The nature of dependency and argument-adjunct distinctions in processing

Chien-Jer Charles Lin (National Taiwan Normal University) clin@ntnu.edu.tw

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I. Introduction
1. In this talk, I focus on the third factor in language design and how it interfaces with the UG (Chomsky, 2005).
   a. Genetic factors, apparently near uniform for the species, the topic of UG.
   b. Experience, which leads to variation, within a fairly narrow range, as in the case of other subsystems of the human capacity and the organism generally.
   c. Principles not specific to the faculty of language. <=

2. The third factor falls into several subtypes:
   a. principles of data analysis that might be used in language acquisition and other domains
   b. efficient computation [v]

3. The various forms of dependencies in language:
   a. Local dependencies in language (Phillips & Wagers, 2007: 742-743)
      i. Thematic dependencies: Agent-Verb-Theme
      ii. Case assignment
      iii. Agreement

   b. Dependencies can be nonlocal (e.g. those involving internal merges):
      i. WH-movement
      ii. Topicalization
      iii. Relativization
      iv. Ellipsis reconstruction
      v. Discourse-oriented dependencies

4. In this talk, I focus on the thematic dependency and its various manifestations in linguistic theorization and sentence processing.

5. Language is about functions between entities:
   "A relation f is a function iff it satisfies the following condition: For any x: if there are y and z such that <x, y> ∈ f and <x, z> ∈ f, then y = z." (Heim & Kratzer, 1998: 10)

6. Argument structure / thematic relations / subcategorization frames
   a. the cornerstone of compositionality in language
   b. Arguments are required by functions. Together they form predications in language.
   c. Distinctions between arguments and adjuncts (Grimshaw, 1990: 108)
      i. Arguments can be selected and subcategorized, in the sense that their presence and the form they take are under the control of individual predicates.
      ii. Arguments must be licensed: they can occur only if they are theta-marked by a predicate as a function of the predicate’s argument structure.
   iii. Adjuncts are not theta-marked and do not need to be licensed by relationship to an a-structure; their licensing conditions pertain to other domains (McConnell-Ginet, 1982, cited from Grimshaw, 1990: 108). They are not subcategorized. Hence, their form is free, and they are never required by a-structure.
   d. Functional Application (Heim & Kratzer, 1998) as the basic operation to construct thematic relations based on argument structure:
      If α is a branching node, {β, γ} is the set of α’s daughters, and {[[α]]} is a function whose domain contains [[γ]], then [[γ]] = {[[β]] ([[α]])}.
   e. Different prominence of the thematic relations (Grimshaw, 1990):
      e.g. introduce (agent (goal (theme)))

7. Now, compare the semantic operations on arguments and adjuncts:

8. Operations on arguments:
   Functional Application (Heim & Kratzer, 1998):
   If α is a branching node, {β, γ} is the set of α’s daughters, and {[[α]]} is a function whose domain contains [[γ]], then [[γ]] = {[[β]] ([[α]])}.

9. Operations on adjuncts:
   Predicate Modification (Pylkkänen & McElree, 2006: 545):
   If α is a branching node, {β, γ} is the set of α’s daughters, and {[[β]]} and {[[γ]]} are both of type <r, v>, then [[γ]] ≡ λx. {[[β]](x) & {[[γ]])(x)}.

10. The syntactic representation of argument structure—the X-Bar Theory
    a. Arguments are complements/sisters to the head.
    b. Adjuncts are sisters to the projection of the head.

11. Examples of arguments and adjuncts in sentences:
    a. John is a student of physics. [argument]
    b. John is a student from Phoenix. [adjunct]
    c. John decided on Saturday. [argument]
    d. John arrived on Saturday. [adjunct]

12. The interface property of argument structure:
    a. It defines relations among entities that are encoded in a clause.
    b. The sentence itself centers on a verb that encodes a kind of event.
    c. The associated participants vary on the continuum of obligatoriness.
    d. What do we do with “implicit arguments”?
    e. Argument structure is often translated as thematic structure.
    f. Associated with thematic structure is the thematic hierarchy (a.k.a. UTAH).
    g. How much of argument structure is linguistic and how much of it is encyclopedic?

