# Making Verb Argument Adjunct Distinctions in English

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Synthesis Paper  
November 2011

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1 Introduction

Most formal theories of grammar generally agree that there is a distinction that can be made between constituents that are arguments and those that are adjuncts. Syntactically speaking, arguments are typically considered to be constituents that are syntactically licensed or required by the head verb of the phrase. As for adjuncts, no such restriction or requirement is necessary for them to be present in a phrase.

Semantically speaking, arguments are necessary participants in the event or state created by the verb and they participate in the manner specified by the verb’s subcategorization frame. Adjuncts, on the other hand, unlike arguments, do not rely on the relational information conveyed by the verb. Rather they comment on the general action or state of the predicaing unit – the verb and its arguments. For example, In the sentence According to my sources, Sue gave Fred the book grudgingly on Friday, the arguments Sue, Fred, and the book participate in the transfer event denoted by the verb give in a very specific manner: Sue is the giver, Fred is the recipient, and the book is the transferred item. The adjuncts of the sentence such as grudgingly and on Friday are present because the predicate denotes an event and not because the verb specifically denotes an act of transfer. In the same way, the adjunct according to my sources, does not care about the specific meaning of the verb; rather it is there to comment on the proposition denoted by the predicate. In other words, in general, constituents that express the roles required by the verb are considered arguments and constituents that are present in the sentence as very general features of the predication are considered adjuncts.

In natural language processing (NLP), identifying the verb’s argument structure is important. In NLP’s statistical parsing task, the automatic system generates the most statistically plausible parses for any given sentence. The automatic system picks from this set the most likely parse. It has been shown that providing a verb’s subcategorization information during syntactic parsing can improve performance (Collins, 1999), for example by helping to resolve such issues as PP-
attachment ambiguity (Hindle and Rooth 1993; Merlo and Esteve Ferrer 2006).

In addition to the parsing task, verb argument structure information is used in distinguishing different senses of a word that are likely to be associated with a particular argument frame (Dligach and Palmer, 2008), in marking required or optional elements in a sentence during machine translation (DeNeefe and Knight, 2009), and discriminating crucial information in a given document from that which is non-critical or parenthetical in text summarization and text simplification. Thus, the key piece in defining verb argument structure in NLP is identifying which constituents in a given sentence should be included in or excluded from the head verb’s subcategorization frame.

Consequently, drawing a distinction between what is an argument and what is not is an important task for both the syntactic resources used in the NLP communities and the lexical resources that provide human annotated data for the training and testing of the automatic systems described above. For grammar formalisms used in NLP such as Tree Adjoining Grammar (TAG) and Lexical Functional Grammar (LFG), a clear definition of the predicate’s subcategorization frame is necessary as this is the basis for establishing the verb’s syntactic definitions (e.g. identifying tree family membership in TAG and representing functional structure in LFG for a verb). Furthermore, lexical and semantic resources such as FrameNet (Ruppenhofer et al., 2010), VerbNet (Kipper et al., 2008), and PropBank (Kingsbury and Palmer, 2003; Palmer et al., 2005), as well as lexical resources such as COMLEX Syntax (Grishman et al., 1994) and Combinatorial Categorical Grammar (CCG; Steedman 2000) provide data for training and testing of automatic systems. Effective supervised processing techniques, whether sentence parsing, machine translation or text simplification, depend highly on the quality and consistency of the annotation based on available resources.

This paper will explore the distinct approaches taken by the linguistics community and NLP’s resource developers, focusing on verb argument and adjunct distinctions. In section 2, we will explore the semantic intuitions behind the distinction. Section 3 will discuss the dimen-
sions by which the distinction is often made in the linguistics literature. In section 4, we will see how the current resources used by automatic NLP systems currently deal with the issue of argument and adjunct distinction.

2 Semantic Intuitions Concerning the Argument-Adjunct Distinction

The task of making the distinction between arguments and adjuncts of a verb is in some sense a way of capturing a basic intuition that if a world event or activity must be described, such an event will necessitate participants (e.g. *birthday boy* in a *birthday party* or *snow* in a *snowstorm*) or other relevant information that is salient to the setting. And as it is in any setting, some information will be more crucial to the described event and other information will be less important (though not necessarily irrelevant). Thus, the linguistic intuition is that in an event described by the verb, there will be key participants without which the event would not be complete and other peripheral information that provides descriptors of the general condition or circumstance of the state or event, which are not as central to the meaning of the verb.

2.1 Thematic Relationships

When we invoke our intuitions of which are “necessary” participants in a given state or event described by the verb, generally speaking, we are referencing the semantics side of the issue. For example, take as an example a *giving* event as seen in the following example:

(1) His father gave him a brand new computer last night for succeeding in his studies.

Here, we have five elements or concepts expressed in the sentence: *His father, him, a brand new computer, last night, and for succeeding in his studies.* In such an event as *giving*, there are certain participants that would be considered necessary to make the story complete. We would first require the mention of the entity who gives, the entity who receives, and the object that is transferred between the two entities. That is, intuition would tell us that for a sentence like
in (1) we have three participants, namely *his father*, *him* and *a brand new computer*, each of which plays a central role in the said giving event and are needed by the verb. The other two expressed elements in the sentence, namely the adverbial *last night* and the prepositional phrase *for succeeding in his studies*, provide a general setting for the event of giving.

In the case of the first three elements, the relationships they have with the verb are often referred to as thematic relations. This concept of thematic relations has been well discussed by numerous studies in the linguistics literature (cf. Fillmore, 1968, Jackendoff, 1972, Dowty, 1989). Thematic relations describe the roles these participants play in the event or state created by the verb. In example (1), then, the *father* is the AGENT or GIVER as he takes on the role of the giving entity, *brand new computer* would be the THEME or TRANSFERRED ITEM, and *him* is the RECIPIENT of the brand new computer. Furthermore, these participating roles are considered required or obligatory in such a way that if they were removed from the sentence as in:

(2) ? His father gave.
(3) ? His father gave him.

the semantics of the sentence would be incomplete. For such utterances as in (2) and (3) to be meaningful, the missing participant(s) (i.e. RECIPIENT and THEME for example (2) and THEME for example (3)) would have to be cited elsewhere and recoverable in the context. Thus, these participants are considered to play a direct role in the relational information conveyed by the verb, and therefore, necessary components of the semantics of the verb. Those participants that are in a thematic relationship with the verb are considered to be semantic arguments of the verb.

In contrast to the arguments, the last two elements in example (1) would be considered semantic adjuncts. Unlike arguments, adjuncts do not rely on the relational information conveyed by the verb. Rather they comment on the general action or state of the predicating unit – the verb
and its arguments. The adverbial *last night* and the prepositional phrase *for succeeding in his studies* are present because they comment on the event described by the verb and its arguments. They are there to set up the context in which the event happens regardless of the specific meaning of the verb: the adverbial sets the time in which the *giving* takes place and the prepositional phrase describes causal events leading up to the event, which serve as a motivation for event’s occurrence.

Thus, in general, the elements in the sentence that are in a thematic relationship with the verb, and play a central role in the event or state presented by the verb are considered to be arguments. These arguments are licensed and required by the verb to realize its full meaning. Those elements in the sentence that do not hold a specific relationship to the verb and provide contextual information “typically information about time, location, purpose or a result of an event” (Saeed, 1997) are considered adjuncts. Unlike arguments, the adjuncts do not care about the specific meaning of the verb. Rather, they modify the entire predicating unit.

Consequently, since the adjuncts are not licensed by the verb, they are considered to be applicable to a wider range of events (c.f. Cowper (1992, p.65)). That is, the same adverbial *last night* in (1) would retain a similar descriptive value even when used to describe other events like “Scotty laughed hard at the jokes *last night*” or “Bethany read the poetry beautifully *last night*”. The same could not be said about the arguments. The noun phrase *a brand new computer* only serves as a TRANSFERRED ITEM in the *giving* event. It would take on an entirely different role specified by the verb in the context of other events (consider “The computer was damaged when it fell to the ground” where *computer* is a PATIENT). As Cowper (1992) and Gawron (1988) note, self-evident adverbials like *last night* make a reference to a time and therefore are related to the verb in a specific way. However, one cannot say what thematic relation a noun phrase like *the computer* should hold if it is not in a relationship with a verb.
2.2 Problem of Semantic Intuition

These intuitions about the nature of argumenthood at first glance seems to be fairly straightforward. If these intuitions are indeed sufficient, then it would seem that determining the semantic representation of arguments and adjuncts should be a simple enough task. Consider the following example:

(4) We ate our supper on our balcony.

Intuitively speaking, central to the eating event are two participants: the one who eats and the entity that is eaten. The prepositional phrase provides a general location or setting in which eating takes place. It would be very simple if we could extrapolate from such an example and say that prepositional phrases like on our balcony could always be considered adjuncts as in example (4). However, as we know, this is not always the case. Consider the following example:

(5) I put the book on the table.

The locative prepositional phrase in (4) is distinguished from the same prepositional phrase in example (5), which would generally be recognized as the argument of the verb put as it is the location in which the book is placed, an element without which the semantics of a putting event would not be complete. That is, unlike the adjunct-like prepositional phrase in example (4), on the table in (5) would have to be classified as an argument. Take into consideration a few more examples, with attention to the adverbials used in the sentences:

(6) Scotty laughed hard at the jokes.
(7) Johnny hit the nail hard to drive it into the wood.
(8) Bethany read the poetry beautifully.
(9) Your project was completed quickly, safely, and beautifully.

If indeed adjuncts are characterized by the ability to be applicable to a wider range of events as the literature suggests, it would stand to reason that adverbials such as hard, quickly or beau-
tifully should be judged adjunct-like as they maintain a similar meaning across a variety of situations. For example, hard in (6) describes the intensity by which Scotty laughed at the jokes, just as it describes the intensity of force used by Johnny to drive the nail into the wood in (7). However, the adverb well in (11) stands as a counterexample.

(10) This child reads well.
(11) This book reads well.
(12) This duck eats well.

Here, the adverb well seems to do more than simply comment on the reading event. It has a direct effect on the interpretation of the meaning of the verb. The sentence in (11) could be used to express how gripping the said book is, which cannot be said about the sentence lacking this adverb: This book reads. In fact, the sentence is rendered nonsensical. In this particular usage of read, then, a manner adverbial such as well is a necessary component for completing the intended meaning and thus is considered to behave more like an argument than an adjunct despite our initial intuitions. Moreover, in example (10), it is not clear if the adverb well is behaving like an argument as in (11) or if is an adjunct as in (8) that happens to comment on the manner in which this particular child reads. This is even more evident in example (12), where the sentence could be interpreted to mean that the animal has a good appetite (i.e. adjunct reading) or that the cooked duck is good for eating (i.e. argument reading). Such a decision would likely depend on the correct identification of the reading of the sentence intended by its speaker or writer, which hopefully would be available in the context.

Finally, in certain cases, the distinction seems to depends on the lexical items present in the sentence. Compare the following pairs of sentences in examples (13) and (14), in which each sentence carries a prepositional phrase with locative information:

(13) a. I cooked the chicken on the grill.
    b. I cooked the chicken on the patio. [adapted from (Fillmore, 1994, p.164)]
(14) a. She kissed her mother on the cheek.
    b. She kissed her mother on the platform. (Quirk et al., 1985, p.511)

Fillmore (1994, p.159) would consider the phrases in the (a) sentences to carry “information that fills in details of the internal structure of an event”, which he calls *frame internal* information, while those in the (b) sentences provide “incidental attending circumstances of that event, the frame-external information”\(^1\). This seems to indicate that the reading of the *on*-phrase in the first sentences should lead to an argument-like reading and that in the second sentences should lead to an adjunct-like reading. The appropriate reading depends on whether the the prepositional phrase is viewed as a modifier of the location of the undergoer argument (an argument-like reading) or as a modifier of the location of the agent argument (an adjunct-like reading).

