applies to full syntactic objects already constructed, with no search – that is, if* $\boldsymbol{C_{HL}}$ *[computational procedure for human language] operates cyclically.*
>
> *(53) Properties of the probe/selector α must be satisfied before new elements of the lexical subarray are accessed to drive further operations.*
>
> *If the properties of α are not satisfied, the derivation crashes because α can no longer be accessed.*

On point 3 (lexical access):

> *If the derivation accesses the lexicon at every point, it must carry along this huge beast, rather like cars that constantly have to replenish their fuel supply. Derivations that map LA to expressions require lexical access only once, thus reducing operative complexity in a way that might well matter for* ***optimal design****.*

Also, on lexical access and subarrays:

*chain properties can be reduced in significant part to identity if lexical arrays are enriched to numerations. To achieve the same result with cyclic choice of successive subarrays requires continual access to the full lexicon and memory of how many times each item has been selected.*

Also, on subarrays:

*Among other questions, what is the status of small clauses, or relative clauses and other adjuncts? Possibly the latter are derived "in parallel," in the manner of multidimensional analyses of coordination or parentheticals, with their own LAs and with the ultimate status of the adjunct being determined in the larger structure in which it is inserted.*

Chomsky:

(28) *a. Computational complexity matters for a cognitive system.*
*b. The solution must be comprehensive, with a guarantee of "quick decision" for all derivations.*
*c. Complexity should not be allowed to grow "too fast."*
*d. Decisions in computation 'attend only to principles of UG.*

## Appendix: MS and Decoding of Structure

[*Much to say here, no time left.*]

Briefly, **MS** terminates when it sees the first item detected.
Target a θ-relevant item:

... pictures of themselves (*of*-insertion)
{pictures$_{the}$, themselves} detect *pictures*

Must be able to distinguish predicate/argument generally. In:

{XP, YP} (predicative vs. substantive)

It must know which branch, XP or YP, to search.

Psycholinguistic experiments indicate asymmetries arise for degraded acceptability of *wh*-fronting in subject vs. object. E.g. "Superiority" or " *wh*-Object Penalty" in Spanish. Some report a "*wh*-Subject Penalty" in Spanish.

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