Exploring Asymmetry Effects in Morphology
2nd Lecture

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Outline

Asymmetry Hypothesis
Asymmetrical relations are core relations of the Language Faculty (Di Sciullo 2005)

Complexity: points of symmetry (choice points / indeterminacy)
Phase asymmetry and reduction of morphological complexity

- Asymmetry: Phase edge/non edge in morphology
  Canonical and inverse a-structure in syntax

- Asymmetry effects observed experimentally
  **Phase edge/non edge**
  NV-{ed, -ing} (Di Sciullo & Tomioka 2011)
  Pre-verbs (Tsapkin, Jarema & Di Sciullo. 2004)

**Canonical/inverse a-structure**
Passive/Middles (Di Sciullo et al. 2007)
Subject-EX, Object-EX (Manouilidou et al. 2008)
Asymmetry in
Phases and reduction of complexity

The syntactic phase:
- F-XP, impenetrable, Isolable specific to $D_S$
- Phase spell-out algorithm
- Contributes to reduce derivational complexity and derives locality effects


The morphological phase:
- F-XP, impenetrable, isolable specific to $D_M$
- Is immune to pied-piping
- Its parts can be modified, but not syntactically isolated
- It is interpreted as $<e,t>$, $<<e,t>$, $t>$, …, but it is not of type $<t>$

(Di Sciullo 2004,2005; Di Sciullo and Landman 2009; Embick 2013; Marantz 2006)
Syntactic phases

1. **Phases are configurations of the form F-XP,**
   XP is a substantive root projection, its category determined by the F that selects it.

2. **The Impenetrability Condition (boundedness effects)**
   The domain of H is not accessible to operations outside HP, only H and its edge are (Spec or elements adjoined to HP).
   \[
   \text{[}_Z\text{P }Z\text{ }[_{\text{HP}} α [H }\text{YP}]]
   \]
   The complement YP is immune to agreement with something in the next phase up. Only H and its edge are accessible to agreement with an element in ZP. (Chomsky, 2001).

3. **Independence at the interfaces**
   A phase is a unit of syntactic computation that exhibits independence at interfaces (it can be sent to Spell- Out and to LF).
   
   Thus, a syntactic phase is a configuration of the form F-XP, where F is the head of the phase and XP its complement. The complement of the head of the phase is not accessible in the next phase up, only the edge (specifier and adjunct) of the phase is. A phase exhibits independence at the interfaces.
Morphological phases

Three Layers of morphological phases are identified in Di Sciullo (2004, 2005a,b): Predicate (Pred), Aspectual (Asp) and Operator (Op) phases:

- **Pred**
- **Asp**
- **Op**

**Pred-affixes:**
- determines the semantic type
- determines the argument structure
- head their minimal tree

**Mod-affixes:**
- determine aspectual modification
- occupy the specifier position of their minimal tree

**Op-affixes:**
- determine the Operator-variable properties
- Internal-bound Ops link a variable in D₀, are in the specifier of their minimal tree
- External bound Ops link a variable in D₃, and head their minimal tree

Examples:

a. \[ [...-a] \rightarrow \{[+a] \text{dream}\} \]
b. \#L₁ [\[-a\] \rightarrow \{[+a] \text{depart}\} \]

c. \#X \rightarrow \{β \text{code}\} \]

\[ [...+t] \rightarrow [...-t,+s] \]

d. \#X \rightarrow \{β \text{know}\} \]

\[ [...+t] \rightarrow [...-t,-s] \]

\[ \rightarrow X \]

e. \#L₄ \rightarrow \{β \text{cat}\} \]

\[ [...+plur,+s] \rightarrow [...-plur,+s] \]

\[ \rightarrow X \]
Asymmetry in morphological phases

Pred phases

| a. Primary: | -er (writer), -ee (advisee), -ion (production), -ize (vapor-ize), -ate (alienate), -ify (codify) |
| b. Secondary: | -able (readable), -ive (instructive), -ous (dangerous), -ic (symbolic), -al (accidental), -ly (happily) |

|  | [V to N] | [N to V] |
|  | [V to A] | [N to A] |
|  | [A to ADV] |

Chomsky wrote “On wh-movement”.
The writer of “On wh-movement” (*by Chomsky).
Grammar is formal.
Linguists formalize *(grammar).