### 2.3 Challenges in NLP

Thus, the NLP community faces with clear semantic challenges when trying to deal with the argument and adjunct distinction. As seen in examples (4) and (5), obviously there is not a single set of rules by which we could say that a certain phrase is an argument or an adjunct, as such a decision would depend on the verb in the sentence. But even if we could delineate verb-specific rules for every verb in the language, we are faced with cases like examples (8)-(12) and (13)-(14) in which the distinction depends on the semantic and syntactic context of the utterances and perhaps even world knowledge that tells us what a normal *reading* event looks like. If we were to hinge our decision on the lexical type and, given examples such as (6) and (8), assume that all adverbials act as adjuncts and are consequently deemed less crucial in the general meaning of the sentence, too much information would be lost for sentences where adverbs behave as arguments like (10) and (11). In the case of (12), if the adverb is ignored only one of the interpretations would be available for the sentence.

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\(^1\) Quirk et al. (1985, p.510-511) makes a similar observation. However, he labels what Fillmore calls frame-internal elements “predication adjuncts” and frame-external elements “sentence adjuncts”
However, the fact that these semantic intuitions are difficult to capture does not negate either the existence or the importance of the semantic intuitions. If indeed arguments and adjuncts participate to different degrees in the state or event of the verb as our semantic intuitions tell us, capturing the distinction in a manner that automatic systems can interpret would get us another step closer to human language understanding. As we have seen in the introduction, there are numerous automatic tasks in NLP that would benefit from a clear distinction between arguments and adjuncts, including tasks like automatic parsing, machine translation, text summarization and text simplification. But in order for such tasks to successfully benefit from the argument/adjunct distinction, the syntactic, lexical, and semantic resources on which these NLP tasks rely have to do an accurate and consistent job in identifying and describing the distinction.

Finally, it is worth to noting that, one of the well known challenges in creating and maintaining NLP resources, especially the creation of labeled corpora, is that annotations are costly. Whether the resource deals with annotating the syntactic structure of a sentence or coming up with a lexical definition for a verb’s subcategorization frame, it is crucially important to maximize the accuracy of annotation while minimizing the costs and time associated with the annotation process is crucial. Establishing clean guidelines for any NLP resource is crucial, as they are the key factor in facilitating quick but consistent decisions in annotating text.

For an illustration of the challenges in creating guidelines, take the English Penn Treebank (ETB; Taylor 1996), as an example. ETB is a syntactic resource that provides the NLP community with manually parsed corpora with phrase structure-like parses, including a wide variety of genres such as written news (e.g. Wall Street Journal), spoken news (e.g. CNN, NBC), and weblogs. The topic of argument and adjunct distinction, as they note, is not a trivial issue. Recognizing the difficulty of argument and adjunct distinction, the ETB creators have chosen not to distinguish arguments and adjuncts at the syntactic level and simply make all post verbal constituents sisters to the verb:
Unfortunately, while it is easy to distinguish arguments and adjuncts in simple cases, it turns out to be very difficult to consistently distinguish these two categories for many verbs in actual contexts. [...] After many attempts to find a reliable test to distinguish between arguments and adjuncts, we abandoned structurally making this difference. Instead we decided to label a small set of clearly distinguishable roles, building upon syntactic distinction only when the semantic intuitions were clear-cut. However, getting annotators to consistently apply even the small set of distinctions discussed here was fairly difficult. (Taylor et al., 2003)

Their solution was to use the label closely related ‘CLR’, instead, which “marks constituents that occupy some middle ground between argument and adjunct of the verb phrase. These roughly correspond to ‘predication adjuncts’, prepositional ditransitives, and some ‘phrasal verbs”’ (Bies et al., 1995). The definition as it stands is somewhat vague and there is no specific indication as to what predication adjuncts, prepositional ditransitives and phrasal verbs actually are. As they note, in practice, even the CLR distinction was difficult to make and it was not always the case that CLRs are used as consistently as perhaps ETB intended².

What we hope to achieve in this paper is to take a look at the arguments made by the linguistic literature on the argument and adjunct distinction and explore the manner in which the distinctions have been handled in the NLP resources. The goal of this paper is not to provide a solution for the argument and adjunct distinction in NLP. Rather, this paper aims to understand why this distinction is such a difficult issue in both the semantic and syntactic community and evaluate the strengths and weakness of the approaches taken by the lexical resources that handle data for automatic systems.

2.4 A Note on Terminology

Before we start unpacking the different definitions of argumenthood, there is a need to clarify some of the terminology that will be used in this paper. So far in this paper, the terms argument and adjunct have been used in the semantic sense of the word (i.e. participants in the predicative

²Gathering from experience, the only place CLR is used consistently is for particles in verb particle constructions.
event or state and modifier of the predicate, respectively). Due to the influences of transformational syntax (e.g. Principles & Parameters (P&P), Minimalist Program (MP)) and its view that semantics can be mapped onto a hierarchical syntactic structure in a systematic and deterministic manner, much of the discussion of argument and adjunct distinction cannot be made without making close reference to the syntactic concept of complements, and core and oblique arguments.

Complements are phrases that are obligatorily selected or subcategorized by the verb. Since objects (both direct and indirect), which are core arguments of the verb, are obligatory in transitive/ditransitive sentences, they are also considered to be complements of the verb. In a similar manner, since oblique arguments (e.g. adverbial phrases) are not required like the core arguments are, they are considered to be syntactic adjuncts (i.e. non-complements) of the verb. Because of this, the term argument has often been referred to by a syntactic ‘counterpart’, complement or core argument, and the term adjunct is sometimes referred to as an oblique argument.

That said, it is a well known that the syntactic complement and adjunct\(^3\) distinction does not line up cleanly with the core and oblique distinction for two reasons: (1) The subject of the sentence is considered a core argument but not a complement and (2) some verbs subcategorize for an oblique as seen in the sentence “He put the book on the table”. While the terms complement and argument are used interchangeably, authors are generally consistent in use of these terms within their respective work.

In this paper, for the sake of brevity, the term argument will be used as a general term to cover both semantic argument and complement as will the term adjunct be the cover term for both semantic and syntactic adjunct. If a specification is necessary, the term complement will be used for syntactic complement and the term modifier will be used for semantic adjunct.

\(^3\)Please note that ‘syntactic adjunct’ here strictly refers to phrases that are not complements of the verb.
3 Dimensions of Distinction

The level of uncertainty discussed in the previous section is reflected in the linguistic literature on how researchers think these arguments and adjuncts should be characterized. While linguists agree that there is indeed a distinction to be made between arguments and adjuncts, the researchers have not yet converged on how to define what it means to be an argument or an adjunct, and how the boundary between the two should be characterized. As writes, “[a]lthough the [argument]/adjunct dichotomy is supposed to play a central role in the Chomskyan version of generative linguistics, there is no generally agreed upon classification of kinds of dependents, nor is there a generally accepted analysis of adjuncts” (Ibid., p.257). Nevertheless, those efforts have been fruitful in gaining a general understanding of some of the characteristics of arguments and adjuncts. Here are a few quotes that reflect varied definitions found in the literature:

Arguments are something that lexical heads have; they are the central participants in the scene that the head presents, and thus in the situations the head is instantiated by. (Gawron, 1988, p.111)

In the traditional literature on parsing, optional phrasal constituents [...] are called adjuncts. (Haegeman, 1991, p.32)

Complements tend to be (though not always) obligatory, whereas Adjuncts are always optional (Radford, 1988, p.263)

Another classic observation involving the do so anaphora is that arguments in VP are closer to the verb than other adjuncts. (Culicover and Jackendoff, 2005, p.128)

Adverbials are the most peripheral elements: (i) their position is most frequently final; (ii) they are usually optional; (iii) they are mostly mobile; and (iv) they do not determine what other elements occur. They may be regarded, from a structural point of view, largely as 'optional extras', which may be added at will, so that it is not possible to give an exact limit to the number of adverbials a clause may contain. (Quirk et al., 1985, p.50)
Varied as they are, the above characterization of arguments and adjuncts display clear themes. We have already seen the first general distinction expressed by Gawron (1988) earlier in this section. It speaks to our semantic understanding of arguments as central participants in the predicate. Secondly, another trend in argument and adjunct distinction seen in the literature, as expressed by Haegeman (1991), Radford (1988) and Quirk et al. (1985), is the notion of obligatoriness and optionality, in which arguments are generally considered obligatory, while adjuncts are considered optional.

A final distinction that is often found in the linguistic literature is one based on the syntactic structure of a sentence. Culicover and Jackendoff (2005) have chosen to use the words closer to the verb to describe the observation that arguments, in English, sit next to the verb and it is rare that other constituents are allowed to intervene between the verb and its argument. Along with the notion of closeness there is also the observation that arguments form a constituent with the verb and they act within the sentence as a single unit. And as we will see in this paper, the free interchange between the terms complement and arguments as seen in Haegeman (1991) and Radford (1988) also speaks to this point.

In this section, we will explore each of the above aspects or dimensions of distinction. We will first begin with the syntactic approaches to argumenthood in 3.1 and discuss the importance of structural and attachment properties of the constituents around the verb for syntactic distinctions. In 3.2, we will take a look at the positions against the use of structural attachment properties as the criteria for argument and adjuncts distinction. In section 3.4, we will return to the semantics side of the issue and discuss the arguments that have been made about the concepts of obligatoriness and optionality. Then we will consider an alternative way of handling the question of argumenthood, which has been proposed by Dowty (2003) in section 3.5.
3 DIMENSIONS OF DISTINCTION

3.1 Structural Distinction

For a discussion of the distinctions proposed by the proponents of the classical or transformational grammar, we will begin with the *do so* test introduced by Lakoff and Ross (1976) for two reasons. The *do so* test is a widely accepted substitution test used to distinguish arguments from adjuncts in linguistic literature appearing in many studies where the topic of argumenthood is discussed. Secondly, it is a very clear and concise illustration of what role the hierarchical syntactic structure has on the distinction of argument and adjuncts. Through the course of this section, we will see that for P&P, MP, and other transformational theories of syntax the argument and adjunct distinction is highly dependent on the structural configuration of the verb phrase.

3.1.1 The *Do So* Test

The test is based on the observation that *do so* serves as an anaphoric substitute to the verb and its arguments (c.f. Culicover and Jackendoff (2005, p.124-127); Cowper (1992, p.31); Quirk et al. (1985, p.81-82)). The following examples illustrate the test:

(15) Robin smokes a pipe after dinner, and Leslie *does so* during breakfast.
    [*does so = smokes a pipe*]
(16) *Robin smokes a pipe after dinner, and Leslie *does so* a cigar during breakfast.
    [*does so = smokes*]
(17) Sue cooked lunch yesterday, and Fred *did so* today. [did so = cooked lunch]
(18) *Sue cooked lunch, and Fred *did so* dinner. [did so = cooked]

The test is that if *do so* cannot refer to the verb without one of its constituents, then that constituent must be an argument. The concept behind this test is that a verb and its arguments form a V’ and the anaphor *do so* must refer to the unit as a whole. For example, in (15) and (17) *do so* is perfectly happy to refer back to the verb and its object. However, when *do so* refers to the verb alone, as in (16) and (18), then the sentence is rendered ungrammatical.

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Example (15) is from Culicover and Jackendoff (2005, p.124), and example (18) is from Cowper (1992, p.31).
Adjuncts, on the other hand, can be included as an antecedent of the *do so* or they can be left out of it (Culicover and Jackendoff (2005); Haegeman (1991)). This can be seen in examples (19) and (20). In fact, the entire VP can be referenced with *do so* as in example (21).

