

The Distinction of Argument and Adjunct as a Gradient Notion

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Hye-Won Choi. 2010. The Distinction of Argument and Adjunct as a Gradient Notion. *Language and Information* 14.1, 25–48. The distinction of argument and adjunct has been an important notion in linguistic theories, especially at the interface of syntax and semantics, and this distinction has been believed to be binary and categorical. However, there are some gray-area cases such as instruments and participant locations, for which the distinction does not appear to be so clear. In this paper, I will explore whether the argument/adjunct distinction is categorical by examining the controversial cases, particularly the instrumental PPs. I will review the syntactic, semantic, and psychological criteria and evidence that have been proposed in literature and see if instruments can be categorized as either arguments or adjuncts by those criteria. By showing that different criteria yield contradictory results, I conclude that roles like instruments have characteristics of both arguments and adjuncts, which seems to suggest that the argument/adjunct distinction is not categorical. (Ewha Womans University)

Key words: argument, adjunct, gradient, instrument

1. Introduction

The distinction of argument and adjunct has been an important notion in modern linguistics, especially in syntax. In most syntactic theories, argument information included in the representations of lexical entries of verbs (and other predicative heads¹) as argument structure is the basis of the construction of clauses (Bresnan 1982, Chomsky 1981, 1986, Foley and Van Valin 1984, Pollard and Sag 1987, among others). The lexico-semantic/conceptual information of argument structure (thematic roles) is mapped to syntactic representations via general mapping principles, constrained by the verb-specific structural information that specifies the number

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¹ While other predicative heads such as nouns and adjectives can take arguments, we will focus on verbs in this paper.

and phrasal type of arguments that a verb takes (subcategorization frames).² As Grimshaw (1990:108) notes, “arguments can be selected and subcategorized, in the sense that their presence and the form they take are under the control of individual predicates.” Adjuncts, on the other hand, are not considered to be lexically encoded via argument structure; their presence is not dictated or constrained by a lexical head. The argument/adjunct distinction has been used to explain many syntactic phenomena, such as extraction. Recently, this distinction has been argued to play a key role in psycholinguistics, in sentence processing and understanding (Abney 1989, Boland 2005, Koenig, Mauner, and Bienvenue 2003, Schütze 1995, Schütze and Gibson 1999, Tutunjian and Boland 2008).

The distinction of argument and adjunct has been believed to be binary and categorical: namely, a phrase is either an argument or an adjunct; there is nothing in between and no phrase can be both. In most cases, the distinction is clear. Most NPs bearing major syntactic functions such as subject and object are clearly arguments, whereas PPs and adverbs whose function is to modify or denote event location or time are clearly adjuncts. See example (1) below (Koenig et al. 2003:68).

- (1) Mary cuts out paper dolls with her embroidery scissors on the porch every weekend.

The agent subject *Mary* and the patient object *paper dolls* in (1) are arguments. They are syntactically and semantically obligatory elements; the agent and patient roles are required participant information encoded in the lexical entry for the verb *cut*. By contrast, the PP that denotes the event location, *on the porch*, and the adverbial phrase that denotes the event time, *every weekend*, are adjuncts, which are not obligatory either syntactically or semantically and which do not have any inherent relationship with the verb *cut*. The presence of these modifiers does not uniquely depend on the verb *cut* but is compatible with most other verbs. Therefore, they are not encoded as the argument structure of *cut*.

Not all arguments are NPs, however. Note PP arguments in (2) below.

- (2) a. Mary gave the paper dolls to her sister.
 b. Mary put the paper dolls on the desk.

Dative PPs as in (2a) and goal PPs as in (2b) are also arguments, which are required and selected by verbs. The dative PP *to her sister* is selected by the dative verb *give*, and the goal PP *on the desk* is required by the verb *put*.

While most PPs are either clearly adjuncts like those of event location and time in (1), or clearly arguments like the dative and goal PPs in (2), some PPs are hard to judge. For example, the PP that bears the instrumental role in (1), *with her embroidery scissors*, is not so distinct. On one hand, the instrument PP is not syntactically obligatory: just like the event location and time adverbials, omission of this phrase would not make the sentence ungrammatical. This is clearly

² In this paper, a broad view of argument structure is adopted. Argument structure is taken to specify the number of arguments taken by a lexical head, as well as the syntactic category and thematic role of each argument.

distinguishable from typical arguments such as subject and object. On the other hand, the instrument role has closer relationship with the verb *cut*. Unlike the event location or time adverbials, the presence of the instrument role appears to be dependent on the verb *cut*; it is not compatible with just any verb. In fact, the instrument PP has been controversial as to its argument/adjunct status. For example, Tesniere (1959), from whom example (1) originally came (cited in Koenig et al. 2003), treated the instrument PP as an adjunct just like other adverbials in the sentence, while Schütze (1995) argues for its argument status.

Instrumental PPs are not the only case that challenges the argument/adjunct distinction. Koenig et al. (2003:79) classify the status of “participant locations”—locations that indicate where a participant in the event is or ends up—the same as that of instruments. They argue that the participant location PPs like *in her notebook* in (3a) and *in his desk* in (3b) behave more like arguments than adjuncts unlike the event location PPs *in her office* in (3a) or *at school* in (3b).

- (3) a. Johanna wrote the address in her notebook, (while) in her office.
 b. Bill hid many compromising pictures in his desk, (while) at school.

Furthermore, Grimshaw (1990:108) proposes that a *by*-phrase in passive has characteristics of both argument and adjunct.

- (4) The city was destroyed by the enemy.

Grimshaw gives up the binary distinction of argument and adjunct and suggests an intermediate category called “a-adjunct” (argument-adjunct) and calls an agent *by*-phrase an argument-adjunct. Similarly, Van Valin (2001:93) complicates the distinction and states that an agent role in passive is a “semantic argument” but “syntactic adjunct.”