The students read these books.
These readable books (*by the students).
Linguists are systematic.
Linguists systematically*(analyze languages).
Asymmetry in morphological phases

Asp phases

a. Positional: pre- (preuniversity), post- (postgraduate), [N to N]
   fore- (forecast), ex- (ex-cop), mid- (midnight)
b. Directional: pro- (proprata), anti- (anti body), counter- (counter missile),
   self- (self-respect)
c. Sequential: re- (rewind), dis- (discharge), un- (unload) [V to V]
d. Spatial: en- (enbox), a- (await)
e. Quantity: semi- (semianual), bi- (bipolar), di- (disyllabic)
   tri-(tridimensional), quadri- (quadriphonic)
f. Prative: un- (unclear), non- (non permanent), in- (incomprehensible),
   a- (asocial), im- (immoral), ir- (irresponsible)

- A graduate/post-graduate program.
- The Americans sent the missile/anti-missle.
- An available/ unavailable solution.
- They loaded/unloaded the hay.
- There is a colon/semicolon missing in the sentence.
- They re/processed the data.
- The students a/wait in front of the president’s office.
Asymmetry in morphological phases

Op phases

a. Internal-bound:
   D: th-words (the, this, that, those, ...), Pronouns: h-im, h-er.
   wh-words: (who, what, where, when, ....)

b. External bound
   Derivation: -most (leftmost)
   Inflection: -ed (washed), -s (drives)
   -s (cats, dogs)
   -s (chats) (Fr) cat+plur
   -e (grandes) (Fr) tall+fem+sing

a. Where are they?
b. He knows where they are.
c. They visited that city and that is one too.
d. They know that John is intelligent.

a. John idolizes his boss
b. The student-s gathered in the lobby.
Asymmetry and PIC at the Operator phase level

Accessibility of the edge, and non-accessibility of the non-edge

-N-phase
a. \[
\left[ \alpha \in -s \left[ \left[ N \alpha \text{ co-} \left[ (\beta \left( [\text{read } \delta] \right)) \right] \right] \right] \right]
\]

-V-phase
a. \[
\left[ \alpha \in -s \left[ \left[ \alpha \text{ union } \left[ (\beta \text{ union } \delta) \right] \right] \right] \right]
\]

b. \[
\left[ \alpha \in -s \left[ \left[ \alpha \text{ al } \left[ (\beta \text{ form } \delta) \right] \right] \right] \right]
\]
Asymmetry and PIC at the Asp phase level

The asymmetry between External sequential affixes (FE) and Internal spatial affixes (FI) follows from the locality of the phase-based derivation of morphological objects.

[w E-af FE [z I-af FI [x a V-af [y b [y root d ]]]]]

riallargare ‘to reenlarge’, riinscatolare ‘to reembox’
*rilargare, ‘to relarge’, *riscatolare ‘to rebox’

However, FI has access to the non-head of V domain as it may add a complement:
E-Asp and I-Asp

Structural differences are coupled with semantic differences pertaining to whether or not the affix may affect the aspect and the argument structure of the verbal predicate, as well as whether or not it applies to an entire event or to a sub-part of an event denoted by the verbal predicate. This can be seen in cases where the external and the internal affixes modify a verb, as in the following examples, where $F_{E}$ may affect the telicity ([t]) of a verbal predicate, and the argument structure of the projection to which they are adjoined, $F_{I}$, cannot.

a. Ha (ri)dormito (per ore/?in un ora). (It)
   ‘He slept again (for hours/?in an hour).’
b. Ha addormentato Gianni (subbito/?per ore).
   ‘(S/He) made Gianni sleep (right away/?for hours).’