(19) Mary will cook the potatoes for fifteen minutes in the morning, and
Susan will *do so for twenty minutes in the evening.* [do so = cook the potatoes]
(20) Mary will cook the potatoes for fifteen minutes in the morning, and
Susan will *do so in the evening.* [do so = cook the potatoes for fifteen minutes]
(21) Mary will cook the potatoes for fifteen minutes in the morning, and
Susan will *do so too.* [do so = cook the potatoes for fifteen minutes in the morning]
(22) *Mary will cook the potatoes for fifteen minutes in the morning, and
Susan will *do so the vegetables.* [do so = cook]

The *do so* test, thus, tells us the time adverbials *for X minutes* and *in the X* are adjuncts, while the object *the potatoes* must be an argument as the sentence in (22) fails. Here are other examples in which the judgement for argument and adjunct distinction from the *do so* test lines up with our general semantic intuitions we have seen earlier in this paper:

(23) a. *His father gave him a gift, and his mother *did so a card.*
    b. *I put a book on the table, and she *did so on the counter.*
(24) a. We ate our supper on our balcony, and they *did so on their porch.*
    b. Bethany read the poetry beautifully, but Carla *did so quite poorly.*

The test correctly predicts that the phrase in bold (23) is an argument and that the phrase in bold (24) is an adjunct. Before we turn to the studies that have disputed the validity *do so* test, we will quickly touch on the conclusions P&P generally derives from these and other constituency tests.

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5Examples (19) - (21) are from Culicover and Jackendoff (2005, p.124).
3.1.2 Importance of the structural configuration

In the traditional syntactic approaches such as P&P the *do so* test has often been sited as evidence for embedded V’ or VP structure over an alternative flat structure. As Culicover and Jackendoff (2005) writes, syntactic behaviors based on *do so* substitutions seen in examples (19)-(22) lead “to the conclusion that the maximal VP consists of a nested structure of VP’s, along the lines of [(25)]:”

\[(25)\]

```
(\text{VP}^3 \\
(\text{VP}^2 \\
(\text{VP}^1 \\
(\text{V} \quad \text{NP} \\
\text{cook the potatoes} \\
\text{VP}^1 \\
\text{PP}^1 \\
\text{in the morning} \\
\text{VP}^2 \\
\text{PP}^2 \\
\text{for fifteen minutes} \\
\text{VP}^3 \\
\text{cooks the potatoes})
```

*Mary will cook the potatoes for fifteen minutes in the morning.* (cf. (19)-(22))

This agrees with the structures proposed by Cowper (1992) and Haegeman (1991). Haegeman (1991) argues that a flat structure that has “no internal hierarchy between constituents of V [in which] all VP-internal constituents are treated as being on equal footing” (ibid., p.79) can only account for examples like (21), where the *the* *do so* substitutes for the entire VP. However, she argues, such a tree would only “be expected to affect either the top-node VP, i.e. the entire VP […], or each of the VP-internal constituents, that is to say V or NP or PP” (ibid., p79-80). Moreover, it does not provide a proper account for the fact that in examples like (19) and (20) *do so* only substitutes in for a portion of the VP. What would be necessary, Haegman suggests, would be a hierarchical structure with V’ nodes at V and at each of the PP levels, that account for substitution behaviors as seen in the *do so* test. In other words, the complement of the verb will be closer or local to the V (i.e. the argument will take up the complement position), the rest of the non-complements or adjuncts would be sequentially joined to a higher V’ node, where there is one V’ node for each of the adjuncts.
This, then, begs the question of how should syntax know which constituents should occupy the correct position in the trees. The theta grid of the verb holds the necessary mapping that assigns the arguments to the complement positions (c.f. Carnie, 2006, p.223-226; Cowper, 1992, p.65; Haegeman, 1991, p.296-297). It includes theta roles\textsuperscript{6} that the verb selects for. Then through a “predictable” and deterministic association (c.f. Chomsky, 1995, p.30-33; Cowper, 1992, p.64-69), the theta roles are assigned to the complement positions on the tree. Unlike arguments, adjuncts are not contained in the theta grid. Though it is not explicitly expressed in any of the P&P literature examined in this paper, the assumption is that all other constituents are systematically attached to a V’ node which dominates, or eventually dominates depending on the number of adjuncts present, the V’ in which the verb is attached.

Thus, in P&P the prime distinction between the adjunct and argument is in the differences in the position in the tree occupied by the constituents, and ultimately this decision is up to the theta grid that assigns the positions (i.e. nodes sharing the same V’ as the verb).

\subsection{3.1.3 Other distinguishing restrictions and diagnostics}

Aside from the do so diagnostics, there are other tests that are often used to establish argumenthood. Here I present a restrictional diagnostic and two other tests that are based on the differences in structural configuration of the complements and the adjuncts.

\textbf{Ordering restrictions:} Radford (1988, p.235) (also Culicover and Jackendoff, 2005, p.130; Cowper, 1992, p.32) notes that when complements and adjuncts are present, the complements will precede the adjuncts, but the adjuncts are not subjected to ordering restrictions. This can be seen in the following example from Cowper (1992, p.32):

\begin{quote}
Note here that the term \textit{theta} role should be distinguished from the term \textit{thematic role} as used in semantics. Theta roles are thematic relations assigned by the verb to a particular position in the syntax (Cowper, 1992). Unlike semantics, in which an argument can hold more than one thematic role (e.g. the thematic role of \textit{his father} in “His father gave him a gift” verb-specific label such as GIVER but also could be labeled with more of a general label AGENT). In syntax, the Theta Criterion indicates that there only can be one theta role assigned per constituent in a theta grid.
\end{quote}
Constituents inside the V’ that directly dominates the verb are fixed in position. Such restriction is not imposed on the constituents that are outside this V’ and are dominated by the VP. In the examples above, if an adjunct is inserted between the verb and its complement as in (c) and (d), the sentence is ungrammatical. But the two adjuncts *quietly and on Thursday can be rearranged as seen in (a) and (b).

**Ellipsis test:** Radford (1988, p.236) writes that “any phrasal expansion of V (i.e. V’ or VP) can undergo Ellipsis under appropriate discourse conditions so that a V and all its [c]omplements, with or without its [a]djuncts can be ellipsed.” Consider the following examples in (27). For the question asked by SPEAKER A, SPEAKER B could answer with any of the responses (a)-(c). However, (d) and (e) are not allowed. The tree for the full response in (a) is shown in example (28).

(27) SPEAKER A: Who will put the book in my mailbox on Tuesday?
    SPEAKER B: a. John will put the book in your mailbox on Tuesday.
    b. John will put the book in your mailbox on Tuesday.
    c. John will put the book in your mailbox on Tuesday.
    d. *John will put the book in your mailbox on Tuesday.
    e. *John will put the book in your mailbox on Tuesday.

(28) [Diagram of the tree for the full response in (a)]
John will put the book in your mailbox on Tuesday.

Thus, the entire V’ is an all or nothing deal, where if the V is to be ellipsed, its complements have to be as well as seen in examples (a) and (c), and selective ellipsis of the complements as seen in examples (d) and (e) are judged ungrammatical. On the other hand the phrase Tuesday can be included or excluded from the elided phrase, as it is not a part of the V’ to which the V is attached. The ellipsis test, thus, would predict the phrases the book and in your mailbox to be arguments of the verb (i.e. theta grid of the verb put would include these as its role playing arguments) and the temporal PP would be deemed an adjunct.

The advantage to using the ellipsis test over the do so test is that it can be used on stative sentences as well. Because do so anaphora serves as a substitution for durative event types, it fails to test stative and non-durative event like in the sentences in (29). The Ellipsis test correctly predicts what the do so substitution cannot, as seen in (30).

(29) *Robin dislikes Ozzie, but Leslie doesn’t do so.
    ?Robin fell out the window, but Leslie didn’t do so.

(30) Robin dislikes Ozzie, but Leslie doesn’t.
    Robin fell out of the window, but Leslie didn’t.

X-happen test: The X-happen test is also a substitution test, in which, much like the in do so test, the X happen will make anaphoric reference to the previously mentioned V’ or VP. Consider the following example:

(31) Sue cooked lunch yesterday, and it did happen/happened with Fred today.
    Sue cooked lunch yesterday, and Fred did so today.

X-happen can also correctly make prediction for non-action events but unlike the Ellipsis test, it cannot be used with a stative sentence (Culicover and Jackendoff, 2005, p.284-285). Example, X-happen serves as anaphora in (32), but it cannot do so in stative sentences like (32).
(32) Robin fell out of the window, but it didn’t happen with/to Leslie.

Robin fell out the window, but Leslie didn’t do so.

(33) *Robin dislikes Ozzie, but Leslie doesn’t do so.

3.1.4 Summary

Despite the fact that many linguists have recognized that the distinction of argument and adjunct is still vaguely characterized and not yet fully understood, many linguistic theories, especially transformational frameworks have made fairly specific claims about the distinction based on argument and adjunct attachment configurations in a syntactic tree. If arguments based on configuration hold, then the distinction of argument and adjunct is easy: all we have to do is look at the attachment properties of each of the constituents, based on this, we decide if it is an argument or an adjunct. However, sadly, what remains is that the tree must be built based on the theta grid information that contains the necessary subcategorization frames that dictate which constituents are selected by the verb as arguments. Unfortunately, in this, syntactic theories are vague on how this is done. All we know is that this decision lies in the semantics of the verb.

Furthermore, as seen, all of the tests seen above and other diagnostic tests not covered in this section are based on the assumption that the syntactic configuration has much to say about the distinction. And in display of circular reasoning, these very tests have been used as evidence for the said configurational differences between arguments and adjuncts. These assumptions, as we will see in the next section are problematic.

3.2 Where Structural Argumentation Fails

As a quick reminder, the do so diagnostic claims that V’ dominating the verb is an all-or-nothing unit – the anaphor do so acts on the whole V’ (e.g. (34)), and the ordering restriction states that the argument must be realized closer to the verb, before the adjunct (e.g. (35)). Moreover, since do so is a substitution test, it will replace the V’ or the VP iteratively(e.g. (36)).

(34) Emily ate a burger on Thursday, and John did so on Friday.
3 DIMENSIONS OF DISTINCTION

*Emily ate a burger on Thursday, and John did so a pizza on Friday.

(35) Emily ate [a burger] [on Thursday].
*Emily ate [on Thursday] [a burger].

(36) Emily ate a burger slowly on Thursday,
... but Emily did so quickly on Friday. [did so = ate a burger]
... and Emily did so on Friday. [did so = ate a burger slowly]
... and John did so too. [did so = ate a burger slowly on Thursday]

3.2.1 Culicover and Jackendoff (2005)

As a counter to these claims, Culicover and Jackendoff (2005) point out that the antecedent of do so “is not necessarily a continuous portion of another sentence” (ibid, p125), where the do so can refer to a span of constituents that are contiguous as in (37) but also noncontiguous as in (38). In addition this, they also note that the anaphor can make access to portions of the VP that could not possibly constitute a single constituent within the P&P framework (Culicover and Jackendoff, 2005, p.126-127).