If certain PPs behave as if they are neither definitive argument nor definitive adjunct but as if they were both argument and adjunct, one could presume that the argument/adjunct distinction may not be a categorical one; rather it may be a gradient notion. In this paper, I will explore whether the argument/adjunct distinction is really categorical by examining the controversial cases mentioned above, particularly the instrumental PPs, like the one illustrated in (1). I will review the syntactic, semantic, and psycholinguistic diagnostics and evidence that have been proposed in literature to test argumenthood, and see if instruments can be categorized as either arguments or adjuncts according to these diagnostics. I conclude that it is difficult to make a conclusive judgment on the argument status of instruments because these criteria yield contradictory results: some criteria seem to support the argumenthood of instruments and others for their adjuncthood. I argue that it is not because we haven’t been able to come up with definitive and decisive criteria (as some suggested) but because the long-believed assumption that argumenthood must be binary and categorical is problematic. A gradient notion of argumenthood is needed to account for in-between cases such as instruments.

2. Criteria for the Distinction of Argument and Adjunct

It is rather surprising to note that no consensus has been reached regarding the basis or criteria for the distinction of argument and adjunct, considering that most linguists believe in the distinction. Despite the syntactic and psycholinguistic importance of the distinction, diagnostics used to distinguish between arguments and adjuncts do not seem to be decisive or reliable, as has been pointed out in several papers (Miller 1997, Schütze 1995, Vater 1978). In this section, we will review the syntactic, semantic, and psycholinguistic diagnostics and criteria that have been developed and documented in literature, and in the following section, we will use these diagnostics to judge whether instrumental PPs are arguments or adjuncts.

2.1 Syntactic Diagnostics

The syntactic diagnostics useful for the argument/adjunct distinction are mostly discussed in depth in Schütze (1995) and Schütze and Gibson (1999), who summarized the ones developed in previous literature (Cowper 1992, Radford 1988, Pollard and Sag 1987, etc.).

2.1.1 Syntactic obligatoriness. One of the most commonly used criteria to distinguish arguments from adjuncts is syntactic obligatoriness. If an NP or PP is obligatorily present in a clause, it is an argument of the predicate, e.g. a verb; if it is optional, it is an adjunct. Compare the optionality of the PPs in (5) and (6).

(5) a. Mary put the chair in the room.

b. *Mary put the chair.

(6) a. Mary saw the chair in the room.

b. Mary saw the chair.

The PP *in the room* in (5a) is an obligatory element of the sentence so that omission of it leads to ungrammaticality as in (5b), whereas the same PP in (6a) is an optional element which is freely omissible as in (6b). What makes the PP obligatory or not is of course the verb: *put* in (6) requires the presence of the PP, while *see* in (6) does not.

However, not all arguments are obligatory. Verbs like *eat* and *drink*, which do seem to require a patient role conceptually and semantically, may have their objects omitted. See examples in (7) (Jackendoff 1977, Van Valin 2001:92).

(7) a. Chris ate (fish).

b. Pat drank (beer).

On the other hand, not all adjuncts are optional either. Some adjuncts appear to be obligatory, as illustrated in (8) (Levin 1993).³ The sentences in (8) are ungrammatical without the adverb *well*, which is obviously not an argument.

³ An anonymous reviewer suggested that we regard certain adverbs (or PPs) such as in (8) as syntactic arguments because they are syntactically obligatory and function as "complements."

- (8) a. The teacher meant *(well).
 b. That decision bodes *(well).

Therefore, although it is applicable to most cases, syntactic obligatoriness is not a reliable test to distinguish arguments from adjuncts, as shown in (7) and (8). Alternatively, we could use semantic obligatoriness instead, to account for the case of *eat* or *drink* in (7). In fact, this is what Van Valin (2001) and Koenig et al. (2003) suggested, which will be discussed in section 2.2.

2.1.2 Iterativity. Thematic roles required by a verb are assumed to be filled by syntactic phrases once and only once. In other words, argument roles cannot be repeatedly filled. This is guaranteed in almost all syntactic theories: Projection Principle in GB (Chomsky 1981, 1986), Biuniqueness condition in LFG (Bresnan 1982), Subcategorization Principle in HPSG (Pollard and Sag 1987). By contrast, modifiers can in theory be added on indefinitely. See the contrast between (9a) and (9b) (Schütze 1995:102).

- (9) a. *Chris rented the gazebo to yuppies, to libertarians.
 b. Kim met Sandy in Baltimore in the hotel lobby in a corner.

The sentence (9a) is ungrammatical because the recipient role is forced to be filled twice by two argument phrases, *to yuppies* and *to libertarians*; neither can the subject or the object be filled more than once. However, event location roles can be iterated, in fact three times in (9b) by three PPs. Therefore, adjuncts can iterate while arguments cannot.

2.1.3 Pro-form replacement. Pro-form replacement test is based on the assumption that a verb has a closer relationship with its argument(s) than with adjuncts. A pro-form can stand for a syntactic constituent encompassing a head and its internal arguments, but one cannot stand for a head to the exclusion of any of these arguments (Schütze 1995:105).

One such example is the *do so* test, originally discussed by Lakoff and Ross (1976).⁴ The pro-form *do so* replaces the verb and its arguments, not excluding any of the arguments, as demonstrated in (10). (10a) and (10b) are ungrammatical because the *do so* phrase has the dative argument *to Sue* and the goal argument *on the shelf* excluded respectively. In contrast, the *do so* can exclude an adjunct phrase, e.g. *in the afternoon* in (11) (Schütze 1995:105).

- (10) a. *John described the film to Mary, and Fred did so to Sue.

However, I do not think that adverbs like the one in (8) are arguments; they seem to be more like (part of) predicates than arguments, similar to the adjectives in *She looks healthy* or *They made him confident*. Arguments are not the only elements that are syntactically obligatory; predicates and predicative complements are too.

⁴ As pointed out by an anonymous reviewer, the *do so* test allows some exceptions. Certain qualifications need to be considered to make the test more reliably applicable. See Schütze (1995) for detailed discussion.

b. *John put a book on the table, and Sue did so on the shelf.

(11) John put a book on the table in the morning, and Sue did so in the afternoon.

Another test that shows that a verb forms a syntactic unit with its arguments, but not with adjuncts, is pseudo-clefting (Klima 1962).

(12) a. *What Fred did to Mary was describe the film.

b. *What John did on the shelf was put the book.

(13) a. What John did on Tuesday was meet Mary.

b. What Chris did in the backyard was cook dinner.

The argument PPs, *to Mary* in (12a) and *on the shelf* in (12b) cannot be separated from the pro verb *did* (which stands for the verb and the other argument); however, the adjunct PPs, *on Tuesday* in (13a) and *in the backyard* in (13b), can be separated (Schütze 1995:106).

