4th ICFL@BFSU

Action Meets Syntax:
Evolingo and Biolinguistic Minimalism

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(1) Design ……..… Microgenesis

(2) Development … Ontogenesis

(3) Evolution ……. Phylogenesis

"To create is to recombine." - F. Jacob

"… an evolutionary novelty may result from the combination of two pre-existing parts with unrelated functions." - M. Ridley

"Evolution has recruited for language purposes brains structures that performed other functions in non-human primates." - T. Deacon

Logical Problem of Language Evolution
(Darwin's Problem)

- How was it possible for FL to emerge during the hominin evolution?
  (Boeckx 2009, Fujita 2002, 2007, Hornstein 2009)
- "… UG is not evolutionarily viable."
  (Christiansen & Chater 2008)

(1) Descriptive Adequacy ➡ <PHON,SEM>

↕

(2) Explanatory Adequacy ➡ I-Language

↕

(3) Evolutionary Adequacy ➡ Human FL

- Language evolution is an instance of biological evolution (and cultural evolution).

  → If one's theory of biological evolution fails to account for the evolution of FL, then it needs a serious reconsideration.

Neo-Darwinism (Modern Synthesis)

- Adaptationist Program
  - Functionalism
- Natural Selection / Sexual Selection as the First Resort
- Gradualism

Neo-Neo-Darwinism (Expanded Synthesis)

- Non-adaptationist Program
  - Formalism
- Pluralism
  - NS/SS as the Last Resort
- Punctuated Equilibrium (saltationism?)
- Exaptation

- Biolinguistic Minimalism
  - (Almost) No Internal Modularity
  - Anti-adaptationism
- Evolutionary Psychology
  - Massive Modularity
  - Adaptationism

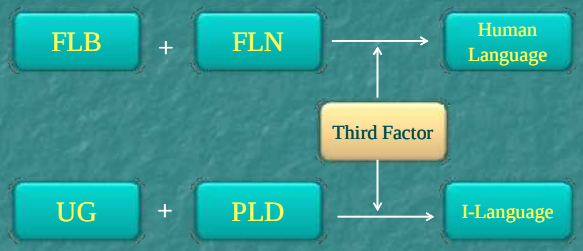
- Arrival of the Fittest
- Survival of the Fittest

- The functions of the components that jointly constituted the language faculty later in the hominin evolution may have had nothing to do with the current (or even original) function(s) of language.
- Animal communication may have only an indirect bearing on language evolution.

Strong Minimalist Thesis (SMT)

- Language is an optimal solution to legibility conditions.
- Unexplained elements of UG are zero.
- There is virtually nothing special about the origins and evolution of language.

- Language is uniquely human.
- Are its components uniquely human, too?
- Minimize the discontinuity elements in language evolution.
- FLN / FLB



"… unbounded Merge is not only a genetically determined property of language, but also unique to it."

"… for both evolution and development, there seems to be little reason to suppose that there were precursors to unbounded Merge."

- N. Chomsky

- … no clear evidence for languages that demonstrably lack recursion of any kind.
  (B. Heine & T. Kuteva)
- Recursion is absent in Pirahã. (D. Everett)
- Many languages have no, or very circumscribed recursion in their syntax.
  (N. Evans & S. Levinson)
- Recursion is just a theoretical artifact.
  (D. Bickerton)

- Derivational recursiveness:
  - Recursive Merge
- Representational recursiveness:
  - Self-embedding

(1) [CP C [TP T [*v*P *v* [VP V [CP C [TP T [*v*P *v* [VP V …

(2) [DP D [NP N [PP P [DP D [NP N [PP P …

(3) [TP T [*v*P *v* [VP V]]]

- Representational recursiveness is just one aspect of derivational recursiveness.

- Actual application of Merge is subject to a variety of constraints.
- If CP is never selected by a head, then there will be no clausal complementation in that language. (functional parametrization?)

- Language evolution boils down to the emergence of:
  - Recursive Merge
  - Interfaces
  - Lexicon

- Decomposing/Factorizing Merge
  - Concatenate + Label (Hornstein 2009)
  - (Proto-) Merge + Embed (Fukui 2006)
- Only the labeling operation belongs to FLN.