(37) Robin slept for twelve hours in the bunkbed, and Leslie did so on the futon.
[do so = slept for twelve hours]

(38) Robin slept for twelve hours in the bunkbed, and Leslie did so for eight hours.
[do so = slept ... on the bunkbed]

(39) Robin broke the window with a hammer, Mary did [it/the same thing/etc] to the table top. [do so/did it = broke ... with a hammer]

(40) Robin proved to George that Mary would win the race, and Bill did [it/the same thing/etc] regarding Susan. [do so/did it = proved to George that ... would win the race]

If indeed do so makes anaphoric reference to a complete V’ at a time, the sentences (38), (39) and (40) should not be grammatically feasible. In the case of (39), it is not only the case that the do so is accessing noncontiguous portions of the VP, but also it is leaving out the object the window,

See Culicover and Jackendoff (2005, p.126-127) for a discussion on how anaphoras such as do it and do the same thing act like do so in standing in for a subportion of a VP.
and therefore, a complement from reference. In the case of (40), the *do so* is substituting for far more than a single verb and its arguments – it is making reference to both arguments and adjuncts of two different verbs. What’s more, the constituent “left out” of the substitution, which by the *do so* test should be an adjunct, is the argument of the embedded predicate *win*. Thus, *do so* cannot consistently substitute for the verb plus its arguments in a previous sentence (Ibid, p.127), and it is not always the case that the adjuncts will be those that can be successfully “left out” from the substitution. In other words, the *do so* test fails to distinguish arguments from the adjuncts.

3.2.2 Przepiorkowski (1999)

A similar argument is made by Przepiorkowski (1999). Citing Miller (1992) he argues that *do so* does not have to refer to the meaning of the entire maximal V’/VP node that contains the verb and its arguments. In each of the cited examples below, Przepiorkowski points out that *did so* refers to the meaning of the verb and not the V’/VP.

(41) a. John spoke to Mary, and Peter *did so* to Ann. [*did so* = spoke]
    b. John spoke to Mary, and Peter *did so* with Ann. [*did so* = spoke]
    c. John kicked Mary, and Peter *did so* to Ann. [*did so* = kicked]

The semantic analysis tells us that the phrase *to Anne* in (a) is the GOAL of the verb *speak*, a verb that directly participates in the event of speaking. Consequently, dropping this argument (i.e. *John spoke*) would alter the meaning of the utterance. On the other hand, the *do so test* incorrectly assesses the phrase *to Anne* in example (41) (a) as an adjunct. A similar problem with the *do so test* is seen in examples (b) and (c) as well where *with Ann* is the GOAL and *to Ann* is the PATIENT, respectively.

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8When eliciting acceptability judgement from a native English speaker for the example (41), the speaker pointed out that the sentence (c) held a second reading for him, namely “Peter kicked Mary to Ann” along with the intended reading of “Peter kicked Ann”. Of course, this second reading would only be likely if Mary were the name of
Przepiorkowski (1999, p.290) framing Miller (1992, p.96)’s position argues that “acceptability of a PP complement do so […] is not whether or not the corresponding complement of the antecedent verb is within the VP of the antecedent, but whether or not the PP complement is acceptable as a complement for the main verb do with a thematic role compatible with that which the corresponding complement of the antecedent verb has with respect to the antecedent verb” (Miller, 1992, p.96). In other words, if the PP complement after do so is thematically the same as the PP complement in a sentence where the antecedent verb sits, then the sentence should also be acceptable. Consequently, the following sentences in which the PP complement that follows the do so has a different thematic role than the one accompanying the antecedent, the sentences are judged unacceptable as seen in example (42):

(42) a. John spoke to [Mary]-GOAL, and Peter did so [for Ann]-BENEFACTIVE.
    b. John kicked [Mary]-PATIENT, and Peter did so [for Ann]-BENEFACTIVE.

Przepiorkowski (1999) further argues that not only is the do so substitution test not evidence for the syntactic complementation of a verb but also that the do so test “cannot say anything about the configurational difference between complements and adjuncts” (ibid.,308). His argument is hinged on the re-classification of do so anaphora as deep anaphora.

Do so anaphora had been classified as surface anaphora by Hankamer and Sag (1976)\(^9\). Surface anaphora are syntactically controlled as seen in example (43), which “requires a coherent syntactic antecedent in surface structure and [...] behaves as a purely superficial syntactic process” (Hankamer and Sag, 1976, p.392). This is distinguished from deep or deictic anaphora that are pragmatically controlled as seen in (44). They have “other properties indicating that anaphoric relation is determined at essentially a presyntactic level” (Ibid, p.392).

\(^9\)For a detailed description, discussion, and analysis of surface and deep anaphora and the classification do so as surface anaphora, see Hankamer and Sag (1976) and Section 7.2 in Przepiorkowski (1999)
(43) a. Sue introduced me to *her* mother.
   b. Anyone who eats that will lose *his* hair.

(44) a. *Her* hands are trembling.
   b. He’s saying that your hair will fall out.

In other words, surface anaphora in (43) will find the antecedent of the pronoun within the surface level of the syntactic structure, while the deep anaphoras of (44) make deictic reference is encoded at a pragmatic level (before syntactic expression) in such a way that the exclamation (a) in example (45) would be possible. Note that in both (a) and (b) in (45), the intended reference for italicized anaphors is Sag’s feat of strength witnessed by Hankamer.

(45) Observing Sag successfully ripping a whole book in half,
   a. Hankamer exclaims, “I don’t believe *it*!”
   b. Hankamer exclaims, *“I don’t believe *so*!”*

However, the *so* in (b), a surface anaphor and an anaphor that Hankamer and Sag (1976) relates to the *do so*, cannot do the same.

Przepiorkowski (1999) notes that because of the requirement that the antecedent should be accessible at the surface syntactic level, the shape of the syntactic structure of the antecedent must parallel the anaphor’s structure, thereby allowing for the use of the anaphor in a syntactic substitution test for complementation (Ibid., p.280-282). And as a surface anaphor, *do so* should not make reference to syntactic units that are distinct in configuration. However, Przepiorkowski (1999) finds a wealth of counter examples in corpus data (Ibid, section 7.3.2). Following are selected examples of the types of unparallelism found in the data. The antecedents are underlined. In each of these examples, there is a syntactic mismatch between the antecedent and the *do so*. For example, the antecedent is a passive in (46), while the *do so* is not.

(46) [Passive Antecedent:] Certainly external forces should not be applied arbitrarily out of mere power available to *do so*. [*do so* = apply external forces]
3 DIMENSIONS OF DISTINCTION

(47) [Nominal Antecedent:] Its cord was useless in effect, so I’d no trouble in its removal, on 
    doing so I was dumfounded by its unexpected contents. \([\text{doing so} = \text{removing its cord}]\)

(48) [Gapped Antecedent:] My current indexer/browser programs assume that the free-text 
    database is a single file. That assumption is straightforward to lift \([\_\_]\), and I plan \(do\ so\) 
    soon. \([\text{do so} = \text{lift the assumptions}]\)

Przepiorkowski (1999)’s argument is that the analysis of the \(do\ so\) test, thus, has to be prag-
    matically controlled. That is, the anaphor would have be re-analyzed as a deep anaphor\(^{10}\). Such 
    being the case, the argument that configurational difference as judged by the \(do\ so\) test can be the 
    criteria for argument and adjunct distinction cannot hold as ““[t]he relevance of this test could be 
    maintained only if \(do\ so\) were treated as a case of surface anaphora in the sense of Hankamer and 
    Sag (1976)” (Ibid, p.308)\(^{11}\)

3.3 Distinction is Semantic

The eventual conclusion that both Culicover and Jackendoff (2005) and Przepiorkowski (1999) 
    arrive at is that the distinction between arguments and adjuncts belongs to the semantic, and not 
    syntactic, level of analysis. Przepiorkowski (1999) suggests that in Head-Driven Phrase Structure 
    Grammar\(^{12}\) all adjuncts should be treated as arguments and therefore be included in the argument 
    structure (ARG-ST feature). The ARG-ST feature in the lexical entry of the verb specifies the 
    arguments of the verb. Through an adjunct-addition lexical rule, the lexical item would gain the 
    adjuncts that appear in the sentence\(^{13}\). In a similar manner, Culicover and Jackendoff (2005) 
    advocate for a flat structure for a verb, its arguments, and its adjuncts, which puts arguments

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\(^{10}\)For a detailed reanalysis of \(to\ do\) as a deep or deictic anaphor, see Przepiorkowski (1999) Section 7.3.3.

\(^{11}\)This analysis is relates directly back to the Culicover and Jackendoff (2005)’s observation that \(do\ so\) and \(do\ it\) 
    are interchangeable in the \(do\ so\) substitution test. Following through the argument made for the definition of deep 
    anaphora by Hankamer and Sag (1976), \(do\ it\) would qualify as a deep anaphor.

\(^{12}\)Head-Driven Phrase Structure Grammar (HPSG) is a lexically driven constraint-based generative grammar. 
    See Pollard and Sag (1994) for an introduction to the formalism.

\(^{13}\)For the full development and use of the adjunct-addition lexical rule and other related features that feed into the 
    addition of adjuncts to the ARG-ST, see Chapter 9 of Przepiorkowski (1999)
and adjuncts on the same footing in their syntactic formalism (see Ibid, Chapter 5 and 6). It is at the Conceptual Structure, which contains semantic, aspectual, referential, and functional information that the distinction between arguments and modifiers of the verb is made. That is, both views argue against the structural distinction of argumenthood; rather they propose that the distinction should be made at the semantic layer of description. Thus in the following section, we will return to the semantics side of the issue and look at the distinctions made based on the concepts of obligatoriness and optionality.

3.4 Obligatoriness, Optionality, and Specificity

When considering arguments and adjuncts, the general tendency is to associate obligatoriness with arguments and optionality with adjuncts. This follows from the notion, discussed in section 2.1, that argument labels are given to the participants in a verb’s event or state and adjunct labels are given to the ‘extra’ information that provide settings to the verb. However, the issue is complicated by the fact that it is not the case that all participants that are involved in an event or a state are always expressed in all possible sentences nor should it be that all participants involved should be expressed in all sentences.

3.4.1 Distinction Amongst Arguments

Jackendoff (2002) makes a distinction between the semantically obligatory/optional and the syntactically optional:

It is often said that eat “licenses an optional argument”. However this conflates semantic and syntactic argument structure. The character being eaten is part of one’s understanding, whether it is expressed or not. This becomes clearer by comparison with the verb swallow. Its syntactic behavior is identical to that of eat [...]. But although one cannot eat without eating something, one can swallow without swallowing anything. That is, swallow differs from eat in that its second semantic argument is optional. [...] More generally, we need at least to be able to say how many semantic arguments a verb licenses, and which of them are obligatorily expressed. (Ibid., p.134)

Here, Jackendoff draws a clear distinction between what is optional in the semantic sense from the
syntactic sense of optionality. This discussion is further developed in Culicover and Jackendoff (2005, p.174-176). The distinction made is this: if a participant is implied in the semantics of the verb, then the participant is semantically obligatory for the verb. Otherwise, it is semantically optional for the verb. These definitions hold independently of the syntactic expression. Consider the following examples:

(49) a. He swallowed/ate (the food).
   b. He swallowed, but he didn’t swallow anything.
   c. *He ate, but he didn’t eat anything.
(50) a. He kicked/ threw the pumpkin (down the stairs).
   b. He kicked the pumpkin, but it didn’t move at all.
   c. *He threw the pumpkin, but it didn’t move at all.

According to the above definition, in example (49), since INGESTED ITEM is implied in the semantics of the verb eat as tested in example (c), this participant is semantically obligatory for eat. In the same way, in example (50), the PATH OF MOTION is implied in the meaning of the verb throw; it is considered a semantically obligatory argument of throw. In contrast to eat and throw, the thing swallowed for swallow and the path of motion for kick are not implied by the verbs’ meanings, and therefore these arguments are considered semantically optional for the respective verbs. Whether or not the argument is syntactically expressed does not change the labels. In fact, semantically obligatory arguments that are not explicitly expressed in the syntax, Culicover and Jackendoff (2005) term implicit arguments (Ibid., p.175).14

14 As a way of simplification, a sense distinction analysis for the verb swallow could potentially be suggested. Consider the following example:

Context: A man takes a sip of his coffee.
*He swallowed, but he didn’t swallow anything.