2.1.4 Ordering. Arguments are generally ordered closer to the verb than adjuncts. Thus, an argument cannot be ordered after an adjunct in English.⁵ If a PP is ordered after an adjunct, it is also an adjunct.

(14) a. While we were flying home, I gave the ring to my girlfriend over Buffalo.

b. *While we were flying home, I gave the ring over Buffalo to my girlfriend.

(15) John saw the mouse three times on Sunday.

(14b) is ungrammatical because *to my girlfriend*, which is an argument, is ordered after the adjunct *over Buffalo*. In contrast, the PP *on Sunday* in (15) is fine to be ordered after an adjunct, *three times*, because it is also an adjunct (Schütze 1995:107).

2.1.5 Separability from the head. Arguments are less separable from the head than adjuncts. If a preposed PP can be followed by a question it is an adjunct; if it cannot, it is an argument (Emonds 1976, Reinhart 1983). For instance, the fronting of the dative argument PP out of a question in (16a) or that of the goal argument PP in (16b) makes the respective sentence fairly unacceptable; however, event location PPs shown in (17a) and (17b) can be freely fronted, which indicates that they are adjuncts (Schütze and Gibson 1999:427).

⁵ There are exceptions to this general ordering too. Manner adverbs can actually precede PP arguments, as shown in (i).

(i) John gave the beans quickly to Bill.

It is also possible to shift a long argument phrase to the sentence-final position, ordering it after an adjunct (heavy NP shift). Schütze (1995) qualifies this test by considering focus factors when noncanonical ordering is possible.

- (16) a. *To Mary, did John give a ring?
 b. *On the shelf, who put the book?
- (17) a. On Tuesday, who drove to the store?
 b. At the concert, did you fall asleep?

Similarly, Van Valin (2001:94) notes that a PP as in (18a), which Koenig et al. (2003) call a participant location, is less separable than an event location PP as in (18b). If a participant location role is indeed an argument as Koenig et al. argue, the contrast demonstrated in (18) is also one of argument vs. adjunct.

- (18) a. *At the office, Leslie arrived.
 b. In the kitchen, Dana read *The New York Times*.

2.1.6 Wh-extraction. Extraction possibilities have also been noted to differ between arguments and adjuncts. First of all, extraction from arguments is freer than extraction from adjuncts (Chomsky 1977, Jackendoff 1977, Radford 1988, Ross 1967, Schütze 1995, Schütze and Gibson 1999). In a cleft sentence, for instance, the recipient argument in (19a) is freer to be extracted than an adjunct in (20a). Likewise, in a *tough*-construction, the goal argument in (19b) is fine to be extracted, while the time adjunct phrase in (20b) is not (Schütze 1995:114).

- (19) a. It was her longtime friend from Maine that Sally resolved after much consternation to give her mother's gold bracelet to.
 b. Which of the many tables was it tough for Harry to decide to finally put the mouse on?
- (20) a. *It was Sunday that John left for Europe from La Guardia on.
 b. *The third act of Othello is tough to leave the theater after.

Extraction from weak islands is sensitive to argumenthood too (Cinque 1990, Rizzi 1990, Schütze 1995, Schütze and Gibson 1999). Extraction of an argument from a *wh*-clause only leads to slight marginality, whereas extraction of an adjunct from the same environment yields sharp ungrammaticality.⁶ (21) and (22) show examples of extraction from *wh*-islands. Note the contrast in grammaticality between the extraction of arguments in (21) and that of adjuncts in (22) (Schütze 1995:114).

- (21) a. ?To which friend do you wonder [whether John gave the book]?
 b. ?On which shelf do you wonder [whether Angelo put the book]?

⁶ Schütze (1995:117) notes that weak island extractions should be used only as confirmation for other tests because a negative result can be taken to support nonargumenthood, but a positive result could be misleading. See Schütze (1995) for details.

- (22) a. *On which day last week do you wonder [whether John bought the book]?
- b. *In which city do you wonder [whether John saw Mary]?

Another kind of weak islands are adversative/factive islands, as illustrated in (23). Here again, the extraction of an argument in (23a) is a lot better than that of an adjunct in (23b) (Schütze and Gibson 1999:428).

- (23) a. To which friend do you deny [that Bob gave this ring]?
- b. *At what time do you regret [that Bob walked to the market]?

We have seen six syntactic tests that can be used for the argument/adjunct distinction. As Schütze (1995) and Schütze and Gibson (1999) themselves admit, most of the diagnostics have the status of heuristics: they are not guaranteed to be accurate in all circumstances, probably because they are sensitive to a couple of different structural properties of sentences that are not always correlated.

2.2 Semantic Criteria

The notion of arguments can be said to be fundamentally semantic in nature (Jackendoff 1977). Arguments are participants that are conceptually necessary to the meaning of a verb, whereas adjuncts are those that are not conceptually necessary (Van Valin 2001:93).

2.2.1 Semantic obligatoriness. As arguments are conceptually necessary to the meaning of a verb and fill the roles in the relation described by the verb, the presence of arguments are entailed or implied by the verb. Therefore, semantic obligatoriness is a natural basis for the argumenthood and has long been proposed as a criterion for argumenthood (Dowty 1982, Jackendoff 1977, Koenig et al. 2003, Van Valin 1993).

Dowty (1982), for instance, proposes the entailment test for argumenthood. He suggests that *I sold the house* entails that 'you sold it to someone,' but *I baked the cake* does not entail that 'you baked it for someone,' so the recipient of *sell* is an argument but the beneficiary of *bake* is not.

- (24) a. I sold the house to her.
- b. I baked the cake for her.

In (24a), the type of situation being described, the number of entities that it must include, as well as their modes of participation in the situation, are all assumed to be encoded in the lexical entry of the verb *sell*, such that upon encountering the verb *sell*, the hearer would activate this schematic information obligatorily (Koenig et al. 2003:61).

Semantic obligatoriness appears to overcome the weakness of the syntactic obligatoriness test, especially for syntactically optional arguments. We have noted earlier that syntactic obligatoriness cannot be a reliable criterion for argumenthood

because some arguments are syntactically optional, as exemplified in (7). Although the patient role *fish* in (7a) and *beer* in (7b) are syntactically optional, they are semantically obligatory because their presence is implied by the verb. In addition, semantic obligatoriness can explain the behavior of the implicit *by*-phrase in passive (Koenig et al. 2003:69).