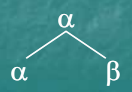
Labeling and `Embed`

- Proto-Merge (α, β) = {α, β}:

(no endocentricity)

Base Set (BS) = {α, β}

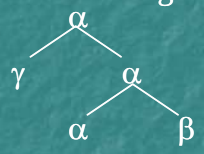
- Embed (α, {α, β}) = α∪BS = {α, {α, β}}:

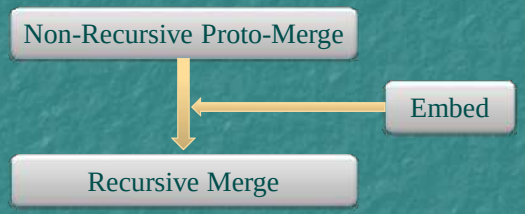


→ endocentricity

- Proto-Merge without Embed

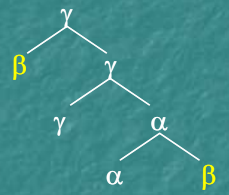
- Recursive Merge with Embed





cf. Exocentric compounds as a fossil of proto-syntax
(Progovac & Locke 2008)

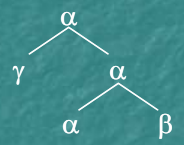
- Internal Merge (Move) + Embed



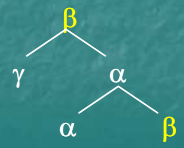
- Why not β for direct Embed without Move?

  Embed (β, {γ, {α,{α, β}}})

- Local Embed



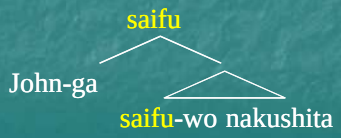
- Non-local Embed



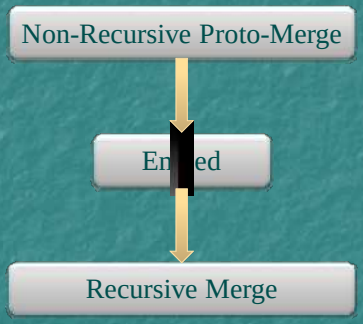
→ exocentricity

- Internally-headed relatives:

(1) [John-ga saifu-wo nakushita no]-wo Mary-ga mitsuketa.
[John-Nom wallet-Acc lost Comp]-Acc Mary-Nom found
'Mary found the wallet John had lost.'



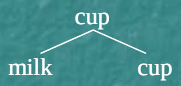
- Merge = Move = Embed (set formation)
- Embed is itself an instance of Merge applying recursively.
- No independent evolutionary/developmental scenario necessary for Move and Embed.
- Embed as an exaptation of proto-Merge?



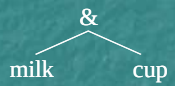
Labeling Two Word Utterances

(1) no label

(2) endocentric



(3) *exocentric



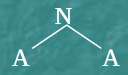
(in the sense of 'milk & cup')

Recursive Merge is already fully operative at the two-word stage.

(see Roeper 2007)

But what about truly exocentric compounds?

(1) Tatemono-no takai-hikui-ga juuyoo da.
building-Gen high-low -Nom important is
'The height of the building matters.'



"Absolute categorial exocentricity"

S. Scalise, A. Fabregas & F. Forza 2009.

(1) [A N+N]:
Serbo-Croatian *ribòlik* 'fish+shape=fish-shaped'

(2) [A V+V]:
Turkish *yapis yapis* 'stick+stick=sticky'

(3) [A V+N]:
French *lève-blocs* 'lift+block=block lifter'

(4) [A N+V]:
Korean *neknek-hata* 'sufficiency+to be= sufficient'

Scalise et al.

Some Possible Precursors

- Syllable Structure
  - Birdsong
  - Music
- Social Intelligence
  - Theory of Mind (ToM)
  - Machiavellian Intelligence
- Navigation and Foraging
- Number
- Manual Dexterity, Motor Control
- Tool Using and Tool Making
  - Action Grammar




Action Grammar

- Pairing Method
- Pot Method
- Subassembly Method

P. M. Greenfield:
Language, tools, and brain: the ontogeny and phylogeny of hierarchically organized sequential behavior. *BBS* 14 (1991).
Language, tools, and brain revisited. *BBS* 21. (1998)