Instead of positing that swallow has an optional argument and is therefore different from the verb eat, it could be considered to have two senses: one of which is synonymous to eat in that it takes a obligatory argument (whether or not it is realized) and the other, referring to the physical act of going through the motion of swallowing without ingesting something. Example (b) in the sentence (49), then, would be an exemplar of the latter sense. The above example is an example of the former sense.
3.4.2 Distinction Amongst Obliques

In Culicover and Jackendoff (2005), the terms obligatoriness and optionality refer to the distinctions made within arguments. For Koenig et al. (2003), as we will see, the terms refer to the different adjuncts. These are not incompatible arguments, as we will see in the following section. Rather, they represent differing cuts at the description, which are based on differing perspectives from which the issue is examined.

In section 2.1, it was discussed that if a constituent is entailed by the event or state described by the verb, then that constituent is considered an argument. By this definition, the non participants would be classified as adjuncts. At first blush, this definition sounds reasonable – it generally does a good job in describing the observations we have made concerning thematic relations. However, Koenig et al. (2003) brings up a problematic issue with this style of definition, namely, the classification of obliques. Here is a reformulation of the definition for argument by (Koenig et al., 2003, p.72):

**Semantic Obligatoriness Criterion (SOC):** If \( r \) is an argument participant role of predicate \( P \), then any situation that \( P \) felicitously describes includes the referent of the filler of \( r \).

Thus by Koenig et al. (2003)’s account, the SOC is the criterion by which an argument is recognized from a set of constituents around the verb. However it is insufficient, as they note that if SOC holds, then the italicized obliques in the following sentence would have to also be considered as arguments:

(51) Marc knits in his office during lunch.

They write, that SOC is too inclusive of what constituents it “lets in” as an argument. This definition as it stands would include ones that should be classified as adjuncts.

If you knit, you must knit somewhere; in other words, any situation described by the predicate corresponding to the English word *knit* includes a location in which the event
occurred. [...] Again, if the SOC were the sole determinant of argumenthood, the denotations of time expressions such as during lunch would qualify as semantic arguments, a conclusion contradicting most linguists’ intuitions. (Ibid., p.72)

The problem is that most conceivable events or states have to be located in a certain space and in a certain time time (Koenig et al., 2003, p.73). These semantic components that describe location, time, and beneficiaries, which Fillmore (1994) calls circumstantials, are entailed in just about any situation. Thus, to stop the SOC from overgeneralizing, Koenig et al. (2003) suggest that a second definition criterion related to the specificity of the verb should be introduced:

Semantic Specificity Criterion (SSC): If \( r \) is an argument participant role of predicate \( P \) denoted by verb \( V \), then \( r \) is specific to \( V \) and a restricted class of verb/events.

SSC forces the choice of argument to be specific to the verb. That is, SSC considers a participant role (as determined by the SOC) as an argument only if the role is asked to “bear additional properties aside from those which are characteristic of the role” (Ibid., p.73). Take the following sentences, as example, paying special attention to the the object or the THEME of the verb:

(52) Marc sang a song yesterday.
(53) Marc wrote a song yesterday.

By the SOC, we recognize that a song plays a role in both verbs (i.e. THEME in both cases). By the SSC we recognize that a song for the specific verb sing additionally takes on a unique property that is not present in a song participating in the writing event, namely a quality that requires vocal folds. In a similar manner, the song in (53) takes on a unique property that is not present in (52), namely the written quality of the song. To say it in another way, SSC capitalizes on the fact that verbs (or certain classes of verbs) semantically ‘color’ their arguments slightly differently, and these roles that take on a different ‘color’ of meaning would be considered by SSC to be an argument. As to the adverbial yesterday, the claim is that the meaning is held constant across two or more verbs (or classes of verbs), and therefore it must be an adjunct. That is, the adverbial passes the SOC, but fails the SSC.
What is not discussed in Koenig et al. (2003) are examples of cases in which it is either difficult to detect the “additional properties” the argument bears above and beyond the regular participant roles. Here is an example in which the extra semantic coloring of the argument is not as evident:

(54) Marc put the apple on the porch.
(55) Marc ate the apple on the porch.

Our semantic intuitions tells us that the oblique in (54) is an argument while the oblique in (55) is an adjunct. In order to correctly classify the locative PP in (54), according to the SSC, it would have to hold a meaning that is slightly different from that in (55). It would be up to each reader’s judgement to decide if it passes the SSC test; however, the semantic distinction for such locatives is slight at most and difficult to make. This is true not only for locatives, but also for roles such as goals, directionals, and benefactives. The question we ask here is if there is a reliable way of testing if a given constituent holds additional semantic meaning that would classify it as an argument. In the rest of the paper, which is not discussed here, Koenig et al. (2003) present linguistic judgement studies where the SSC is put to test. Given the studies, it seems reasonable that such cases would have been addressed. However, they are not explicitly discussed.

3.4.3 Comparing (Culicover and Jackendoff, 2005) and (Koenig et al., 2003)

In Culicover and Jackendoff (2005), obligatoriness and optionality were dimensions of distinctions amongst the constituents already classified as arguments. That is, obligatory arguments were distinguished from optional arguments, but they were both arguments nonetheless. Here in Koenig et al. (2003), they are seeking to establish a clearer definition for arguments in such a way that amongst obliques it allows as arguments only those obliques that coincide with our intuition of argumenthood.

As noted above, these distinctions are not incompatible. In the general linguistic literature,
there is a systematic ambiguity as to how the terms *obligatory* and *optional* are used. The first approach to defining obligatory or optionality is to note that amongst arguments there are those that are obligatory for the completion of the predicate’s event or state, and those that comment on the setting of said event or state. Here is a graphical illustration:

<table>
<thead>
<tr>
<th>obligatory</th>
<th>optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>arguments/complement</td>
<td>adjuncts</td>
</tr>
<tr>
<td>semantically obligatory</td>
<td>semantically optional</td>
</tr>
</tbody>
</table>

This analysis is consistent with Culicover and Jackendoff’s (2005) view. A subdistinction is made within the subcategorized constituents into those that are semantically obligatory and semantically optional. The last box in the third row is blank as all adjuncts are considered to be optional.

The second cut can be made through the syntactic core-oblique argument layer. When the cut is made through this layer, then semantic obligatoriness spans over both core and oblique arguments since either can be a potential semantic participant in the verb’s event or state. Optionality spans only over the oblique arguments. Here is a graphical illustration of the overlap between what is semantically obligatory/optional and what is core/oblique. The bottom left slot is empty because all core arguments subcategorized by the verb are considered to be obligatory.

<table>
<thead>
<tr>
<th>obligatory</th>
<th>optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>core arguments</td>
<td>oblique arguments</td>
</tr>
</tbody>
</table>

The distinctions presented by Koenig et al. (2003) are better represented by this analysis. In their case, the focus was on correctly separating the argument obliques from adjunct obliques so that the obliques that provide setting or circumstantial information about the predicate, such as those in (51) repeated in (56), would be classified as adjuncts.

(56) Marc knits in his office during lunch.
Thus, Koenig et al. (2003) and Culicover and Jackendoff (2005) differ, but not incompatibly so, in their use of the terminology of obligatoriness based on the differing approaches the two studies have taken. What remains the same in both cases is that they see the distinction not as a simple dichotomy between arguments and adjuncts coinciding with obligatoriness and optionality, but rather something more complex than that.

3.4.4 Summary

The concept of obligatoriness and optionality have been often cited as criteria for argument and adjunct distinction, but what exactly these terms mean somewhat differs from one analysis to another. In the case of Jackendoff (2002) and Culicover and Jackendoff (2005), we start off with the arguments, and the distinction based on optionality is a criterion by which we decide whether or not an argument was latent in the meaning of the verb. In case of (Koenig et al., 2003), obligatoriness and specificity become criterions by which we can properly classify obliques as arguments.

Then the question is, what does this buy us in terms of defining the line between argument and adjuncts for NLP? Culicover and Jackendoff (2005) would suggest that there is a further distinction to be made within arguments. The task now is not simply focused on distinguishing arguments from adjuncts, but also optional arguments from adjuncts. And according to this account, since whether or not the argument is syntactically expressed does not affect the semantic obligatory/optional status of the argument, the task is now far less quantifiable and context dependent than running sentences through a set of tests or heuristics like the constituency diagnostics discussed in section 3.1. Even if we could simplify some of Culicover and Jackendoff’s (2005) distinctions by positing sense differences as seen for the verb *swallow*, we are still left with the differences in *kick* and *throw* to consider.

As for (Koenig et al., 2003), the distinction is slightly simpler in that they suggest a way of correctly labeling the appropriate obliques as arguments rather than adjuncts as in *on the porch*
in *Marc put the apple on the porch*. However, as discussed, identifying the extra properties that the arguments bear in contrast with adjuncts of similar form and role comes down to subjective judgements. Some distinctions are so slight that without world knowledge, we have no distinction to make. In such a case, reliable definitions and guidelines for the distinction would be highly challenging, making the task of argument and adjunct distinction not only difficult for humans but infinitely more so for automatic NLP systems.

### 3.5 Dowty (2003)

So far we have operated under the assumption that, despite the disagreement on where the distinction should be made, there is a distinction to be made. More specifically, we have examined studies that try to identify semantic and syntactic criteria by which we can say that certain constituents are arguments and certain others are adjuncts. But what would happen if we posit there is no dividing line between arguments and adjuncts? That is, even if there are decidedly “argument-y” things and “adjunct-y” things in a sentence as our intuitions seem to suggest, clear argument and adjunct categories might not exist.

Dowty (2003) suggests that viewing the argument-adjunct issue as a case of clear dichotomy may not be the right analysis. He argues that most distinctions that syntax and semantics have tried to draw between arguments and adjuncts have failed precisely because there is no single clean line that can be drawn between what is the argument-like constituent and an adjunct-like constituent. His proposal on the problem of argumenthood is that of a dual analysis, where any given constituent of the VP is able to be analyzed as being potentially an adjunct as a means of deriving an argument analysis. As a point of illustration, Dowty (2003) does a short case study on the preposition *to* (Ibid., p.8-11). Consider the following examples:

(57) Mary kicked the ball *to the fence*.
(58) Mary explained the memo *to John*. 
What Dowty seeks to claim is that there is a semantic similarity between the two prepositional phrases headed by to: they both indicate a physical or abstract location at which something arrived as a result of the action of the predicate. However, the two phrases are also different. In example (57), the PP headed by to expresses the new location at which the object arrives at as a result of the action. This is distinguished from the to phrase in (58), whose meaning is less compositional and more argument-like as the dative phrase in (57). For example, (58) “does not mean that memo itself came to be at/near John, but only that the information contained in the memo came to be more fully understood by John, as a result of Mary’s explanation” (Ibid., 9).