- (25) a. The vase was sold to collect money for the charity.
 b. *The vase sold to collect money for the charity.

According to the syntactic obligatoriness test, the implicit agent *by*-phrase in (25) would be judged to be an adjunct. The semantic obligatoriness test, however, would judge otherwise. The contrast between (25a) and (25b) shows that the passive verb *sold* in (25a) entails the presence of an agent role so that it becomes the controller for the *to*-infinitive; by contrast, the middle verb *sold* in (25b) does not imply the presence of an agent role, thus leaving the *to*-infinitive without a controller.

However, semantic obligatoriness alone cannot guarantee argumenthood; it is only a necessary condition. Recall that some adjuncts are obligatory too, as exemplified in (8). There can be semantically obligatory adjuncts too. As a matter of fact, canonical adjuncts like event location or event time roles can be said to be entailed of almost all situations (Bresnan 1982). For instance, in (24b), if you bake something, you must bake it in some place at some time. In other words, any event or situation includes a location and time in which the event occurred. Thus, if the semantic obligatoriness is the only criterion on argumenthood, almost all adjuncts would be judged to be arguments (Koenig et al. 2003:72).⁷ Noting the problem, Koenig et al. (2003) suggest another semantic criterion, semantic specificity, along with semantic obligatoriness. One major difference between semantically obligatory arguments and semantically obligatory adjuncts is that adjuncts are common to most verbs, while arguments are not.

2.2.2 Semantic specificity and dependence. Another semantic characteristic that distinguishes arguments from adjuncts is that arguments co-occur with a small, semantically restricted class of heads, while adjuncts can occur with a relatively broad range of heads. Additionally, the semantic contribution of arguments is dependent on the particular identity of head that selects them, whereas adjuncts make a rather uniform contribution to semantic content across the verbs (Grimshaw 1990:108, Koenig et al. 2003:73, Marantz 1984:15, Pollard and Sag 1987:136, Schütze 1995:100, Schütze and Gibson 1999:410).

First, compare the difference in compatibility between (26a) and (26b) (Schütze 1995:102). The arguments *his friend* and *of the danger* can occur only with *inform* among the five verbs listed in (26a). It is because they fill the roles for the relation that only *inform* describes but not other verbs; their semantic specificity restricts the range of verbs that they can co-occur. In contrast, the adjunct *in the afternoon* is compatible with almost any verbs including those listed in (26b).

- (26) a. John {informed/*saw/*hit/*admired/*surprised}

⁷ If event locations or time are assumed to be not required of the predicate itself, but of the event, they can avoid being regarded as arguments.

his friend of the danger.

- b. John {died/sneezed/broke his arm/saw Fred/laughed at Bill}
in the afternoon.

In fact, Koenig et al. (2003:78) have conducted an extensive survey of verbs (3909 verbs) and report that agents (such as causal force, volition, and notion), the most canonical, semantically obligatory arguments, co-occur with 15% to 30% of the verbs, whereas semantically optional adjuncts co-occur with above 90% of the verbs. Class-restrictedness appears to concur with semantic obligatoriness.

Semantic dependence is a related criterion to specificity. Notice the difference between (27a) and (27b) (Schütze and Gibson 1999: 411).

- (27) a. Kim {depended/blamed the arson/decided} on Sandy.
 b. Kim {ate/was sad/broke her ankle} on Sunday.

In (27a), the meaning of *on Sandy* is dependent on the verb and thus different across the verbs listed. Arguments are interpreted only with reference to the verb. In contrast, interpretation of *on Sunday* in (27b) is constant across the verbs. Adjuncts can be interpreted correctly without any reference to the verb or rest of the sentence.

2.3 Psycholinguistic Evidence

The distinction between arguments and adjuncts is important not only to syntactic theories but also to research on human sentence processing. A number of psycholinguistic studies have provided evidence for the early use of lexically-encoded argument structure information in building and processing sentences. In self-paced reading or eye-tracking experiments, processing time for arguments is faster than that for adjuncts, indicating that argument structure information is available upon encountering the verb, which facilitates processing.

For instance, Abney (1987, 1989) suggests that ambiguity such as involved in the interpretation of the PP *in the Volvo* in (28) is resolved favoring argument interpretation over adjunct interpretation: namely, the PP is preferred to be interpreted as the argument of the noun head *interest* than as the adjunct of the verb head *thought*.

- (28) I thought about his interest in the Volvo. (NP argument vs. VP adjunct)

However, Clifton, Speer, and Abney (1991) provide a different result with both self-paced reading and eye-tracking tasks. Rather than finding a preference for argument attachment, as predicted by Abney (1987, 1989), Clifton et al. (1991) found a VP-attachment preference. They manipulate the argument status as shown in (29) and report that VP attachment is preferred to NP attachment regardless of argument status.

- (29) a. The saleswoman tried to interest the man in a wallet/his fifties.
 (VP argument vs. NP adjunct)

- b. The man expressed his interest in a wallet/a hurry.
(NP argument vs. VP adjunct)

That is, VP-attached PPs were read faster than NP-attached PPs, but argument status had no early effect, although it may have effect later.⁸ Clifton et al. (1991) suggest that a PP is initially attached to the VP using a minimal attachment strategy, a structural principle sensitive only to the number of nodes in syntactic trees, preferring fewest syntactic nodes (Frazier 1978, Frazier and Rayner 1982, Rayner, Carlson, and Frazier 1983). This account assumes that no information about the particular lexical items in the sentence such as argument structure is relevant to the initial parsing choice although there is late effect of argument structure.

Reevaluating Clifton et al.'s (1991) experiments, however, Schütze (1995) suggests that their conclusion cannot hold due to the particular sentences and methodology used in the experiment: several of their "adjunct" examples actually involved VP-arguments; other items were confounded by a variety of factors. Furthermore, Speer and Clifton (1998) provide data that suggest that readers read PPs faster when they express arguments of a verb than when they express adjuncts, even when the two PPs are equated for their relative plausibility. Also, Schütze and Gibson (1999) show that upon encountering a phrase which can ambiguously attach, the parser prefers attachments that make the ambiguous phrase an argument. Additionally, Boland and Blodgett (2006) have found that in an eye movement experiment, readers spend less first-pass time on argument PPs than adjunct PPs. Unlike Clifton et al.'s (1991) claim, these results show the early effects of argument status for PP attachment ambiguities, as illustrated in (30), where the argument is read faster (Tutunjian and Boland 2008:7).