13. Predictions (processing implications & issues) of the argument/adjunct distinctions:
    a. There are processing differences between arguments and nonarguments.
    b. The sentence itself centers on a verb that encodes a kind of event.
    c. The associated participants vary on the continuum of obligatoriness.
    d. What do we do with “implicit arguments”?
    e. Argument structure is often translated as thematic structure.
    f. Associated with thematic structure is the thematic hierarchy (a.k.a. UTAH).
    g. How much of argument structure is linguistic and how much of it is encyclopedic?
II. Sentence Processing
14. Argument phrases are easier to process than adjunct phrases. (P&M: 548)
15. The potential causes for the processing asymmetries?
   a. The lexical nature of thematic operations being the fundamental building block.
   b. The operation FA is intrinsically easier than PM.
   c. The parser weights FA over PM.
   d. FAs are more predictable and the relations are more frequently established based
      on one’s experience. PMs are more variable and thus harder to compose.
      (frequency/experience-based account; lexical and pragmatic factors).
16. Theories of sentence processing regarding argument/adjunct distinctions (following
    Tutunjian & Boland, 2008):
17. Pure Frequency Hypothesis (MacDonald et al., 1994)
   a. Purely lexical predictions for the argument/adjunct distinction
   b. No intrinsic difference between argument and adjunct attachments
18. Global Structural Hypothesis (Ferreira & Henderson, 1990; Frazier, 1987)
   a. Minimal Attachment predicts attachments to the higher positions.
   b. (However, Late Closure predicts attachments to the lower positions.)
   c. Arguments are attached to the position where minimal change should be made to
      the current phrase structure. (Global structural simplicity is enforced here.)
   d. Adjuncts are attached based on lexical as well as encyclopedic knowledge.
   e. N.B. My take: the parser attaches a linguistic object high whenever the linguistic
      object can be taken as a complement to the existing structure. The heads that were
      encountered early already activated an argument frame for upcoming arguments to
      fill. This, however, only applies to arguments. Adjuncts attach low obeying Late
      Closure (e.g. I saw the girl crying in the park).
   a. Arguments are represented lexically (like those predicted by PFH).
   b. Adjuncts are processed non-lexically by syntactic rules.
III. Processing evidence from English: PP attachments
20. Temporary ambiguity in PP attachment (Schütze & Gibson, 1999):
   21. The spy saw the cop with ...
      a. a telescope [VP attachment]
      b. a revolver [NP attachment]
   22. I thought about his interest in the Volvo. (Argument Preference Strategy; Abney, 1989)
      a. NP attachment [argument; preferred]
      b. VP attachment [adjunct]
   In cases of attachment ambiguity, the parser prefers the attachment that maximizes the
   extent of the argument relation between the attaching phrase and the attachment site.
24. Rayner et al. (1983):

(22a) better than (22b) in first pass processing => attach high [see Schütze & Gibson,
1999 for a discussion on alternative accounts]
25. Diagnostics for PP attachments as arguments or as adjuncts/modifiers (Schütze & Gibson, 1999: 425-428)
   a. Optionality:
      Arguments to a particular lexical head can be obligatory, whereas modifiers are
      (almost) always optional. [Note, however, that there are also optional arguments as
      most of the attached PPs are; the underlines are mine.]
   b. Ordering:
      Argument generally must precede modifiers (Jackendoff, 1977; Pollard & Sag,
      1987), while modifiers may follow other modifiers and arguments may follow
      other arguments.
   c. Iterativity:
      Modifiers phrases can usually iterate while argument phrases cannot.
   d. Pro-form replacement:
      If a PP is obligatorily deleted when the noun or verb head with which it is
      associated is replaced by a pro-form, that PP is an argument of the replaced head;
      if not, it is a modifier.
   e. Separation from the head:
      If a PP can be separated from its associated noun by a copula or a relative clauses
      construction, it is a modifier; if not, it is an argument.
   f. Wh-extraction:
      Wh-extraction of or from a PP that is inside a direct object is generally possible,
      but this is not so for modifiers.
   g. Instrumentals:
      Instrumentals pattern with arguments on three of the syntactic tests.
26. Schütze & Gibson (1999): Experiment 2