The difference in the appropriateness of a punctual or a durative adverbial modification indicates whether the event denoted by the verbal predicate has or not a natural end point or Terminus [t].
E-Asp and I-Asp

Once $F_I$ has applied to a V-phase, superior functional $F_E$ (sequential and temporal) which may affect the telicity or boundedness of the event denoted by the verbal predicate may no longer affect the internal aspectual structure [t] of the V-phase.

a. Gianni ha corso (per cinque minuti/#in cinque minuti). (It)
   ‘Gianni ran (for five minutes/#in five minutes).’
   correre ‘to run’ (activity)

b. Gianni è accorso (#per cinque minuti/in cinque minuti.) (It)
   ‘Gianni ran up (#for five minutes/in five minutes).’
   a-correre ‘to run up’ (accomplishment)

c. Gianni è riaccorso (#per cinque minuti?in cinque minuti). (It)
   ‘Gianni ran up again (#for five minutes/in five minutes).’
   ri-a-correre ‘to run up again’ (accomplishment)
E-Asp and I-Asp

As $F_I$ may change the telicity of the verbal predicate to which it is adjoined, we predict that $F_I$ may not adjoin to telic predicates, whereas $F_E$ may do so. This prediction is borne out, e.g. from Italian *anascere ‘to be born at’ *aesplodere ‘to explode at’, *avincere ‘to win at’ vs. rinascere ‘to be born again’, riesplodere ‘to explode again’, rivincere ‘to win again’.

The facts show that a morphological phase is in effect a domain of cyclic interpretation and spell-out. The $F_I$ domain is distinct from the $F_E$ domain.

However, $F_I$ has access to the non-head of V domain as it may add an internal argument / complement to the verbal projection.
Asymmetry in phases

Phases are asymmetric domains of computation and interpretation. Their asymmetrical properties contribute to the reduction of derivational complexity.

Morphological phases cannot be equated with syntactic phases:

Contrary to a syntactic phase, a morphological phase is not propositional. Asymmetric selection holds between the head of the phase and elements in its complement domain, while symmetric selection may hold between the head of a syntactic phase and its complement. The PIC fails to apply across the board in morphological phases.

See Di Sciullo (2004) for discussion.
Question

Are asymmetrical relations, such as the ones observed in morphological phases, complement non-complement and Internal and External Aspect, processed by the human brain/mind?
Predictions

• Given the Asymmetry hypothesis, we expect to find experimental evidence for asymmetric relations in early stages of language development (Gauthier, Shi & Yi 2007), in different sorts of linguistic objects (Tsapkinis et al. 2004, Di Sciullo and Tomioka 2011), and their deterioration in pathological languages, including the language in patients with Alzheimer’s disease (Manouilidou et al. 2008).
Deep Asymmetry Effects

Experimentations:

• F1 > v acceptability judgments (Di Sciullo & Tomioka, 2010)
  - significant acceptability differences between novel object-V and adjunct-V

• F2 > F1 lexical decision tests, and ERP (Tsapkini et al. 2004)
  - longer RTS with F2V than with F1V
  - N400 F1V/ F2V

• Passives vs. Middles acceptability judgments (Di Sciullo et al. 2007)
  - longer acceptability judgments with middles than with passives

• Psych-V alternations sentence completion task with pAD (Manouilidou et al. 2008)
  - pAD performance is at chance level with non canonical argument structure
Deep Asymmetry Effect in NV Compounds

The asymmetry between objects and adjuncts has received much attention in works on compound formation (e.g., Baker 1988, Rosen 1989, Rivero 1992, Spencer 1995, Kuiper 1999). A major puzzle concerning compounds is that even though Head-movement captures the compound formation of object-verb type (Baker 1988), it cannot account for the presence of adjunct-verb compounds.

a. the meat-cutting knife
b. the finger-painted portrait

In this experiment 10 English speakers saw 60 sentences containing two types of novel compounds – noun
 arg
-verb, and noun
 mod
-verb. All the verbs used in the compounds are mono-transitive and the classification of the compound is evident from the sentence. When the nominal constituent is the logical object of the verb, the nominal saturates the argument requirement of the verb and hence the compound is an intransitive verb. When the nominal constituent is an adjunct, in contrast, the argument requirement remains unsaturated and the compound is a transitive verb.