Dowty (2003) points out the usual analyses for these examples would be either (1) to recognize the semantic similarity between the two PPs and assign the thematic label GOALS to both of the phrases, or (2) to recognize the differences in semantic expressivity by assigning a different semantic representation for each argument-like or adjunct-like uses of the preposition to. The problem with these approaches, as he writes, is that former thematic analysis makes no the distinction between the uses and latter approach commits the error of not being able to generalize that the two usages are related. Thus, the dual analysis view, which Dowty proposes, remedies both issues by positing, first, an adjunct analysis for both expressions to serve as a launching point for secondary, argument, analysis:

The idea behind the dual analysis view can be thought of [...] as the claim that the locative adjunct analysis of all occurrences of to, from and other locative prepositions is a PRELIMINARY ANALYSIS which serve language-learners\(^\text{15}\) as a semantic “hint” or “crutch” to figuring out the idiosyncratic correct meaning of the complement analysis for the non-locative instance: a preliminary adjunct analysis of the to-PP (as locative) [(57)] gives way to a complement analysis of to-PP structure as in [(58)]. (Ibid., 10)

\(^{15}\)Dowty (2003) has a small section devoted to the implications of the dual analysis view, and how it is cognitively a more feasible explanation for language learners who are picking up the argument and adjunct distinction. He notes that if learners first access the adjunct analysis and use it as a clue to learning the argument analysis, the learning burden would be softened. This is an interesting argument as a basis of his views, but there is only one small paragraph expanding on this claim, so there isn’t much more that could be said about it.
Dowty (2003)’s claim is that “virtually all complements have a dual analysis as adjuncts” and any adjunct can potentially be reanalyzed as a complement (Ibid., 12). Thus, according to his analysis, what makes up the quality of arguments and adjuncts lies in their placement along a directed continuum; every VP constituent other than the verb goes through an adjunct analysis before it can get to the argument one. While it’s unclear from the text when exactly it is that adjuncts would also be analyzed as arguments, at least in this way both argument and adjunct analyses should be available for any given sentence.

3.6 Summary

Thus far, we have explored in this paper the difficulties in coming up with clearcut distinctions between arguments and adjuncts in linguistics literature. Syntax offers us tangible set of structures that lend to easier quantification of the distinction through constituency tests, which ideally would provide us with clear guidelines for annotated resources and easier extraction of features for the use of automatic systems. However, as we have seen, syntactic tests of VP constituency that are the basis for most of the tests for complementhood are not without exceptions – even the widely favored do so test has been argued to sometimes fail at distinguishing arguments from adjuncts. As Culicover and Jackendoff (2005) and Przepiorkowski (1999) argue, the distinction should be made at the level of semantic description.

However, the distinctions based on the semantic representation is in some ways even more difficult to pin down. The main problem behind a strict casting of the distinction between argument and adjunct as a task of semantic distinction is that much of how we determine the argumenthood of a constituent in a sentence becomes largely dependent on educated intuitions and our understanding of how the world “works” (i.e. what is realistically possible or impossible). Our native judgement of what “feels” like a participant or not could be easily swayed by certain lexical items, by the context of the utterance, or simply by how far we are willing to bend our reality for a feasible reading. As it would seem, our judgement of what should be more “neces-
sary” to an event is vague at best, consequently there is not one complete set of features we can list about arguments (or adjuncts) that would suffice for all possible arguments (or adjuncts) in English. Intuitions and acceptability judgements are difficult to put in quantifiable terms, which is necessary for the benefit of automatic systems. Moreover, while the discussions in the literature on using the semantic concepts of obligatory and optionality as a way of distinction are linguistically informative, it does not provide NLP with more useful clues for discriminating arguments or adjuncts. If anything, it suggests that the story of argument and adjunct distinction is more complicated than we would have initially supposed. Dowty (2003)’s dual analysis view offers a more flexible way of looking at the argument and adjunct distinction; however, it too recognizes that the distinction is difficult to pinpoint since both argument and adjunct analyses are available for an utterance for any given verb.

4 NLP Resources

In essence, all of the observations made and views proposed by the linguistics literature on the argument and adjunct distinction show that there is some degree of argument/adjunct distinction to be made, but it is seemingly without a clear solution. From a linguistic perspective this is not problematic since it provides ample room for discussion and continuous evaluation of existing theories. However, the same cannot be said for NLP. NLP has to be able to say something definite about the argument and adjunct distinction, since machines have no intuitions to rely on.

In this section we will take a look at three NLP resources and the way they deal with the argument/adjunct distinction. First we will take a look at COMLEX Syntax as an example of a resource that relies on a pre-established set of syntactic and semantic criteria for the argument and adjunct distinction. Then we will turn to a more verb or event specific way of framing argumenthood by looking at how PropBank and FrameNet handle the distinction.
4.1 Distinction Based on Enumerated Criteria

Meyers et al. (1994) present their work on annotation of data with argument/adjunct labels as used in COMLEX Syntax. The authors report on criteria and conditions from the linguistic theories that can be used to distinguish an argument from an adjunct and an adjunct from an argument. With these sets of conditions and other linguistic tests, they show that lexicographers can be trained to consistently distinguish an argument from an adjunct.

4.1.1 COMLEX Syntax

COMLEX Syntax is a lexical resource developed by hand at New York University and distributed by the Linguistic Data Consortium (Grishman et al., 1994; Macleod et al., 1998a). The aim of COMLEX Syntax is to provide the NLP community a comprehensive dictionary of English words, marked up in a consistent manner for the use of machine learning systems. Their intent was to keep the lexical resource as theory neutral as possible in order to facilitate the use of the resource for many different types of tasks in NLP.

Each entry in COMLEX contains syntactic information including syntactic features and the word’s part of speech. With the exception of adverbs, the lexical entry also includes all of the possible complement structure in which the word participates. Here is an example of a verb entry:

(verb :orth "remark" :subc ((pp-that-s :pvall ("to")) (s) (pp :pval ("on" "about")) (that-s) (p-wh-s :pval ("on" "about"))) :features ((vsay)))

An entry begins with the part of speech of the word. The verb entry as seen above specifies the word remark under orthography (:orth), the subcategorization frame of the verb (:subc) and the syntactic features associated with the verb (:features). The subcategorization here specifies that the verb remark can occur in five distinct syntactic frames; it can occur in conjunction with pp-that-s – a PP followed by a complement clause led by that (e.g. They remarked to the authorities that they had entered illegally.), s – a sentential complement (e.g. They remarked he
was always late), *that*-s – complement clause lead by that by *on* or *about* (e.g. *They remarked that he was always late.*), and *pp* – a prepositional phrase headed by *on* or *about* (e.g. *They remarked on the boy’s improvement.*) (Macleod et al., 1998b, p.36). The syntactic feature *vsay*, in this example, specifies that the verb can occur with a direct quotation as its complement as in “he said ‘good for him’.” (Macleod et al., 1998b, p.36).

In this manner, COMLEX Syntax has compiled a resource containing entries for approximately 39,500 words including verbs, nouns, adjectives and adverbs.

### 4.1.2 Meyers et al. (1994)

Because COMLEX Syntax needs for the lexical entries of the verbs to reflect an accurate list of complements, Meyers et al. (1994) presents the set of criteria they employed to distinguish a verb’s complements from its adjuncts. This is an important aspect of the resource as it is often used in automatic parsers to prune out unlikely parses based on the representations of predicate argument structure available in the lexical entries of verbs. As Meyers et al. (1994) note, if complements are mistakenly classified as adjuncts, the parser would miss a parse; conversely, if the adjuncts are mistakenly classified as complements, the parser would produce a spurious parse (Ibid., p.2). COMLEX Syntax’s solution to the issue of argument/adjunct is to define a set of very specific rules that distinguish one from the other. Specifically Meyers et al. (1994) break down these rules into two sets of criteria for identifying complements: (1) criteria used to recognize constituents as arguments and (2) criteria used to recognize constituents as adjuncts.

**Criteria for Complement-hood** In the first set, Meyers et al. (1994) identify “testable criteria for complement-hood” (Ibid., p.3) that group into two subsets: *sufficient criteria* and *rules of thumb*. In the case of *sufficient criteria*, they seek to define a set of criteria, each of which is recognized as sufficient conditions for a complement (Ibid., p.3). Following is the list of sufficient criteria:
The rules of thumb, unlike sufficient criteria, provide general suggestive guidelines to help the annotators establish complement-hood of a constituent. This is the list of Meyers et al. (1994)’s rules of thumb for complement identification:

**Rules of Thumb**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>XP occurs with a verb V with high relative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Complements</td>
<td>NPs, PPs headed by “to”, clauses (other than relatives, “whether” and “if”).</td>
</tr>
<tr>
<td>Complement Alternations</td>
<td>XPs which participate in dative, spray/load or other are usually complements.</td>
</tr>
<tr>
<td>Linear Order</td>
<td>An XP between head and a complement is probably a complement.</td>
</tr>
</tbody>
</table>

For the most part the authors do not include examples or specific descriptions for each of these rules. What is noted, however, is that these rules have exceptions (Ibid., p.5), and the extent to which they were referenced for the complement-adjunct distinction varied from one annotator to another (Ibid., p.3)\(^{16}\). Thus, we will return to a discussion on sufficient criteria as seen above.

Some of the sufficient criteria are based on prototypical syntactic and semantic observations about complements’ characteristics as seen in section 3. For example, criterion for obligatoriness tests for the ungrammaticality of a sentence when the a complement is dropped (e.g. *Mary felled the tree.) vs *Mary felled.) and passive criterion judges the constituent to be a complement if it can appear in the subject position in a passive sentence (e.g. *The pudding is a complement in...

\(^{16}\)Meyers et al. (1994) also presents a fifth rule of thumb: Island Constraints defined as “Most complements can violate island constraints” (Ibid., p.3). Only note there is on this criterion is that it “was included mainly for historical reasons [...]" although it did not prove to be sufficiently consistent for the task” (Ibid., p.5).
Mary ate [the pudding] since it is the subject of the the passive form *The pudding was eaten*.

Moreover, the *implied meaning* criterion reflects the observations by Culicover and Jackendoff (2005) seen in section 3.4, in which certain arguments are semantically required by the verb. This criterion states that if the constituent is included in the semantics of the verb, then it is considered a complement as seen in the following example:

(59) a. John ate *something*.
    b. John ate.
    c. John ate *slowly*.

That is, as seen before in section 3.4 a verb like *eat* includes the *ingested item* in its semantics while an adverbial such as *slowly* would not be implied.

The *selected restriction* criterion reflects Koenig et al. (2003)’s specificity criterion (SSC), which summarizes the idea that the verb imposes additional semantic properties on its arguments. For example, we saw the distinction between *singing a song* and *writing a song*, where the meaning of “song” is colored by the verb. On a similar note, in Meyers et al. (1994)’s the selection restriction criterion tests to see if the verb presupposes that a complement should be a certain semantic type. Take the following sentences as examples:

(60) a. Gertrude teased *it*. [+animate]
    b. Gertrude read *it*. [+readable]
(61) a. ? John teased *the book*.
    b. ? John read *the baby*.

According to the selected restriction criterion, the verb *tease* accepts only animate objects as complements, while the verb *read* only accepts readable objects. This is true even if the complement is a semantically unspecified phrase like a pronoun in example (60) – *it* “must be interpreted as fulfilling the selectional restriction imposed by [the verb]” (Ibid., p.4). Additionally, Meyers et al. (1994) argue that when the verb imposes selectional restrictions on the XP, semantic anomalies in sentences can be resolved by changing the meaning of the XP and not the verb. Thus, the
complement-hood of the book and the baby in sentences (61) is established, since these sentences are semantically anomalous but the reading can be made well-formed by reanalyzing the meaning of the book as some animate being or positing a world in which the baby is a readable entity.

Finally, the theta role criterion claims that the type of thematic role seen in the complements differs from that of the adjuncts. That is, the assumption made here is that the argument and adjunct distinction could be sufficiently made on the basis of thematic roles alone.