<table>
<thead>
<tr>
<th>conditions</th>
<th>critical region</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP argument</td>
<td>The company lawyers considered employee demands for a raise but they (344 ms) didn’t act until a strike seemed imminent.</td>
<td></td>
</tr>
<tr>
<td>VP modifier</td>
<td>for a month (372 ms)</td>
<td></td>
</tr>
<tr>
<td>Unambiguous PP</td>
<td>after a month (345 ms)</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion:
- NP arguments are processed faster than VP modifiers.
- This difference was not due to an object that is missing. Rather, at the point of for, the
  PP is already taken as an argument, being attached low onto the noun demand, not
  onto the verb (as would be predicted by Minimal Attachment).
- The Argument Preference Strategy is a better predictor for PP attachment than
  Minimal Attachment.
- An alternative account can be Late Closure or Recency. However, in other studies, it
  has been found that a PP argument that attaches high (onto the VP) can be preferred.
- Another alternative account is frequency, which was rejected because it showed no
  correlations with the RT data. In addition, many of the diagnostics cannot be
  accounted for by frequency.
27. Boland & Blodgett (2006) focused on double object constructions tracking eye movements:

<table>
<thead>
<tr>
<th>conditions</th>
<th>VP argument</th>
<th>VP adjunct</th>
<th>NP argument</th>
<th>NP adjunct</th>
</tr>
</thead>
<tbody>
<tr>
<td>(high)</td>
<td>The</td>
<td>offered</td>
<td>some exceptions</td>
<td>to the business,</td>
</tr>
<tr>
<td></td>
<td>environmental agency</td>
<td></td>
<td></td>
<td>this year 268ms</td>
</tr>
<tr>
<td>(low)</td>
<td>offered</td>
<td></td>
<td></td>
<td>267ms</td>
</tr>
<tr>
<td>(high)</td>
<td>offered</td>
<td></td>
<td></td>
<td>292ms</td>
</tr>
<tr>
<td>(low)</td>
<td>offered</td>
<td></td>
<td></td>
<td>290ms</td>
</tr>
</tbody>
</table>

- In this study, the height of the attachment sites is controlled. The effects can be said to be purely about the complement versus adjunct distinction.
- They found immediate influence of the argument status.

28. See also evidence for argument/adjunct distinctions in production studies (Watson et al., 2006):
   a. Intonational boundaries are more likely to occur before adjuncts than before arguments.
   b. Obligatory subcategorization is a better predictor of intonational boundary than semantic closeness.

The reporter investigated [shorter... the crash] and this unnerved the officials.
The reporter arrived [longer... after the crash] and this unnerved the officials.
The reporter’s investigation [shorter... of the crash] unnerved the officials.
The reporter’s arrival [longer... after the crash] unnerved the officials.

IV. Data from sentence processing in Mandarin Chinese
   a. Processing view on 王八死了父親--Processing of resumptive relative clauses involving DOCs (Ning, 2008; Ning & Lin, 2008)
   b. Alienability in the processing of relational nouns (Lin, 2007)

29. Resumptive pronoun processing in Mandarin Chinese (Ning, 2008; Ning & Lin, 2008): The unaccusative hypothesis (Baker, 1983; Burzio, 1986; Postal 1984; Pullum 1991; see Friedman et al., 2008 for processing evidence):
   a. Unaccusative verbs— The vase broke [ba04].
   b. Unergative verbs— John broke the vase.

30. The argument structure of GIVE and RECEIVE VERBS are actually different:
   a. GIVE <causer, experiencer, theme>.
   b. RECEIVE <agent, theme, <affectee> is selected for by the LIGHT VERB Vgong-tou.