Each type of compound appears in three contexts: the control context is the participle use, in which the compounding is most productive, and two verbal contexts with different tense/aspect morphology (\textit{ing} or \textit{ed}).

The noun-\textit{j}-verb compound is a saturated predicate and hence it appears as a participle with \textit{ing}, combining with a noun that is interpreted as the subject). The noun-\textit{adj}-verb compound is an unsaturated predicate and hence it appears as a passive participle with \textit{ed}, combining with a noun that is interpreted as the object.

The morphology of (a) is homophonous with the progressive aspect marker \textit{ing}, and the morphology of (b), with the simple past tense \textit{ed}.
Material

Adjunct-V
(8) The valet sand-parked the client’s car.
   The pilot desert-flew the small plane.
(9) The sailor was sea-parking his yacht against the rule.
   The florist was glass-painting the orchid.

Object-V
(10) The dreamer star-counted all night.
    The traveler bird-caught in the back yard.
(11) The biologist was root-collecting in the forest
    The scientist was cell-counting in the lab.

Fillers
(12) The girl turned on the clock-light on the wall.
    The penguin met her pole-sister after the storm.
    The actor bought a wish-dress for the party.
    The editor inserted the sentence as an afterthought.
The means of acceptability ratings

<table>
<thead>
<tr>
<th></th>
<th>Object-V</th>
<th>Adjunct-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>past tense (ed)</td>
<td>3,43</td>
<td>2,74</td>
</tr>
<tr>
<td>progressive(ing)</td>
<td>2,72</td>
<td>3,45</td>
</tr>
</tbody>
</table>
Processing deep Asymmetry

Processing is sensitive to deep asymmetric relations.
- Same precedence relations, different deep asymmetric relations
- Object-V
- Adjunct-V

Differences in acceptability of novel compounds suggest that human processing is sensitive to deep asymmetrical relations, here the difference between a phase and the edge of a phase.
Prefixed verbs

Independent evidence for word internal asymmetric relations (Di Sciullo 1997)

a. $af_l > af_2 > \text{root} / \quad *af_2 > af_l > \text{root}$ (precedence)    réenfermer/*enrefermer
b. $af_l^n > af_2 > \text{root} / \quad * af_l > af_2^n > \text{root}$ (iterativity)    rerefermer/*enrefermer
c. $af_l > af_2 > \text{root} / \quad * af_l > af_2 > \text{root}$ (locality)    réembarquer/*rebarquer

a. Elle a réemporté/*enréporté les livres. (Fr)  
b. Elle a réenfermé/*enfermé le chat dans la cave.  
a. Il a réembouteillé/ *rebouteillé le vin.  
b. Il a réembarqué/*rebarqué sur le bateau.  
a. Elle a rerefai /redéfai le puzzle.  
a. Il a (re)dormi pendant des heures.  
b. Il a (r)endormi Jean immédiatement.
On-line Lexical Decision Tests


Question: Does the asymmetry between F2 and F1 influence the way in which the verb is processed? refermer 'to close again', enfermer 'to close in'

Matched for:
- surface and base form frequency
- word-length (2-4 syllables)
- semantic transparency
- base form consistency (free-standing)

Design:
- 72 critical stimuli divided into 2 experimental lists
- Each verb appears only once, either as a prefixed or base-form
- Filler words: nouns, adjectives, and verbs (Density 75%)
- Nonwords were created by changing the first, middle, or final consonant of randomly selected words matched for frequency.
- The total of 394 items in each list were randomized and divided in four blocks for each subject.
- 30 training items were also used in the beginning of each session.

Participants:
- 24 native French speakers
- university students, normal-to-corrected vision, no reading disorders
Mean RTs and SDs for prefixed and stem forms

Statistically significant effect of form (base forms show faster latencies than prefixed forms)
Significant interaction between the type of prefix and the form of the verb
- Latencies for base forms for both types of prefixes are not different from each other.
- However, **forms with external prefixes show significantly longer latencies than forms with internal prefixes**.

