

## **Standardization of the Complement/Adjunct Distinction**

### **Abstract**

This paper[a] reports on criteria for distinguishing complements from adjuncts in the development of COMLEXSyntax[b], a large on-line syntactic lexicon of English. Correct, or at least consistent, criteria are crucial for lexicography and natural language processing. Complement/adjunct criteria from linguistics and lexicography leave a gray area – optional complements are difficult to distinguish from adjuncts. In an experiment we conducted, four graduate students make substantially the same Complement/Adjunct distinctions for 205 examples using our criteria.

### **1. Lexicography and the Complement/Adjunct Distinction**

Since complements, but not adjuncts, should be listed in lexical entries of verbs, it is important that lexicographers have clear criteria. In our view, Longman's Dictionary of Contemporary English (Proctor 1978, referred to below as LDOCE) makes this distinction adequately (although we are unsure what criteria they use). However, we have detected some errors in making this distinction in the Oxford Advanced Learner's Dictionary (Hornby 1980, referred to below as OALD). For example, (1a, b, c, d) each contain a subordinate clause (gerundal or infinitival). The bracketed adjunct phrases in (1a, b) are adjuncts (OALD marks them as complements), but (1c, d) are complements. The adjunct clauses are optional and can occur with a wide variety of verb phrases with much the same meaning as in (1a, b). In contrast, the complement clauses are obligatory for the relevant meanings of (1c, d).

- (1) (a) He opened the door [to let the cat out] (OALD, p. xxxvi)
- (b) She lay [smiling at me] (OALD, p. xxx)
- (c) He started [to let the cat out]
- (d) She continued [smiling at me]

Herbst (1984, 1987, 1988) distinguishes complements and adjuncts for lexicography, using a few of the same criteria that we do, but we use many more criteria overall. Herbst also draws on different sources than

we do, namely Valency theory. Herbst 1987 uses one criterion equivalent to our Obligatoriness Criterion (see Figure 1 below); three criteria which are subsumed by our adjunct criterion 2, i.e., purpose clauses, concomitant “with” and benefactive (cf. Figure 3); and three criteria which we found to be inconsistent. Contrary to Herbst, “what” can question the object of an adjunct preposition in “What did John wash the dishes in?”; “where” can question complements in sentences like “Where did you put my keys?”; and an adjective in the construction

NP + V + NP + Adj

can be an adjunct, as in (2).

- (2) We left the room angry

## **2. The Importance of the Complement/Adjunct Distinction for Parsing**

At least four factors make the Complement/Adjunct distinction important for parsing natural language:

- I Complements of a verb V occur with V more frequently than with other verbs, whereas adjuncts occur with equal frequency with a large variety of verbs;
- II Incorrectly classifying a complement as an adjunct may cause a parser to miss a parse;
- III Incorrectly classifying an adjunct as a complement may cause a parser to add a spurious parse;
- IV In an accurate representation of predicate argument structure, heads predicate of their complements, but adjuncts predicate of the heads they modify.

Factor I is crucial for those parsing heuristics based on Frazier’s (1978) “Minimal Attachment” analysis. Minimal attachment heuristics prefer complement attachment to adjunct attachment when there are attachment ambiguities. Since these heuristics depend on the Complement/Adjunct distinction, incorrect assessments will produce undesirable results. Example (3) is three ways ambiguous depending on the status of the

bracketed PP: 1. the telling takes place in the house (PP is an adjunct of “tell”); 2. the running takes place in the house (PP is an adjunct of “run”); and 3. the house is the endpoint or goal of the running (PP is the complement of “run”). According to minimal attachment, reading 3 is preferred.

(3) I told Mary to run [in the house]

Factors II and III assume a parser which generates all possible parses for a given utterance. The bracketed phrase in (4) is ambiguous between a complement reading in which the baby’s destination (or goal) was “under the table”, and an adjunct reading in which “under the table” was the location where the baby did its crawling. Since most verbs allow the adjunct reading, “crawl” must be specifically marked to allow this prepositional phrase complement. If “crawl” is not so-marked, the complement reading will not be allowed, i.e., the parser will only get one parse of (4) (the adjunct reading). The bracketed phrase in (5) is unambiguously an adjunct. If the verb “eat” is incorrectly assumed to take this complement, then this sentence will incorrectly receive two parses: the (correct) adjunct reading in which “under the table” is the location where eating is taking place; and one spurious complement reading.

(4) The baby was crawling [under the table]

(5) The baby ate its cereal [under the table]

Factor IV distinguishes between complements and adjuncts, in terms of the predicate argument relation. One consequence of this discussed below is that adjuncts impose selection restrictions on heads, but heads impose selection restrictions on complements.

In summary, consequences of errors in making the complement/adjunct distinction include: generating too few parses of utterances, generating spurious parses, missing preferences among parses, and misrepresenting predicate argument structure.