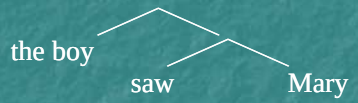
I. Pairing Strategy

II. Pot Strategy

- Merge (saw, Mary) = {saw, Mary}
- Merge (John, {saw, Mary}) = {John, {saw, Mary}}

III. Subassembly Strategy

- Merge (saw, Mary) = {saw, Mary}
- Merge (the, boy) = {the, boy}
- Merge ({the, boy}, {saw, Mary})
  = {{the, boy}, {saw, Mary}}



Subassembly strategy required

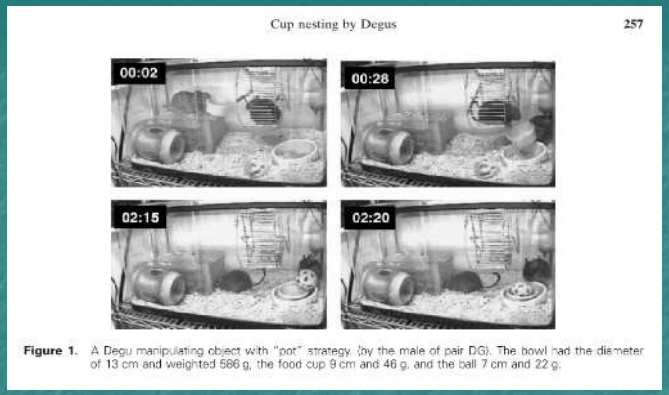

Cup nesting by Degus 257

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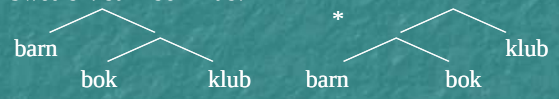
Figure 1. A Degu manipulating object with "pot" strategy. (by the male of pair DG). The bowl had the diameter of 13 cm and weighted 586 g, the food cup 9 cm and 46 g, and the ball 7 cm and 22 g.

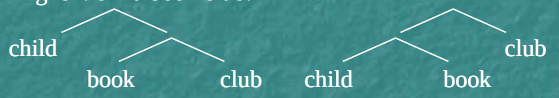
N. Tokimoto and K. Okanoya: Spontaneous construction of "Chinese boxes" by Degus (*Octodon degu*): A rudiment of recursive intelligence? *Japanese Psychological Research* 46 (2004).

Subassembly Strategy in Compounding

Swedish: barn bok klub:

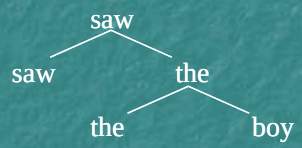


English: child book club:



T. Roeper and W. Snyder. 2005.

- Subassembly-type Merge (Sub-Merge) is the genuine recursive device in human language.



What if the bare noun *boy* is already a syntactically complex object (*n*+BOY, etc.)?

Lexicon as a Conceptual Barrier

- To the extent that the lexicon belongs to FLN as a distinct component of grammar, language evolution becomes a harder topic.

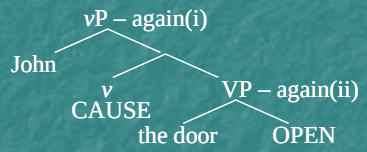
Anti-Lexicalism

- Words are also generated by recursive syntax.
- The (substantive) lexicon is decomposed into FLN (recursion) and FLB (SM/CI)
- The syntax-CI interface may be optimized
- There is *virtually* no lexicon.

Syntactic Nature of 'Lexical' Verbs

(1) John opened the door again.
  i. repetitive reading
  ii. restitutive reading

(2)



(3) LCS: [*x* CAUSE [*y* OPEN again(ii)] again(i)]

Ditransitives

(1) a. John gave Mary a book.
b. [$_{vP}$ John *v* [$_{VP}$ Mary V a book]]
c. [*J.* CAUSE [*M.* HAVE *B.*]]

(2) a. John gave a book to Mary.
b. [$_{vP}$ John *v* [$_{VP}$ a book V to Mary]]
c. [*J.* CAUSE [*B.* GO to *M.*]]

- The mapping between syntactic structure and conceptual structure is straightforward.