- (30) The saleswoman tried to interest the man in a wallet/a nice way.
(VP argument vs. VP adjunct)

Psycholinguistic researches as introduced above support a view that argument structure of a verb (or noun) can facilitate the processing of its arguments as encountering a verb (or noun) immediately provides the information regarding the number and mode of arguments. Yet, it is not to say that factors other than argumenthood are unnecessary (Schütze 1995:146): factors such as people's knowledge of the world or frequency do seem to influence processing (MacDonald, Pearlmutter, and Seidenberg 1994, Sedivy and Spivey-Knowlton 1994, Taraban and McClelland 1988, Trueswell and Tanenhaus 1994). Still, a certain amount of the variance in attachment preferences cannot be explained by other factors including co-occurring frequencies or world knowledge, but only by the syntactico-semantic information of argument structure although it surely correlates with such frequencies to a substantial degree.

⁸ The early effect (the one achieved before the reader finishes reading the concerned argument) is crucial in psycholinguistic experiments because it shows that the reader anticipates the argument in concern when encountering the verb. Argument structure may have the late effect but this does not necessarily support the idea that the lexical information (argument structure) of the verb plays a role.

3. Instrumental PPs: Argument or Adjunct?

The argument status of instruments is controversial. Some linguists treat instruments as adjuncts (Carlson and Tanenhaus 1988, Dowty 1989, Sedivy and Spivey-Knowlton 1994, Spivey-Knowlton and Sedivy 1995), and others argue that they behave like arguments (Schütze 1995, Schütze and Gibson 1999, Van Valin 1993, Van Valin and Lapolla 1997). Instruments are, on one hand, like adjuncts in that they do not participate in valence alternations such as passive (Carlson and Tanenhaus 1988) and that they are syntactically optional (Dowty 1989); on the other hand, instruments pass some traditional tests of argumenthood, differing from typical adjuncts like event locations or time participants.

An instrumental is an “inanimate force or object causally involved in the action or state identified by the verb” (Fillmore 1968) and “an intermediary between actor and patient in the decomposition of an action” (Jackendoff 1977). Instruments are usually marked by the preposition *with* in English, but of course, not all *with*-phrase are instruments, as shown in (31): the *with*-phrase in (31b) is comitative and the one in (31c) is a manner phrase (Schütze 1995:124). Also, not all instruments are *with*-phrases, as illustrated in (32).

- (31) a. John stirred the soup with a spoon.
 b. John visited his parents with Mary.
 c. John opened the box with care.

- (32) John filled out the form in pen.

3.1 Syntactic Diagnostics

Instruments pattern with arguments on three of the six syntactic tests introduced in section 2. As syntactic obligatoriness does not seem to be a reliable test, we will see how instruments behave regarding the remaining five tests in this section.

3.1.1 Iterativity. As for iterativity, instruments come out as arguments (Schütze 1995:129-130). As demonstrated in (33), instrumental PPs cannot be iterated.

- (33) a. *Mary cut the meat with a tool with a saw.
 b. *John cut the meat with a knife with the sharp end.
 c. *John painted the wall with a paintbrush with the ends of the bristles.

As discussed earlier in section 2.1.2, an argument role can have only one syntactic realization and therefore cannot be filled more than once. As shown in (33), instruments pattern with arguments on the iterativity test. From this fact, Bresnan (1982) also concludes that instruments should be treated as arguments.

3.1.2 Pro-form replacement. As for the pro-form tests, instruments behave like adjuncts. Just as adjuncts can co-occur with a VP pro-form *do so*, as noted by Lakoff and Ross (1976), instrumental PPs can too, as illustrated in (34) (Schütze 1995:125). Recall that arguments cannot co-occur with *do so*, as shown in section 2.1.3.

- (34) a. Sue stirred the soup with a spoon, but Fred did so with a fork.
 b. John filled out the form in pen, and Mary did so in pencil.

Also, instrumental PPs can be separated from the verb and its arguments in a pseudo-cleft construction as in (35), which is also an adjunct-like behavior.

- (35) What John did with the knife was cut the bread.

3.1.3 Ordering. Instrumental PPs behave like adjuncts in terms of ordering too. Unlike arguments, instruments can be ordered after adjuncts, as illustrated in (36).

- (36) John will break the door down on Tuesday with a crowbar.

Contrast this with the argument examples demonstrated in section 2.1.4.

3.1.4 Separability from the head. In terms of separability from the head, instruments are like arguments. An instrumental PP cannot be followed by a question, like other arguments (Schütze and Gibson 1999:428).

- (37) *With the knife, who sliced the salami?

Contrast this with the adjunct example illustrated in section 2.1.5.

3.1.5 Extraction. Instruments pattern with arguments in various extraction tests. Like arguments, illustrated in (19), instruments allow direct preposition stranding in complex constructions where it is generally degraded for adjuncts. Notice the contrast between the adjunct examples shown in (20) and the following examples in (38) (Schütze 1995:131).

- (38) a. It is this flimsy key that he convinced her to be willing to open such a heavy door with.
 b. This flimsy key is extremely hard to convince yourself to be willing to open such a heavy door with.

Weak island extraction is another test that shows that instruments differ from typical adjuncts. Baker (1988:243) explicitly argues for the argument status of instruments on the basis of the following contrast between (39a) and (39b), where (39b) represents a canonical adjunct extraction (Schütze 1995:131).

- (39) a. (?)With which key do you always forget [how to open doors]?

- b. *How do you always forget [with which key to open doors]?

In addition to the extraction from a *wh*-island, extraction from a factive island shows that instrumental PPs are more like arguments than adjuncts. See (40) below (Schütze and Gibson 1999:428).

- (40) With which key do you deny [that the butler could have opened the door]?

To summarize, instrumental PPs pattern with arguments on three syntactic tests such as iterativity, separability from the head, and extraction; however, they behave like adjuncts on such tests as syntactic obligatoriness, pro-form replacement, and ordering. That is, the syntactic tests unfortunately do not all draw the same dividing line for instruments between arguments and adjuncts.