### 3. Identifying Complements

We assume the following definition:

Definition 1: Complement – Given a Verb Phrase which includes a head verb V, a phrase XP, XP is a complement if XP is an intrinsic part of the action, state, event, etc. described by the VP, i.e., the verb predicates of the XP.

We have developed testable criteria for complement-hood based on: Definition 1, claims made in the linguistic literature, and our examination of the data. Each criterion listed in Figure 1 is sufficient for XP to be a complement. The Figure 2 criteria are rules of thumb, rather than sufficient criteria. These rules of thumb have exceptions, but are useful for identifying complements subject to verification by the other criteria. Due to space limitations, we defer to Meyers, Macleod and Grishman 1994 for details.

Figure 1. Criteria For Complement-hood

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1. Obligatoriness	XP is obligatory for VP to be grammatical or for a particular sense of V to be possible.
2. Passive	XP can only be the subject of the passive if XP is a complement. Only Complement PPs can be stranded by pseudo passive.
3. Theta Roles	XP has an argument theta role: theme, source, goal, patient, recipient, experiencer, proposition, question, etc.
4. Implied Meaning	XP is optional, but is implied if omitted.
5. Selection Restrictions	If V imposes selection restrictions on XP, XP is a complement.

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Figure 2. Rules of Thumb

6. Frequency	XP occurs with verb V with high relative frequency
7. Typical Complements	NPs, PPs headed by “to”, clauses (other than relatives, “whether” and “if”)
8. Complement Alternation	XPs which participate in alternations are usually complements. (See Levin 1993)
9. Linear Order	An XP between a head and a complement is probably a complement.
10. Island Constraints[1]	Most Complements can violate “island constraints”

Criteria 1, 2 and 3 are standard and need only be illustrated by example. (6) and (7) exemplify Criterion 1; (8) and (9) exemplify Criterion 2; and (10) through (13) exemplify argument theta roles (cf. Gruber 1965, and others).

- (6) (a) Mary felled [the tree] (complement)  
(b) \*Mary felled
- (7) (a) Mary woke up [John] (complement)  
(b) Mary woke up  
(c) Mary woke up [slowly] (not a complement)
- (8) (a) Mary ate [the pudding]  
(b) [The pudding] was eaten. (complements can passivize)
- (9) (a) Many people lived [in [that mansion]]  
(b) [That mansion] was lived in by many people (complements can passivize)
- (10) John gave Mary (recipient, goal) the book (theme)
- (11) The package came [from Cleveland] (source)
- (12) The giant sponge with fangs frightened [the swimmer] (experiencer)
- (13) Mary kissed her father (patient) on the cheek (goal)

By Criterion 4, the bracketed phrase in (14a) is a complement because some NP like the bracketed phrase is implied when omitted, as in (14b). In contrast, the bracketed phrase in (14c) is not a complement, because it is not implied when omitted.[2]

- (14) (a) John ate [something]  
(b) John ate  
(c) John ate [slowly]

Criterion 5 states that given a phrase [VP V XP], if V imposes selection restrictions on XP, XP is a complement of the verb. Following McCawley 1968 (attributed to Fillmore) and Lakoff 1969, we view selection restrictions as presuppositions associated with one constituent of a phrase about the nature of the other constituents. For example, the verb “tease” in (15) presupposes that its complement is animate. In (15), “it” and “something” is interpreted as fulfilling this selection restriction. Thus either pronoun can refer to a dog, but not a book. (16) and (17) illustrate how semantic anomaly interacts with the selection restrictions. If we change our assumptions about the world so that the semantically anomalous sentences (16b) and (17b) are well-formed (semantic anomaly is indicated by %), the word/phrase imposing selection restrictions remains constant in meaning, but our assumptions about the selected phrase change. (16b) and (17b) would be well-formed in a world in which ideas were alive (ideas are different), and math could be learned by hammering math books into one’s head (learning is different). Thus “tickle” selects its NP, but the adjunct PP “with a hammer” selects its head verb.[3]

- (15) Gertrude teased it/something (+animate)
- (16) (a) John tickled [the baby] (complement)  
(b) %John tickled [the idea]
- (17) (a) Mary removed the nail [with a hammer] (not a complement)  
(b) %Mary learned math [with a hammer]

#### 4. Identifying Adjuncts

We assume the following definition:

Definition 2: Adjunct – Given a Verb Phrase VP which includes a headverb V, a phrase XP, XP is an adjunct if XP modifies V or VP. XP is not intrinsic to VP.

Our adjunct-hood criteria (Figure 3), are based on: consequences of definition 2; claims made in the linguistic literature; and our examination of the data. Our reason for identifying adjuncts is to provide a set of criteria for determining that some phrase is NOT a complement. Conflicts between adjunct and complement criteria were usually resolved in favor of complements, as the former were treated like our rules of thumb, rather than hard-and-fast criteria.[4] Due to space limitations, we

defer to Meyers, Macleod and Grishman 1994 for details. We note in passing that we found criteria 1 and 2 to be the most useful.