Evidence from Developmental Data

CAUSE (2;0.4) ≥ HAVE (2;0.7) ≥
Double Obj verbs (2;1.6) >
GO (2;4.0) ≥ Dative Obj verbs (2;4.9)

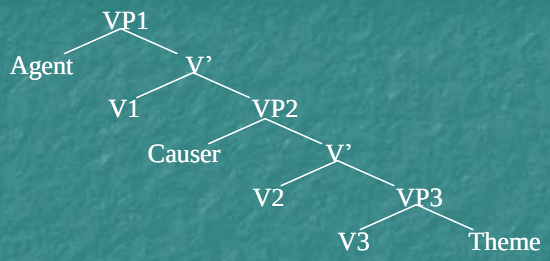
J. Viau 2006. *Give* = CAUSE + HAVE/GO: Evidence for early semantic decomposition of dative verbs in English child corpora. *BUCLD* 30.

Merge in Early Grammar

- "No verb is an island."
- "Children start to use Merge already with their very first word combinations."

A. Ninio. 2006. *Language and the Learning Curve*. OUP.

Three-Layered Split VP



cf. [x DO [x CAUSE [y BECOME …]]]

"Causes are realized in a position that is asymmetrically c-commanded by the Agent position."

L. Travis 2005. Agents and Causes in Malagasy and Tagalog, in *The Syntax of Aspect*. OUP.

- *tham/hây* causatives in Thai:

(1) *Saakhaa tham kracok tœœk dooy taŋcay.
Saka cause mirror break by intend

(2) Saakhaa hây dek win dooy taŋcay.
Saka have child run by intend

(3) Saakhaa tham hây kaw?ii lom dooy taŋcay.
Saka cause have chair fall by intend

R. Vichit-Vadakan 1976. The concept of inadvertence in Thai periphrastic causative constructions, in M. Shibatani ed. *Syntax and Semantics* 6: *The Grammar of Causative Constructions*. Academic Press.

(1) This glass breaks easily.
[TP this glass T [μP μ [VP1 IMP V1 [VP2 V2 [VP3 breaks this glass]]]]]

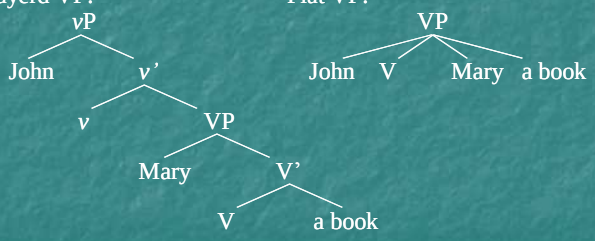
(2) This glass suddenly broke.
[TP this glass T [VP1 V1 [μP μ [VP2 IMP V2 [VP3 breaks this glass]]]]]

Middles	implicit Agent	Generically quantified	+stative
Ergatives	(implicit Causer)	Existentially quantified	+eventive

Simpler Syntax? (Culicover and Jackendoff 2005)

John gave Mary a book.
CS: [x CAUSE [y HAVE z]]

Layerd VP:



Flat VP:

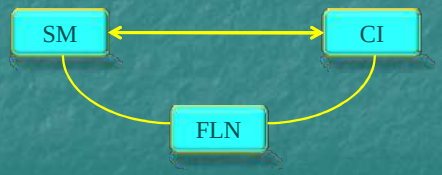
- Flat VP: optimal for SM-system
  - Language for communication
  - Lexicalism
- Layerd VP: optimal for CI-system
  - Language for thought
  - Anti-Lexicalism
- Symplicity is in the eye of the beholder.

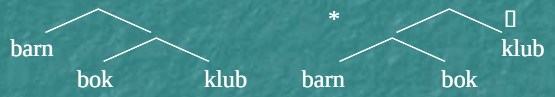
(1) John killed the cat on purpose.
(2) John caused the cat to die on purpose.

J. Fodor (1970)

(1`) [$_{vP}$ x CAUSE [$_{VP}$ y DIE]]
(2`) [$_{vP}$ x *v*(cause) [$_{VP}$ V [$_{TP}$ T [$_{vP}$ y *v*(die) [$_{VP}$ V]]]]]

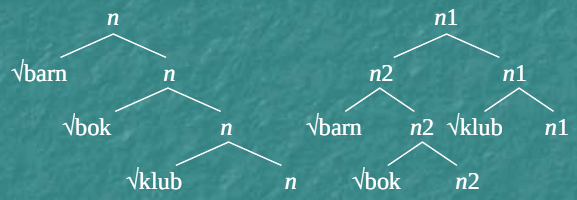
- From FLB to FLN:
- Recursive syntax could be an exaptation from the recursive CI-system.