Despite the split results of the syntactic tests, Schütze (1995) still argues for the argument status of instruments, claiming that the *do so* phrase replaces only the verb and its internal arguments excluding external arguments like an instrumental, and that the ordering generalization has systematic exceptions, as in the manner adverb positioning and stress reordering. However, it is undeniable that instruments are different from prototypical arguments such as subject, object, dative object, and goal argument, which cleanly pass all the syntactic tests. Therefore, we reach a temporary conclusion that syntactic diagnostics do not make a conclusive call regarding the argument status of instrumental PPs, showing properties of argumenthood and of adjuncthood.

3.2 Semantic Criteria

As the syntactic diagnostics yield split results about the argumenthood of instruments, we now turn to the semantic criteria discussed in section 2.2.

3.2.1 Semantic obligatoriness. Dowty (1982) claims that one can add an instrumental phrase, as well as benefactive and locative phrases, to virtually any verb and the meaning of the sentence containing an instrument could have been complete without it. That is, the presence of an instrumental is not entailed by the meaning of the verb and therefore it is an adjunct. Koenig et al. (2003:79), however, suggest that instruments in fact are not a unified category and there exist two classes of instrument-taking verbs, those that allow but do not entail or require the presence of instruments and those that do entail or require their presence. According to them, only those instruments that are required by verbs are arguments; those that are only allowed are adjuncts. To identify semantically obligatory instruments, they suggest to ask the following question (Koenig et al. 2003: 79):

- (41) Does the verb describe situations in which one participant must, can, or cannot use another participant to perform an action?⁹ (e.g. *Marc poked the frog* requires Marc to have used something?)

⁹ Koenig et al. (2003:80) further qualify the definition such that body parts, for example, could count as instruments only if objects other than body parts could be used as instruments as well. Thus, mouth is not an instrument of eating, according to this definition.

According to this definition of argumenthood, the instrument PP of *poke* is an argument, as in (42a), but the instrument PP of *sip* is not (Koenig et al. 2003:81).

- (42) a. The policeman poked the body with a stick. (semantically obligatory)
 b. The policeman sipped his iced tea with a straw. (semantically optional)

Whereas the use of *poke* in (42a) requires the presence of something that the policeman used to poke the body, the use of *sip* in (42b) does not entail that something was used by the policeman to sip his tea. Similarly, consider the contrast between the verbs *chop* and *eat*: *chop* describes situations that must include an instrument; in contrast, *eat* describes situations that do not necessarily include an instrument (Koenig et al. 2003:79).

It is important to note that the *with*-phrase plays the same instrument role in both (42a) and (42b), even though only *poke* lexically requires its presence. This suggests that the semantic type of a participant role needs to be dissociated from its obligatoriness and that arguments cannot be defined as members of a predefined list of thematic roles. In other words, a single role type, e.g. instrument, may or may not be an argument: its argumenthood boils down to the detailed conceptual or semantic property of each verb.

However, this criterion is not without fault either. One major problem with semantic obligatoriness is the potential difficulty in ascertaining whether something is entailed or required. For example, it is not immediately clear whether *I broke the window* entails the use of some instrument, possibly including a part of one's own body. In addition, it needs to be explained why instruments split and only one group are arguments, while canonical arguments such as agents and patients do not split in their argumenthood. Also, even semantically obligatory instruments can be syntactically optional in many cases, while typical agents and themes are syntactically obligatory in most situations.

3.2.2 Semantic specificity and dependence. We have noted in section 2.2.2 that arguments are the roles that are restricted to only a small group of verbs. According to Koenig et al. (2003:78), agent properties (such as causal force, volition, and notion), which are the most frequent arguments, target between 15% and 30% of verbs (3909 verbs total). We can use this as a rough estimate of the upper limit for the specificity condition.

The table in (43) summarizes the percentages of verbs that require or allow five syntactically optional roles.

- (43) Verbs that require or allow 5 syntactically optional roles (Koenig et al. 2003:80)

Participant role	Verbs requiring role	Verbs allowing role
Instruments	12.0	35.0
Participant locations	7.0	1.5
Event locations	98.2	0.0
Time	99.8	0.0
Beneficiary	0.0	94.1

Out of 3909 verbs, 12% require an instrument role. The distribution of instruments is a lot smaller than the upper limit 30%, and thus we can safely conclude that instruments are restricted to a small set of verbs. Note on the side that participant locations also pass this criterion. This contrasts with typical adjunct roles—event location and time—which are required by almost all verbs, 98.2% and 99.8% respectively.

In fact, instruments can occur only with a proportion of verbs containing an agent, either expressed or implied (Schütze 1995:126).

- (44) a. John broke the window with a rock.
 b. The window was broken with a rock.
 c. *The window broke with a rock.

The instrument *with a rock* can occur with the active verb *break*, which explicitly require an agent as in (44a), and also with the passive verb *broken*, which implicitly require an agent as in (44b), but not with the middle verb *break*, which does not require an agent as in (44c). In general, verbs that do not require an agent are not compatible with an instrument, as demonstrated in (45) (Schütze 1995:126-127).

- (45) a. *John lost the book to Bill with bad luck.
 b. *The boat floated on the surface of the water with an inflated tube.
 c. *The water flowed with locks.
 d. *The blood coursed through his veins with a heart pump.

As such, the distribution of instruments is not free: it depends on semantic properties of the predicate with which it co-occurs. This differentiates it from canonical modifiers like *on Tuesday*, for instance.

The last question to ask is whether the interpretation of an instrument depends on the identity of the head. Dowty (1982) argues that an instrument's relationship to an event is constant regardless of the particular verb. However, Schütze (1995:128) argues for semantic dependence of instrumental interpretation. Citing Marantz's (1984) examples in (46) that show implicational differences, he argues that interpretation of instruments depend on the verb.

- (46) a. Elmer unlocked the porcupine cage with a key.
 b. Elmer examined the inscription with the magnifying glass.