31. Huang (2009, course handouts at NTNU) furthered this distinction to 3-place predicates:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-place</td>
<td>V Theme</td>
<td>Agent V</td>
</tr>
<tr>
<td>2-place</td>
<td>Experiencer V Theme</td>
<td>Agent V Theme</td>
</tr>
<tr>
<td>3-place</td>
<td>Causer Experiencer V Theme</td>
<td>Agent V Affectee Theme</td>
</tr>
<tr>
<td></td>
<td>inner subject</td>
<td>outer object</td>
</tr>
<tr>
<td>3-place</td>
<td>張三絞了李四兩本書</td>
<td>張三絞了李四兩本書 DOC of the GIVE type</td>
</tr>
<tr>
<td>3-place</td>
<td>Resumptive pronoun or gap</td>
<td>Resumptive pronoun preference</td>
</tr>
</tbody>
</table>

32. 張三絞了李四一棟房子．(Huang, 2009)  
Zhangsan zu-le Lisi yi-dong fangzì.  
Zhangsan rent-LE Lisi one-CL house  
a. Zhangsan rented Lisi a house.  
Zhangsan = landlord <= preferred  
b. Zhangsan rented a house from Lisi.  
Zhangsan = tenant

33. Different argument structures:
34. The argument requirements for GIVE and RECEIVE VERBS are actually different:
   a. GIVE <causer, experiencer, theme>.
   b. RECEIVE <agent, theme, <affectee> is selected for by the LIGHT VERB Vgong-tou.

35. ½ song ‘give’ vs. ½ tou ‘steal’ in corpus (Ning, 2008):

<table>
<thead>
<tr>
<th></th>
<th>½ song ‘give’</th>
<th>½ tou ‘steal’</th>
</tr>
</thead>
<tbody>
<tr>
<td>XYZ</td>
<td>38%</td>
<td>100%</td>
</tr>
<tr>
<td>XZ</td>
<td>12%</td>
<td>100%</td>
</tr>
<tr>
<td>XY</td>
<td>44%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

36. Processing predictions of these two constructions:
   **Asymmetrical Processing of Unaccusatives and Unergatives (APUU):** Sentences like 張三絞了李四兩本書 (i.e., 3-place unaccusatives) should be easier to process than sentences like 張三絞了李四兩碗飯 (i.e., 3-place unergatives) for the following reasons:
   a. The argument structure of GIVE already specified the three arguments to be taken, thus providing the parser with sufficient information for syntactic integration.
   b. The RECEIVE verbs only take two arguments and would involve insertions of additional functional phrases (e.g., ApplPs). These purely functional projections (at S-syntax) are more costly to construct in on-line processing.

37. That is, when argument requirements are lexicalized, they involve effects of argument saturation like the GIVE verbs (thus easier to process). When the arguments are subcategorized for by syntactic projections, they involve more costly operations (e.g., functional projections) like the RECEIVE verbs. (cf., Tang 2009 FOSS-6)

38. Resumptive relatives:
   a. 張三打死了他那個孩子
   b. 張三喜歡她的那個女孩子

a. Chinese relative clauses are head-final; without proper motivation, they may lead to garden path (Lin, 2008).  
張三喜歡的那個女孩子  
zhangsan like de that girl  
‘the girl that Zhangsan likes’

b. Processability enhances grammaticality (Thesis IV; Lin, under review).

c. Garden path reduces grammaticality (Thesis V; Lin, under review).

d. Overall, gapped relative clauses are more acceptable than resumptive ones.
e. Why?
   i. For processing reasons (due to the potential garden-path effect).
   ii. However, except for grammatical reasons, we may prefer a resumptive
       over a gap. (Ning & Lin, 2008)

f. Grammaticality judgments of gapped and resumptive relatives:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Object</th>
<th>Oblique</th>
<th>Indirect object</th>
<th>Indirect object relatives of the 'Give' verbs</th>
<th>Indirect object relatives of the 'Take' verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gap</td>
<td>Resumptive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   Ning & Lin (2008)

   g. Observations:
      i. Gapped relatives are generally better than resumptive relatives.
      ii. However, resumptive relatives are better than gapped ones for oblique
           object relatives.
      iii. The patterns do not follow in sentences involving three arguments.