<table>
<thead>
<tr>
<th>Mean RTs and SDs for prefixed and stem forms</th>
<th>Mean RTs</th>
<th>SDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>En stem</td>
<td>648</td>
<td>95</td>
</tr>
<tr>
<td>Re stem</td>
<td>628</td>
<td>80</td>
</tr>
<tr>
<td>En prefixed</td>
<td>724</td>
<td>97</td>
</tr>
<tr>
<td>Re prefixed</td>
<td>766</td>
<td>140</td>
</tr>
</tbody>
</table>

This difference cannot be accounted for by any difference in stem frequencies or surface frequencies or by any other distributional factor, e.g., syllable length, affixal homonymy, etc., it can only be attributed to the particular configurational properties of the prefixes.

Conclusion:
There is a difference in accessing internally vs. externally prefixed verbs.
Evoked Related Potentials

Experimental paradigm: Evoked Related Potentials (ERPs)

Is the F1/F2 asymmetry reflected in differential electrophysiological activity of the brain devoted to syntactic processing?

Previous findings:

Syntactic processing is correlated with two ERP components, namely an early left anterior negativity (ELAN) which is assumed to reflect automatic syntactic analysis (Friederici et al., 1996). Priming usually elicits a reduced N400 effect with respect to the unrelated control condition at the single word level (Dunay et al., 2001; Koivisto & Revonsuo, 2001).
Hypotheses:
We expected to find an N400 effect when the related conditions for both verb categories were compared to their unrelated ones and an early negativity and/or a late positivity difference between the two priming conditions involving F1 vs. F2 prefixed verbs.

Category 1: *fermer-enfermer* (related)
Category 2: *fermer-refermer* (related)
Category 3: *parler-enfermer* (unrelated)
Category 4: *parler-refermer* (unrelated)

Experimental paradigm
Visual lexical decision task with contiguous priming:

<table>
<thead>
<tr>
<th>Fixation point</th>
<th>Prime</th>
<th>Target</th>
<th>ISI</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>fermer</td>
<td>refermer</td>
<td></td>
</tr>
<tr>
<td>250ms</td>
<td>250ms</td>
<td>2000ms</td>
<td>I sec</td>
</tr>
</tbody>
</table>

Stimuli:
54 verbs with external prefixes
*fermer-refermer* 'to close again'
54 verbs with internal prefixes
*fermer-enfermer* 'to enclose'
Control primes matched with the base verbs for - surface frequency- word-length- semantic transparency
Data acquisition parameters
- 64-channel system
- Instep system (version 3.3)
- 4 electrodes (2 vertical and 2 horizontal) used for ocular movement correction amplified 3,500 times
- ERP recordings were amplified 10,000 times using a 0.02100Hz bandpass filter
- Electrode impedance reduced to <5kg2
- Sampling rate set to 250Hz
- Continuous recording was divided into 1970ms epochs including a -1 00 ms baseline prior to target onset.

ERP components
Time windows for the ERP components:
  - N100: 70-220 ms
  - N400:350-550 ms
  - P600: 550-800 ms

Participants:
11 native French speakers,
20-35 years old, normal-to-corrected vision, no reading disorders
Results
Results

N400 is reduced for the related condition as compared to the unrelated one for both verb categories in line with the previous priming literature.

However, in the case of internally prefixed verbs, this difference is more pronounced in the anterior areas, whereas in the case of externally prefixed verbs it is more pronounced in the posterior areas.

The difference between internal and external prefixes is not observed at the electrophysiological level with an early negativity but rather with a late positivity having a left temporo-parietal distribution.

These results indicate that the asymmetry between F1 and F2 prefixed verbs can be observed at the electrophysiological level.
Summary

Deep asymmetry effects observed experimentally

Phase edge/non edge
NV{-ed, -ing}
Phase internal asymmetry
I/E prefixed verbs
  F2 > F1 lexical decision tests, and ERP
  -longer RTS with F2V than with F1V
  -N400 F1V/ F2V

Deep asymmetrical relations are processed by the human brain/mind.

**Canonical/inverse a-structure**
  Passive/Middles
  Subject-EX, Object-EX
Selected references