Marantz (1984) notes that in (46a) *a key* is an intermediary "agent" in the act of unlocking: Elmer does something to the key, the key does something to the cage, and the cage unlocks. By contrast, in (46b) *the magnifying glass* is not an intermediary agent but merely a tool required to complete the action of examining. This contrast in meaning does not emerge from considering the PPs in isolation, but depends crucially on the main predicate. As Marantz points out, this distinction

correlates with the possibility of using the instrument as a subject, as shown in (47), which suggests that this is not simply a matter of pragmatic inference (see Van Valin 2001:94 for discussion of similar examples).

- (47) a. A key unlocked the cage.
 b. *The magnifying glass examined the inscription.

If the implicational differences noted in (46) depend on the main predicate, not on the contents of the PP, instruments are like arguments in depending on the verb for their interpretation.

To summarize, semantic criteria such as semantic obligatoriness and semantic specificity/dependence show that at least a subset of instruments are arguments. However, judgment on semantic obligatoriness is not always clear-cut. For instance, can one *break* something without using a tool (including a body part)? Maybe not, but what if he/she dropped it? Also, the notion of specificity and class restrictedness is not so obvious either. Although Koenig et al. (2003) suggest 30% as the upper limit for class restrictedness, it remains to be a question how to define class restrictedness. They group agent roles into three subcategories (causal force, volition, notion) and show that each subgroup is restricted to 15% to 30%. This means that the percentages could differ depending on how to group the agent role. Also, what if a certain role is restricted to 35% of verbs? Should we decide it to be an adjunct? In addition, it is not just arguments that are restricted by verbs. Certain adjuncts are restricted by predicate type too, for instance, adverbs like *deliberately* and PPs like *for three hours* (Schütze 1995:127-128).

Semantic criteria, probably due to their nature, inevitably have gray area. Even setting aside the obligatoriness, which is often hard to judge, specificity and restrictedness do seem to come in degrees, and therefore, a categorical distinction of argument and adjunct does not appear to be possible with semantic criteria. In addition, semantic obligatoriness already splits instruments into two groups: argument instruments and adjunct instruments. Interestingly, even the “argument” instruments by Koenig et al.’s definition behave as if they are adjuncts according to some syntactic tests, and the “adjunct” instruments behave as if they are arguments according to other syntactic tests, as demonstrated in section 3.1: *stir*, which requires the presence of an instrument does not pass some syntactic tests; by contrast, *break* and *open*, which do not require the presence of instruments, pass some tests as arguments. Then we can reach a temporary conclusion that there are at least four degrees of argumenthood: (1) definitive arguments (e.g. agent, patient), (2) “argument” instrument/participant location, (3) “adjunct” instrument/participant location, (4) definitive adjuncts (event location, event time).

3.3 Psychological Evidence

Instruments have been claimed to function as arguments under some processing theories (Tutunjian and Boland 2008, Koenig et al. 2003, Schütze 1995, Schütze and Gibson 1999) and as adjuncts in others (Sedivy and Spivey-Knowlton 1994, Spivey-Knowlton and Sedivy 1995). As seen in section 2.3, the possible attachment of the PP in the V-NP-PP structure is one of the best known syntactic ambiguity

problems in sentence processing literature. Such ambiguity is involved in the instrumental *with*-phrase in (48) too (Schütze 1995:95).

- (48) a. The spy saw a cop with a telescope.
 b. The spy saw a cop with a revolver.

The instrumental *with*-PP can be attached either to be associated with the verb *saw*, or to modify the NP *a cop*. In (48a), the PP *with a telescope* is favored to be attached the VP; in (48b), the PP *with a revolver* is favored to be attached to the NP. The NP attachment is preferred in (48b) because one cannot see with a revolver, yet an incremental parser cannot determine which attachment of the PP will be better until the disambiguating noun, *revolver*, is encountered. So the question is how a human processor decides which structure to assign upon encountering a partial sentence like *The spy saw the cop with*, and if argument structure plays a role for this decision.

It has been found that the processing time for the VP attachment as in (48a) is faster than the NP attachment as in (48b). Abney (1989), Schütze (1995), Schütze and Gibson (1999), and Tutunjian and Boland (2008) explain it with the argument preference strategy in processing: namely, the processing time for the VP attachment is faster because the phrase *with a telescope* is an argument of *saw* (1995:97). That is, if the instrument is an argument of the verb *see*, requiring its presence lexically, a human parser, upon encountering the verb *saw*, anticipates an instrument argument coming, and therefore the processing time is shortened. On the other hand, in (48b), the noun *revolver* cannot fill the expected role of instrument and thus ends up modifying the NP, which delays the whole processing time.

In contrast, Rayner et al. (1983) and Clifton et al. (1991) explain the VP-attachment preference with the minimal attachment strategy, as noted earlier in section 2.3. Namely, the VP attachment is preferred because it minimizes the structural cost, not because the *with*-PPs are arguments. Sedivy and Spivey-Knowlton (1994) and Spivey-Knowlton and Sedivy (1995) also claim that the argument preference strategy cannot explain the preference for VP-attachment (see also Carlson and Tanenhaus 1988 and Dowty 1989). Instead, Spivey-Knowlton and Sedivy (1995) argue that the attachment of *with*-PPs is guided by the co-occurrence frequency between verbs and adjuncts. In a corpus analysis, they found that for action verbs, *with*-PPs are more likely to attach to a verb than a direct object, while, for psychological or perception verbs, *with*-PPs are more likely to modify a direct object than a verb. They report two experiments involving the attachment of *with*-PPs, one using action verbs, which found a consistent VP-attachment preference, and one using psych/perception verbs, which found an NP-attachment preference when the direct object was indefinite. In fact, this contrast could be explained by an argument preference, which would favor VP-attachment for instrumental uses of *with*. Recall the discussion in section 3.2, where instruments are restricted to verbs that require agents, i.e. action verbs. Then, we can figure that only the instruments used with action verbs are arguments, while those used with psych/perception verbs are not, which naturally explains why VP-attachment is preferred for the former and NP-attachment is preferred for the latter.

Meanwhile, Ferretti, McRae, and Hatherall (2001) argue for the argument status of instruments. Ferretti et al. (2001) demonstrate that isolated verbs prime typical agents (*arresting, cop*), patients (*arresting, criminal*), and instruments (*stirred, spoon*), but not locations (*swam, ocean*). They conclude that agents, patients, and instruments are arguments while locations are not, based on the criterion that a phrase is an argument if a verb's lexical representation specifies semantic information about it. However, it has been criticized that semantic priming in a lexical decision task may not be a valid evidence for argument status (Tutunjian and Boland 2008).