40. Asymmetry in the processing of GIVE and RECEIVE verbs in resumptive relatives.
   i. 張三花了李四兩輛車。  [GIVE VERB]
   ii. 張三花了四五百元。  [RECEIVE VERB]
   iii. 張三送了他兩輛車。  [GIVE VERB]
   iv. 張三送了他五百元。  [RECEIVE VERB]
   v. 張三送了他兩輛車的那個人。  [GIVE VERB]
   vi. 張三送了他兩輛車的那個人。  [RECEIVE VERB]
   vii. 張三送了他五百元的那個人。  [GIVE VERB]
   viii. *張三送了他五百元的那個人。  [RECEIVE VERB]

41. Self-paced readings of the resumptives with verbs of the GIVE and RECEIVE

42. Why the asymmetry?
   a. Proposal 1a: Argument structure of GIVE and RECEIVE produces different
      degrees of garden path in the two sentences (Ning & Lin, 2008).
      i. 張三送了他兩輛車 的那個人。  [GIVE VERB]
      ii. 張三送了兩輛車 的那個人。  [GIVE VERB]
      iii. 張三送了他五百元 的那個人。  [RECEIVE VERB]
      iv. *張三送了五百元 的那個人。  [RECEIVE VERB]
Inalienable possessor arguments in possessive processing (Lin, 2007)

a. the boy's mother:
   i. the woman who is the female parent of the boy
   ii. the mother who the boy was painting a portrait of
b. the boy's hand:
   i. the hand on the arm of the boy
   ii. the hand of a sculpture that the boy was sketching
c. the boy's essay:
   i. the essay that they boy wrote
   ii. the essay by E. B. White that they boy will talk about in class

Barker (1995) on possessive descriptions: Nouns can be distinguished into
a. those that express intrinsic possessive relations (e.g., *pet*)
b. those that construct possessive relations extrinsically (e.g., *animal*).

Lexical possession:
a. a pet of John
b. John's pet

Extrinsic possession:
a. an animal (*of John*)
b. John's animal

Chinese data on alienability and secondary predication I:

a. 我把他的雙腿打斷。
   wo ba ta de shuang tui daduan
   I BA he GEN two leg break
   'I broke his two legs.'
b. 我把他的棒棒打斷。
   wo ba ta de gubang daduan
   I BA he GEN drumstick break
   'I broke his drum stick.'
c. 我把他的演講打斷。
   wo ba ta de yanjiang daduan
   I BA he GEN lecture break
   'I broke (interfered) his lecture.'

Chinese data on alienability and secondary predication II:

a. 我把他的雙腿打斷。
   wo ba ta de shuang tui daduan
   I BA he break two leg break
   'I broke his two legs. (lit. I broke him two legs.)'
b. *我把他的鼓棒打斷。
   wo ba ta daduan gubang daduan
   I BA he break drumstick break
   'I broke his drum sticks.'

Data from self-paced reading tasks (Lin, 2007): N1 BEI N2 V1 DE N3 V2
父親/員工 被 警察 抓走 的 總裁 顯得十分慌張。
fuqin/yuagong bei jingcha zhuangzi de zongcai xiandu shifen huangzhang
father/employee BEI police take REL chairperson appear-very-nervous
'The chairperson whose father/employee was taken by the police appeared very nervous.'
b. **Adjunct-coercion effect:** When the possessee is an alienable noun, a possessive relationship has to be coerced at the head noun position, making it more costly to process.

54. Back to the asymmetry in GIVE and TAKE verbs in resumptives:

a. **Argument-integration effect:** When the head noun is subcategorized for by the ditransitive verb GIVE, it is easier to integrate it into the relative clause, making gapped relative easier than resumptive (as would be predicted by the general tendency). [the inner subject advantage]

b. **Adjunct-coercion effect:** When the head noun is not subcategorized for by the RECEIVE VERB, a resumptive has to be at the gap position for the constriction of an ApplP so that the applicative reading of the additional argument can be licensed (coerced). [the outer object disadvantage]

V. **Concluding remarks:**

a. Arguments and adjuncts are distinguishable in sentence processing. (new evidence from Chinese sentence processing)

b. Argument/complement saturation (i.e. at L-syntax) is achieved with greater efficiency than predicate modification. The latter may be an instance of the effect of coercion, which involves type-shifting and/or insertions of functional projections in structure.

c. Implications: Various higher levels of applicatives will be more costly to process if they are selected for purely by empty functional heads.

d. Inner subjects and outer objects are processed with different degrees of computational efficiency.

References