Given that *bok* is syntactically complex, the right-branching compounding also requires Sub-Merge.

→ 'Root' compounding

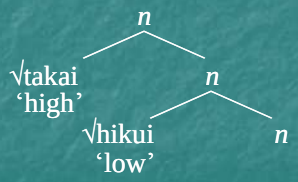


cf. M. Mukai, Recursive compounds. *Word Structure* 1 (2008).

- Exocentric compounds are in fact endocentric.

(1) A+A→N

(2) √ + √ + *n*→N



- The issue of whether protolanguage was holophrastic (à la Wray, Arbib) or synthetic (à la Bickerton, Tallerman) is largely irrelevant here.
- Word-like elements in protolanguage (proto-words) could exist in the absence/prior to syntax.

From Pot to Subassembly
From Subassembly to Merge

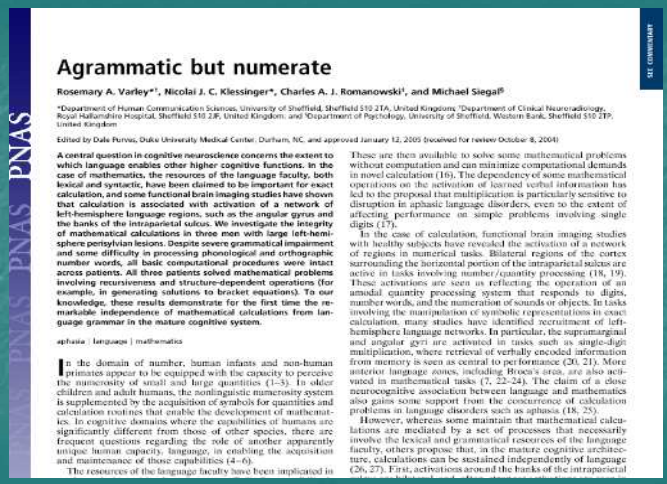
	Merge	Action Grammar
Unbounded?	Yes	No/Yes
Symmetric?	Yes/No	No

Merge to Successor Function?

Merge (1,1) = 2

Merge (2,1) = 3, etc.

Mathematical capacity is an abstraction from linguistic operations.



PNAS PNAS PNAS

SEE COMMENTARY

Agrammatic but numerate

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Edited by Dale Purves, Duke University Medical Center, Durham, NC, and approved January 12, 2005 (received for review October 8, 2004)

A central question in cognitive neuroscience concerns the extent to which language enables other higher cognitive functions. In the case of mathematics, the resources of the language faculty, both lexical and syntactic, have been claimed to be important for exact calculation, and some functional brain imaging studies have shown that calculation is associated with activation of a network of left-hemisphere language regions, such as the angular gyrus and the banks of the intraparietal sulcus. We investigate the integrity of mathematical calculations in three men with large left-hemisphere perisylvian lesions. Despite severe grammatical impairment and some difficulty in processing phonological and orthographic number words, all basic computational procedures were intact across patients. All three patients solved mathematical problems involving recursiveness and structure-dependent operations (for example, in generating solutions to bracket equations). To our knowledge, these results demonstrate for the first time the remarkable independence of mathematical calculations from language grammar in the mature cognitive system.

aphasia | language | mathematics

In the domain of number, human infants and non-human primates appear to be equipped with the capacity to perceive the numerosity of small and large quantities (1–3). In older children and adult humans, the nonlinguistic numerosity system is supplemented by the acquisition of symbols for quantities and calculation routines that enable the development of mathematics. In cognitive domains where the capabilities of humans are significantly different from those of other species, there are frequent questions regarding the role of another apparently unique human capacity, language, in enabling the acquisition and maintenance of those capabilities (4–6).

The resources of the language faculty have been implicated in

These are then available to solve some mathematical problems without computation and can minimize computational demands in novel calculation (16). The dependency of some mathematical operations on the activation of learned verbal information has led to the proposal that multiplication is particularly sensitive to disruption in aphasic language disorders, even to the extent of affecting performance on simple problems involving single digits (17).