Figure 3. Criteria for Adjunct-hood

1. Frequency	XP occurs with most verbs with roughly the same frequency and meaning
2. Typical Adjuncts	purpose clauses, PPs/AdvPs/Subordinate clauses headed by “before”, “after”, “while”, “because”, “although”, “if” or “by”; instrumental/concomitant “with” phrases, “by means of”, benefactive, place, manner and time AdvPs and PPs
3. Selection Restrictions	An Adjunct imposes selection restrictions on the verb/VP
4. WH Words	AdvPs/PPs which can be questioned with “Why” or “How”
5. Fronting	Adjunct PPs front more naturally than complement PPs
6. Island Constraints	Adjuncts cannot usually violate “island constraints”

## 5. Experimental Evidence

To test the consistency of our criteria, we instructed four of our graduate student lexicographers to identify all and only the complement phrases which followed highlighted verb forms in 205 sentences and sentence fragments.[5] We selected 35 verbs beginning “j”. Then we selected sentences and sentence fragments from a text corpus by a simple algorithm.[6] Table 6 lists the number of complement phrases each student selected, followed by the portion of these complements chosen by the other students.

Although the first set of results listed in Figure 4 are quite encouraging, our criteria are actually more consistent than these results indicate. The second group of results in Figure 4 are calculated after removing from consideration 44 examples that at least one lexicographer noted as problematic. Out of the 205 examples, all four students agreed on the complement/adjunct status of each phrase following the verb in 142 examples. Of the 63 other examples, the graduate students wrote notes to the experimenters indicating 25 to be problematic. 19 of the examples which the students agreed upon were also noted as problematic. In practice these discrepancies could be resolved by interaction among the lexicography staff.

Figure 4. A Comparison of Complement Selection for 205 examples by Four Graduate Students

Students	Comple- ments	Classified as Complements by Other Students				
		A	B	C	D	Average
A	213		200 (94%)	203 (95%)	206 (97%)	95%
B	229	200 (87%)		206 (90%)	215 (94%)	90%
C	234	203 (87%)	206 (88%)		214 (91%)	89%
D	232	206 (89%)	215 (93%)	214 (92%)		91%

Average Recall: 91%

Results After Pruning 44 Examples From Consideration

Student	Comple- ments	Classified as Complements by Other Students				
		A	B	C	D	Average
A	164		160 (98%)	155 (95%)	161 (98%)	97%
B	179	160 (89%)		161 (90%)	171 (96%)	92%
C	175	155 (89%)	162 (92%)		163 (93%)	91%
D	176	161 (91%)	171 (97%)	162 (92%)		94%

Average Recall: 93%

## 6. Conclusion and Final Remarks

This paper showed that the complement/adjunct distinction should be made in dictionaries used for the parsing of natural language. For this reason, we have developed consistent criteria for distinguishing complements and adjuncts. These criteria are justified on the basis of experimental evidence.

The experiment was performed between the months of December 1993 and February 1994, shortly after the criteria were first drawn up. The students have used these criteria since then. We have had considerable time to correct misunderstandings about the criteria on the part of the students. It is therefore quite probable that further tests would find even more consistent results than those given above.



## Notes

- [a] Meyers, Macleod and Grishman 1994 is a more detailed version of this paper.
- [b] COMLEX Syntax has been supported by the Advanced Research Projects Agency through the Office of Naval Research under Awards No. MDA972-92-J-1016 and N00014-90-J-1851, and The Trustees of the University of Pennsylvania.
- [1] Extractions (in WH questions, relative clauses, etc.) of either a complement or an adjunct out of a syntactic “island” (See Ross 1967 and Huang 1982) may be ill-formed, but complement extraction is “better” than adjunct extraction. For example, the extraction out of the NP headed by “fact” is better in (i) than in (ii) (Either answer could be “eating her lunch”). The extraction tests were difficult to apply consistently due to reliance on gradations of grammaticality.
- (i) ?What did John misrepresent the fact that Mary spent lots of time doing?
- (ii) \*What did John misrepresent the fact that Mary walked doing?
- [2] The term “something”, in (14a) is meant as a variable over NPs, not the word “something”. Note that an adverbial of the class which includes “slowly” is not implied by (14c).
- [3] Using metaphor, any word in a semantic anomalous sentence can change in meaning. (17b) could mean that Mary’s math teacher was strict. However, metaphorical readings of semantically anomaly are not relevant to the adjunct/complement distinction.
- [4] Evaluative adverbial complements are an exception to criterion 4, as shown in (i).
- (i) How did Sarah feel? Sarah felt well.
- [5] Our lexicographers marked from 0 to 3 complement phrases for each example.
- [6] Our corpus included: the Brown Corpus, newspaper and magazine articles, Department of Energy Abstracts, and other miscellaneous documents.

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