**Criteria for Adjunct-hood** With criteria for adjunct-hood, Meyers et al. (1994) seek to provide a way of identifying arguments and, consequently, “determining that some phrase is NOT a complement” (Ibid., p.5). Here are the listed criteria:  

<table>
<thead>
<tr>
<th>Criteria for Adjunct-hood</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>XP occurs with most verbs with roughly the same frequency and meaning</td>
</tr>
<tr>
<td>WH Words</td>
<td>AdvPs/PPs which can be questioned with “Why” and or “How”</td>
</tr>
<tr>
<td>Fronting</td>
<td>Adjunct PPs front more naturally than complement PPs</td>
</tr>
<tr>
<td>Selection Restriction</td>
<td>An adjunct imposes selection restrictions on the verb/VP</td>
</tr>
<tr>
<td>Typical Adjunct Phrases</td>
<td>Purpose clauses, PPs/AdvPs/Subordinate clauses headed by “before”, “after”, “while”, “because”, “although”, “if” or “by”; instrumental/concomitant “with” phrases, “by means” phrases, “by means of”, benefactive, place, manner, and time AdvPs and PPs</td>
</tr>
</tbody>
</table>

Meyers et al. (1994) do not specifically discuss the frequency and the WH-words criteria. All that is said of them is that they are based on “linguistics literature and [their] examination of the data”. However, general assumptions could be made. In the case of the frequency criterion, it is in line with the now familiar observation that since adjuncts are not licensed by the verb, they are likely to appear in a wider range of events. If so, it stands to reason that an adjunct’s frequency will be higher in comparison to the frequency for specific complements of a particular

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17The criteria for adjunct-hood also included Island Constraints as a 6th criterion. Again, as for the complement rule of thumbs, the only note made in the text on this contraint was that it was included mainly for historical reasons. (Ibid., p.5)
type. For the WH-word criterion, likely they are referencing the idea that the WH-words why and how specifically refer to the purpose/cause and manner, respectively, which are considered to be expressed by adjuncts. They do note however, that there is an exception to the adverbial complement cases as seen in the example *Sarah feels badly*, which can be questioned using *How does Sarah feel?*. According to the WH-words criteria, *badly* would be incorrectly classified an adjunct.

The fronting criterion is a syntactic observation that adjunct PPs (e.g. (62)) front more readily than the complement PPs (e.g. (62)).

(62) a. John did his homework on Tuesday.
   b. On Tuesday, John did his homework.

(63) a. John put the books on the table.
   b. ?On the table, John put the books.

The selection restriction criteria, is the counterpart to that of the complements (i.e. criterion 5). While in selection restriction criterion for complements, the restriction was made by the verb on the complements, here, the restriction is imposed by the adjunct on the verb and its complements. Consider the following examples Meyers et al. (1994) provide for this criterion:

(64) a. They did it *somewhere.* [+action]
   b. They did it *with a hammer.* [+physical action]
   c. They did it *to please their mother.* [+intentional]
   c. They did it *quickly.* [+action]

(65) a. ?Bruce exists *in New York.*
   b. ?Mary learned math *with a hammer.*
   c. ?Hildegard grew taller *to please her mother.*
   d. ?Jeffrey seemed hungry *quickly.*

According to Meyers et al. (1994), the selectional restrictions are seen in sentences in (64) in that even when the verb is semantically unspecified, the adjunct has the ability to restrict the
semantics of the verb. For example, the adjunct *with a hammer* likely selects for events or actions that require some sort of instrument. In the same way, Meyers et al. (1994) argue that the semantic anomaly seen in sentences in (65) “is resolved by changing the meaning of the verb, not the XP (ignoring the metaphor)”. For example, the phrase *with a hammer* imposes a restriction on the verb and its complements (i.e. *Mary learned math*) – a physical action requiring an instrument on the verb and its complements. Since there is a clash between the restriction and the semantics of the predicate, the sentence is anomalous. To make this sentence semantically acceptable, the meaning of the verb would have to change in order to allow learning to be something like a physical activity that can be achieved through the use of a hammer. What is not noted here is that the anaphora *did it* cannot substitute for non-action or non-eventive predicates (see section 3.1.3), making it unclear whether the [+action] in examples (a) really a restriction imposed by the adjunct. The semantic restriction for (d) does not seem problematic, as the adverbial *quickly* is understood to modify activities or events that possess some duration and imposes an aspectual restriction on the action or event. However, it is likely the restricted semantics in examples (a) and (b) would likely have to be reanalyzed.

Finally, on the typical adjunct phrases criterion, Meyers et al. (1994) deems it self explanatory and does not expand on this criterion. But the claim seems to lie in that there can be a certain set of thematic or lexical cues that can be used to distinguish arguments from adjuncts. However, Meyers et al. (1994, p.7-8) eventually note that adjunct phrase criterion overgenerates for the following examples, which should be examples of complements:

(66) a. They chipped in to buy a quadraphonic sound system.
    b. She cared for Mary.
    c. The meeting began at five o’clock.
    d. Mary met with Sally.
    e. John surprised Mary by yelling really loud.

Now, it is not clear by which criteria or intuition they arrive at the decision that these examples
are not cases of adjuncts. Assuming that they are correct in their assessment that these should be considered arguments/complements, when faced with such conflicts, the solution they arrive at is to “carefully enumerate the conflicting criteria. If any of the sufficient [...] criteria are satisfied, the XP in question is a complement; otherwise, the XP is an adjunct” (Ibid., p.7). In other words, in case of conflict, the sufficient criteria for complement identification takes precedence over the criteria for adjunct classification:

[W]e are aware of *they chipped in* means “they chipped in for something” or “they chipped in to buy something”. Therefore this XP is a complement either by [obligatoriness] complement criterion or [implied meaning] complement criterion. Similarly the italicized phrase in [b] resembles a benefactive phrase (a type of adjunct) for the “take care of” the sense of the verb *care*, it is actually a complement since it is obligatory in this sense. (Ibid., p.7)

Finally, Meyers et al. (1994) report that their criteria resulted, on average, in an inter-annotator agreement rate of 91%, which is generally considered a fairly high agreement rate for a task this complex (Ibid., p.9). Four lexicographers were trained as annotators in the task of complement identification using the developed criteria as described above. They annotated 205 sentences. Out of the total annotated instances, Meyers et al. (1994) selected 35 verbs beginning with the letter ‘j’ (presumably for randomness), then using automatic algorithm they extracted a subset of annotated data involving the selected verbs. It isn’t clear from the text just how many total instances were extracted in total. But given the numbers, likely somewhere in the neighborhood of about 290 instances were selected for inter-annotator agreement rate. The each annotator was pitted against the other three, and the percent they agreed on was recorded. The numbers were then averaged for the final figure of 91%. This is an encourage figure in that show a high level of consistency amongst the annotators\(^{18}\).

\(^{18}\)What would have been helpful to also know is how much training the lexicographers went through to achieve a high agreement rate. It would be impressive if the training were minimal.
4.1.3 Summary

The strength of the rule- or criteria- based approach to argument and adjunct distinction is in that it provides a consistent way of annotation: that is, if the annotators are able to interpret the established set of criteria as intended. Meyers et al. (1994) do show that their method produces on average an agreement rate of 91%, which is a fairly high rate for natural language annotation. However, there is an assumption made in Meyers et al. (1994): if a set of criteria will result in high inter-annotator consistency, it will also result in accurate and desirable annotation. The question to pose here is: does high consistency have to imply the validity of the criteria? Take the following as an example:

   b. John mailed a postcard from Paris, and Mary did so from London.

(68) a. John just came from Paris.
   b. *John just came from Paris, and Mary did so from London.

According to the favored do so test, the italicized complement should be an adjunct in example (67). Meyers et al. (1994)’s theta role criterion for complements predicts the exact opposite: the PP would be considered a goal and, therefore, an argument. Here’s the issue: so long as they are done consistently, technically labels of arguments or adjuncts do not matter. What matters is that the labels correctly segregate what needs to be segregated. So if the do so test is correct, then we would say the phrase from Paris is an adjunct in (67) and an argument in (68), and Meyers et al. (1994) would be wrong to classify both examples as arguments. The point is, even if their criteria produces highly consistent distinctions, it is still important to ask distinctions are correct.

The second issue with this method is that Meyers et al. (1994) do not address at length the fact that the 9% on average inconsistency found in the data is likely as serious as the 91% consistency they achieve. This stems from the issue that it is the exceptions or the unusual usages, which can cause disagreement even in human speakers, that are likely to cause the automatic systems to stumble on. If data can be systematically annotated and every piece of data handled
perfectly, then there would be no reason for an automatic system to fail to predict correctly. It
would be essential to do a close error analysis of the minority of the data that are problematic to
the annotators to see if they would serve as a basis for an update in their current criteria.

4.2 Distinction Based on Specific Events or Predicates

In contrast to the Meyers et al. (1994)’s approach, the lexical resources PropBank and FrameNet
approach the issue of argumenthood by considering verbs or event frames on an individual basis.
The approach is not precisely to establish a set of detailed criteria that will apply to all instances
in the data. Rather, for both PropBank and FrameNet, the goal is to come up with semantic
frames for verbs, which will allow for consistent annotation.

4.2.1 English PropBank

The English PropBank, is a semantic resource that was developed for the task of semantic role
labeling (SRL), which seeks to automatically identify and extract the different semantic relation-
ships between words in a given text (Palmer et al., 2005; Kingsbury and Palmer, 2003). Resources
that PropBank provides include two things: annotated data and a repository of lexical informa-
tion. PropBank’s annotated data includes various types of text including newspaper, magazine,
and weblog texts. The data is annotated with the lexical repository that defines verbs’ argument
structures.

It is in the definitions of argument structures that the argument-adjunct treatment is found.
The definitions of verbs are contained in what is called a Frame File that can include one or more
Frameset for a given verb, and each Frameset corresponds to a different subcategorization frame
of the verb. Here is an example:

Frameset id: \textit{give.01}, \textit{transfer}
\textbf{Arg0}: giver
\textbf{Arg1}: thing given
\textbf{Arg2}: entity given to

A verb entry includes a unique Frameset id, a descriptive text of the word, and the verb’s argument
structure. For the verb *give*, the argument structure includes the *numbered arguments* (i.e. ARG0, ARG1 and ARG2) as described in the Frameset. The Frameset id makes a distinction between this use of the verb as in “John *gave* cookies to Mary” and the verb in “I am *given* to wonder what so great about it!”, which has a different argument structure, and this is assigned a different Frameset id *leave.01*. Thus, the annotation of the sentence “John *gave* cookies to Mary” would look like the following. With respect to the verb *leave*, John would be annotated as the ARG0, *cookies* as ARG1 and *for Mary* as ARG2 according to the transfer Frameset.

\[\text{[John]} - \text{ARG0} \quad \text{left} \quad \text{[cookies]} - \text{ARG1} \quad \text{[for Mary]} - \text{ARG2}.\]

In addition to the numbered arguments, PropBank defines *modifier labels* starting with ARGM. Accompanying the label ARGM will be one of the many function (semantic) labels that describe the modifier (e.g. TMP for temporal, LOC for locative). For example, in a sentence such as “John left cookies for Mary on Thursday”, *on Thursday* would be labeled as ARGM-TMP, with the temporal function tag, TMP, which defines the semantics of the modifier. Thus, the argument and adjunct distinction to a large extent lines up with the *numbered arguments* and the *modifier labels*.

However, numbered arguments do not always correspond to the general linguistic analysis of arguments. Consider the following Frameset and the corresponding examples:

(69) raise.01: ‘go up quantifiably’

\[\begin{align*}
\text{Arg0: Agent} \\
\text{Arg1: Thing rising} \\
\text{Arg2: Extent, amount risen} \\
\text{Arg3: Start point} \\
\text{Arg4: End point}
\end{align*}\]

a. [John]-ARG0 raised [his hand]-ARG1 [to ask a question]-ARGM-PRP.

b. [Oil production]-ARG1 raised [by 11k barrels/day]-ARG2 [to 321k barrels]-ARG4.