In the case of calculation, functional brain imaging studies with healthy subjects have revealed the activation of a network of regions in numerical tasks. Bilateral regions of the cortex surrounding the horizontal portion of the intraparietal sulcus are active in tasks involving number/quantity processing (18, 19). These activations are seen as reflecting the operation of an amodal quantity processing system that responds to digits, number words, and the numeration of sounds or objects. In tasks involving the manipulation of symbolic representations in exact calculation, many studies have identified recruitment of left-hemisphere language networks. In particular, the supramarginal and angular gyri are activated in tasks such as single-digit multiplication, where retrieval of verbally encoded information from memory is seen as central to performance (20, 21). More anterior language zones, including Broca's area, are also activated in mathematical tasks (7, 22–24). The claim of a close neurocognitive association between language and mathematics also gains some support from the concurrence of calculation problems in language disorders such as aphasia (18, 25).

However, whereas some maintain that mathematical calculations are mediated by a set of processes that necessarily involve the lexical and grammatical resources of the language faculty, others propose that, in the mature cognitive architecture, calculations can be sustained independently of language (26, 27). First, activations around the banks of the intraparietal

Modular Architecture of the Mind

- Domain-Specificity
- Informational Encapsulation
- Autonomous
- Innate
- Mandatory
- Fast
- Deterministic
- Neural Localization
- Idiosyncratic Pathological Breakdown

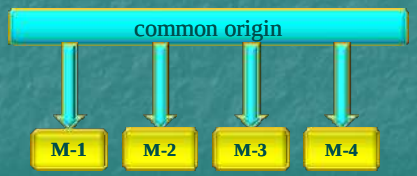
	Central System?	Adaptation?
Fodorian Module	No	No
Chomskyan Module	Yes	No
Darwinian Module	Yes	Yes

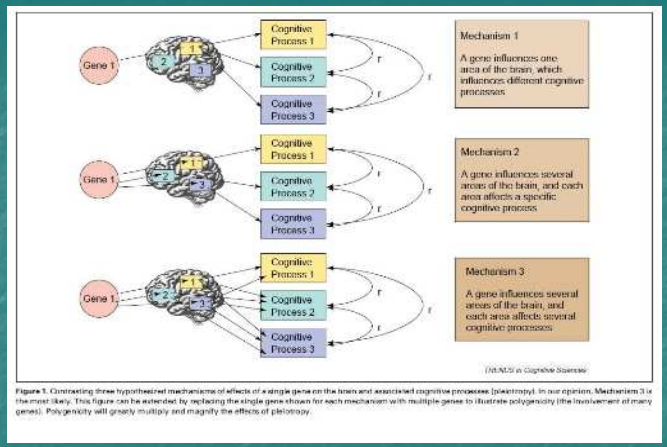
- "Modularity, a biological approach that views organisms as the integration of partially independent, interacting units at several hierarchical levels, has been described as 'a conceptual framework for evo-devo', and 'a meeting place for evolutionary and developmental biologists'."

  B. K. Hall and W. M. Olson eds.: *Keywords & Concepts in Evolutionary Developmental Biology*.

- Against Strong Innateness
- Departure from strong genetic determinism in *Evo-Devo* and in MP
- "The third factor" in general biological design

- G. Marcus (2006):
  descent-with-modification modularily
  (as opposed to *sui generis* modularity)





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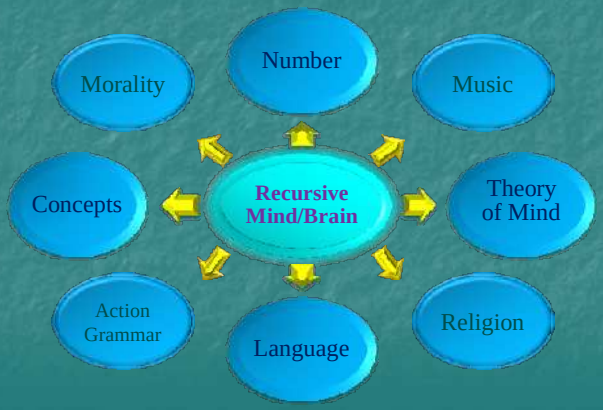

Thank you.