The common usage of the verb *raise* would look much like the example seen in (a). Conse-
quently, the likely analysis of the arguments for the verb would include the *raiser*, the *AGENT* of the action, and the *raised entity*, the *THEME* of the action. However, PropBank includes three other participants for the verb. The reason behind this is that PropBank relies on the frequency of occurrence in a corpus to determine whether or not a constituent should be considered an argument of the verb. The following is a statement found in the guidelines for PropBank Frameset creators or ‘framers’.

The problem of distinguishing arguments from modifiers is not an easy one. There are different syntactic, semantic, and other types of criteria which could be used, however, they do not usually agree on where to draw the line. Our approach is a practical one: a semantic role is being marked as an argument, if it frequently occurs in a corpus and is specific to a particular class of verbs. (Babko-Malaya, 2005)

Since the framing and annotation of the example (69) was based on the Wall Street Journal and the sentences such as (b) occur more frequently, PropBank frame creators included the extent, start and endpoint of the *rising* event. Moreover, PropBank frames are not necessarily the same across semantically similar types of verbs. Consider the following example:

(70) push.01:`(try to) cause motion`
[John]-ARG0 pushed [the box]-ARG1 [into the hallway]-ARG2.

(71) kick.01:`drive or impel with the foot`
[John]-ARG0 kicked [the box]-ARG1 [into the hallway]-ARGM-DIR.

In (70), the PP *into the hallway* is considered an argument of the verb *push*, while that is not so for the verb *kick* in (71). Given that the semantics of both PPs are implicit in the semantics of the verb (e.g. *John [pushed / kicked] the box into the hallway*), and that both sentences behave in the same manner given the *do so* test (e.g. *John [pushed / kicked] a box into the hallway, and Mary did so into her room*), regardless whether they should be both adjuncts or both arguments, it stands to reason that the verbs should be treated in the same way in its argument structure. The likely explanation of the discrepancy between the two Framesets is that given the corpus the
framers were working with, likely *push* was far more often in found in company with the *PATH OF MOTION* than *kick* was.

Thus, PropBank treats the argument and adjunct distinction somewhat uniquely. Unlike Meyers et al. (1994), the PropBank does not seek to develop general criteria to distinguish between arguments and adjuncts. Rather, its task is to identify the semantic participants of an individual verb and describe its subcategorization frame using the frequency of occurrence with the verb to decide if an argument is numbered or not.

There is one other noteworthy point. As one can see, numbered argument labels are highly coarse grained. That is, they do not specify the semantics related to the identity of that argument, so there is no good way of telling what the thematic role of the label would be without specific examples. The effect of having a coarse grained label was evaluated in a paper by Yi et al. (2007). In this paper, the authors found that while ARG0 and ARG1 were fairly consistently *AGENT* and *PATIENT*, respectively. However, they also noted that the thematic roles of the higher numbered arguments (i.e. ARG0-ARG4) varied widely. In an effort to see the effect of introducing more fine grained distinctions amongst PropBank labels, Yi et al. (2007) introduced to the numbered arguments thematic labels from VerbNet, a lexical resource containing more fine grained labels. Yi et al. (2007) observed an increase in the performance of automatic systems when PropBank’s ARG2 labels were paired up with thematic labels that more narrowly identified the semantics of the argument.

As a followup to this finding, PropBank is now in the process of introducing thematic information into ARG2 to ARG5 labels. Specifically, for all numbered arguments on or above 2, the numbered argument are being paired with the function or semantic tags found in ARGMs. For example, given the verb *raise*, we would now see:

(72) *raise*.01: ‘go up quantifiably’

Arg0: Agent
Arg1: Thing rising
**Arg2-EXT**: Extent, amount risen  
**Arg3-DIR**: Start point  
**Arg4-DIR**: End point

This generally coincides with Dowty’s analysis. Instead of just providing numbered argument labels, they would be paired with or modifier function tags or, effectively, adjunct-like information. Perhaps with a different process, it allows for the exactly same capability Dowty suggests: the NLP community has the ability to do both argument and adjunct semantics over the same data and same labels.

### 4.2.2 FrameNet

Much like PropBank, FrameNet is a lexical resource that provides semantic representations of predicates, including verbs, nouns, and adjectives. In FrameNet, each sense of a word is paired with a *semantic frame*, which is defined as a schematic representation of event or situation and is described through the use of participant roles called *frame elements* (FEs) (Fillmore and Petruck 2003, p.359; Ruppenhofer et al. 2010, p.5). An FE can either be a considered core or non-core to the semantic frame. For example, currently there are 35 verbs and nouns whose senses are associated with the semantic frame *Ingestion*, which, in turn, is described by two core FEs, *INGESTOR* and *INGESTIBLE*, and nine non-core FEs including *INSTRUMENT* and *MANNER*.

Closer in concept to PropBank than COMLEX Syntax, FrameNet does not make the argument and adjunct distinction on the basis of a pre-established set of semantic and syntactic criteria that apply evenly to all predicates. Rather, the notion of argumenthood and argument structure is approached through the concept of semantic *coreness* of the participant roles involved in a semantic frame.

A core FE “instantiates a conceptually necessary component of a frame, while making the

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19For the purposes of this paper, semantic frames will be in Courier font, core FEs will be in **BOLDED SMALL CAPS** and non-core FEs will be in **REGULAR SMALL CAPS**.
frame unique and different from other frames” (Ruppenhofer et al., 2010, p.19) and is considered essential to the meaning of a semantic frame (Fillmore and Petruck, 2003, p.359). Core FEs are thought to have a certain set of properties. Core FEs generally have to either be always expressed overtly expressed or implicit in the interpretation when omitted. Consider the following examples (Ruppenhofer et al., 2010, p.19-20) that invoke the Ingestion frame:

(73) [Mary]-INGESTOR devoured [the soup]-INGESTIBLE [with a spoon]-INSTRUMENT.
(74) [John]-INGESTOR eats [her lunch]-INGESTIBLE [at school]-PLACE [everyday]-TIME.
(75) [Marc]-INGESTOR eats [every three hours]-TIME.

The semantic frame Ingestion identifies the INGESTOR and INGESTIBLE as they are both necessary participants in the act of devouring or eating. Even when the INGESTOR is not explicit in the sentence (75), it still has to be understood from the context. FEs that are not explicit in the sentence, but nevertheless implicitly or conceptually instantiated as a participant FE (i.e. if present would fill a semantic role), are considered to be null instantiated elements, they are recognized and annotated accordingly. For example, sentence (75) would be annotated as the following:

(76) [Marc]-INGESTOR eats [every three hours]-TIME [INI20 INGESTIBLE].

A non-core FE, also called a peripheral, does not characterize a frame uniquely like a core FE does, nor does it “introduce additional, independent or distinct events from the main reported event” allowing it to be “instantiated in any semantically appropriate frame” (Ruppenhofer et al., 2010, p.20). Moreover, all of the circumstantial modifiers such as TIME, PLACE, and MANNER

\footnote{INI stands for Indefinite Null Instantiation, instantiation of an FE. It is to be distinguished from the Definite Null Instantiation (DNI). DNI is an FE whose identity is fully recoverable from the context (e.g. Stephanie contributed $20, where RECIPIENT, a charitable organization, is the missing FE.). INI is an FE whose identity itself is not recoverable from the context but the type of the FE is available (e.g. objects of transitive verbs that are used intransitively) (Fillmore and Petruck 2003, p.360; c.f. Ruppenhofer et al. 2010, p.24-26 for complete discussion of null FEs).}
are strictly considered non-core FEs in any given frame. In examples (73)-(75), INSTRUMENT, TIME, and PLACE are defined by the frame as instantiating non-core FEs.

Thus, generally speaking, the concept of argument coincides with FrameNet’s core FE and that of adjunct coincides with the non-core FE. However, it is not always the case that all of FrameNet’s core FEs necessarily will be ones that would be classified as arguments in the general linguistic literature. Here is an example of the frame Practice:

(77) [Mary]-AGENT practiced [piano]-ACTION [for John’s wedding]-OCCASION.
(78) [Mary]-AGENT practiced [typing]-ACTION [for a raise]-PURPOSE.

Generally speaking for verb practice, two arguments are often specified: the agent of practice and the practiced action. In addition to the two arguments, FrameNet specifies a third core FE – the OCCASION for the practice as seen in example (77). This adverbial phrase would be considered a modifier, hence an adjunct, in general linguistic literature since it expresses the purpose of an action\(^{21}\). However, as seen (78), the frame Practice also includes a non-core PURPOSE FE, which tells us that FrameNet makes a finer distinction between the two types of phrases\(^{22}\).

In addition to the core and non-core FEs, there is a third FE called an extra-thematic FE, which on the whole is unique to FrameNet. Extra-thematic FEs are defined as FEs that introduce “additional, independent or distinct” events and situations that do not belong in the main semantic frame (Ruppenhofer et al., 2010, p.20,97). In other words, extra-thematic FEs acts as elements that combine one frame with another frame in such a way that an external frame is embedded into the main frame or an external frame is used to describe one of the FEs in the main frame. In the following examples, only the extra thematic FE is labeled and the verb is italicized:

\(^{21}\)According to the do so test, the phrase is an adjunct: John practiced piano for Mary’s wedding, and Marc did so for his recital.

\(^{22}\)Interestingly, PropBank leaves both types of purpose phrases to ARGM (i.e. ARGM-PRP). Also, in addition to the agent (ARG0) and theme of practice (ARG1), it also adds an INSTRUMENT as a third argument (ARG2) for sentences like “[Mary]-ARG0 practiced [the sonata]-ARG1 [on her piano]-ARG2 [for John’s wedding]-ARGM-PRP.”
(79) The ferry that Kenneth was on was hijacked [twice]-ITERATION.
(80) The mousse was chilled [around the edges]-SUBREGION.
(81) Someone even mowed the lawn [for Camile]-BENEFICIARY.
(82) Every pet I’ve had has croaked [on me]-MALEFICIARY.
(83) Pat put the butter in the fridge [along with the margarine]-COPARTICIPANT.

In example (79), the FE twice describes the number of times the event instantiated by the frame Piracy occurs (Ruppenhofer et al., 2010, p.20,99). In example (79), the extra-thematic SUBREGION focuses on a subregion of one of the participants that the predicate specifically describes (i.e. the edges of the mousse was chilled). In the case of (81) and (82), the extra-thematic FE describes the beneficiary (i.e. benefiting entity) or the maleficiary (i.e. harmed entity) on which the semantics of the frame acts. Finally in (83), the extra-thematic indicates a co-participating entity in the Placing frame. That is, the FE is not a part of the Placing frame. It simply combines the frame with another conceptual frame in which there is a mention of a second participant.

4.2.3 Summary

For both PropBank and FrameNet, the aim is to identify the proper thematic roles that are necessary in the event or state described by the verb. PropBank relies on frequency of occurrence to decide which constituents should be counted as numbered arguments, and FrameNet decides on the conceptual elements a semantic frame needs to identify, i.e., the core FEs. In both cases, rather than relying on a set of criteria for the identification of the arguments, the task is done on a verb by verb or frame by frame basis.

The strength of this approach is that, for any given verb of a particular usage there is a good chance that the framed arguments are correct. Also, both resources will be able to account for the unique and unusual usages of predicates, provided that there are frames associated with the predicates. The downside of this approach is it is less generalizable across verbs as each new instance of a verb or frame would have to be evaluated in its own right.
5 Conclusion

In this paper, we have analyzed the current status of argument and adjunct distinction in the linguistics literature and explored how this distinction is handled in NLP resources. Ideally, the best solution for any NLP application would be to have a specific set of features or criteria that makes a clean distinction between constituents that are arguments and those that are adjuncts. However, it is clear that there is no one set of criteria that suffices for distinctions across all verbs. If Dowty is actually correct in that all elements in the sentence can be given both an argument and an adjunct analysis, it would suggest that the quest for cleanly identifying the distinction might be misguided.
References