In addition, Koenig et al. (2003:88) conducted a study to determine whether differences in the semantic obligatoriness of participant roles has an immediate influence on parsing. They compared the processing of sentences whose main verbs either semantically required (e.g. *behead*) or merely permitted (e.g. *kill*) an instrument in the events they described. Consider the extraction examples in (49).

- (49) a. Which sword | did the rebels | *behead* | the traitor king with - | during the rebellion?
- b. Which sword | did the rebels | *kill* | the traitor king with - | during the rebellion?
- c. With which sword | did the rebels | *behead* | the traitor king - | during the rebellion?
- d. With which sword | did the rebels | *kill* | the traitor king - | during the rebellion?

Interestingly, sentences with semantically obligatory instrument verbs like *behead* elicited faster reading times than sentences with semantically optional instrument verbs like *kill*. The results of this study provides psychological evidence supporting the obligatoriness criterion for argument status. Furthermore, when the main verb was an optional instrument verb like *kill*, sentences with NP fillers elicited longer reading times than sentences with PP fillers, as in (49b) vs. (49d), but not when the main verb was an obligatory instrument main verb like *behead*, as in (49a) vs. (49c) (Koenig et al. 2003:94). This pattern is consistent with the hypothesis that readers use instrument participant information with *behead* (regardless of the syntactic form being PP or NP) to predict upcoming instrument gaps for WH fillers, but not with *kill*, for which readers would not expect the prescribed instrument information unless the preposition *with* is provided in PP.

Finally, Boland (2005) conducts eye-tracking experiments on location, instrument, and recipient roles and provides an interesting observation that instruments pattern in between definitive arguments (such as recipients) and definitive adjuncts (such as locations). As illustrated in (50), the queue sentences were provided for each type of role and the times for looks to the corresponding pictures of a typical and an atypical object (e.g. *a stick* vs. *a hat*) were measured (Boland 2005:242).

- (50) a. Intransitive/Location (pictures: girl, bed/bus, pillow, toy car)
The girl slept for a while . . . on the bed/bus this afternoon.

- b. Action/Instrument (pictures: donkey, farmer, stick/hat, grass)
The donkey would not move, so the farmer beat it vigorously . . .
with a stick/hat every day.
- c. Dative/Recipient (pictures: newspaper, mother, teen/toddler, dictionary)
The newspaper was difficult to read, but the mother suggested it anyway . . . to her teenager/toddler last week.

The results summarized in the table (51) show that for both typical and atypical targets, looks to potential instruments are more likely than looks to potential adjunct locations, but are less likely than looks to potential recipients. The figures represent the probability of a look to the target picture 500-1000 ms after the verb onset (Boland 2005:249).

(51) The probability of a look to the target picture (Boland 2005:249)

	Location	Instrument	Recipient
Typical Target	.29	.34	.39
Atypical Target	.24	.27	.39

It is noted that this finding runs counter to text co-occurrence statistics, so it is not predicted by the frequency account. Rather, it suggests that instruments have some of the same properties as arguments. What makes it more interesting is that the action verbs used in this experiment were *bump*, *beat*, *attack*, *eat*, *assault*, *damage*, *smash*, and *clean*, none of which meet the semantic obligatoriness criterion proposed by Koenig et al. (2003), and therefore the instruments are adjuncts according to them (Boland 2005:249). If the instruments are appropriately classified as adjuncts, then they should pattern with the locations but they do not.

Although Boland (2005) concludes that instruments are not lexically specified arguments for action verbs like *attack*, *eat*, and *clean*, we can see that they are not like adjuncts, either. Furthermore, if even those instruments classified as adjuncts have some argument-like properties, we can easily imagine that those instruments classified as arguments according to Koenig et al. (2003) have more argument-like properties. Pairing with the results from Koenig et al.'s experiments showing the processing difference between the two classes of instruments, we can conclude that psychological evidence show that instruments are situated in the middle between definitive arguments and definitive adjuncts. This psychological evidence matches our temporary conclusion based on the semantic criteria that there are at least four degrees of argumenthood.

4. Conclusion

We have reviewed the syntactic, semantic, and psycholinguistic criteria and evidence proposed to distinguish arguments from adjuncts in literature and examined the status of instrumental PPs according to them. The syntactic diagnostics yield contradictory results: instruments are judged to be arguments according to the three tests but to be adjuncts according to the other three. In terms of semantic

criteria, some instruments are arguments while others are adjuncts depending on their semantic obligatoriness. Let alone the difficulty of judging whether a certain instrument is semantically obligatory or not, or semantically restricted or not, even the “argument” instruments do not behave like such canonical arguments as agent, patient, or recipient in terms of some syntactic tests. On the other hand, even the “adjunct” instruments pass certain syntactic tests of argumenthood. Finally, psycholinguistic evidence show processing differences not only between obligatory instruments and optional instruments but also between optional instruments and canonical adjuncts. All in all, the inconclusive results from the syntactic, semantic, and psycholinguistic tests indicate that instruments have properties of both arguments and adjuncts and thus cannot be categorized as either arguments or adjuncts. If we insist on the categorical distinction of argument and adjunct, instruments belong nowhere. However, if we assume that the distinction of argument and adjunct is not categorical but gradient on a continuum, instruments seem to be located somewhere between arguments and adjuncts, one group closer to the definitive arguments and the other group closer to the definitive adjuncts.

In fact, the idea of gradience of argumenthood is not so surprising considering that argument structure is an area where syntax and lexical semantics meet. It is in a sense understandable that syntactic principles and semantic properties do not necessarily converge, raising mismatches for some roles (Levin and Rappaport Hovav 2005). Even Schütze (1995:111), who strongly argues for the argument status of instruments, admits that argumenthood may not be an “all-or-nothing” phenomenon if it is fundamentally a semantic notion, although he rejects the semantic distinction due to its haziness. As a matter of fact, Manning (2003) proposes that the subcategorization frames of a verb, which are closely related to argument structure, are not categorical. He even argues that grammar in general is not categorical. If the argument/adjunct distinction is indeed a gradient and probabilistic notion, it would not be absurd to say that a phrase is more like an argument than an adjunct but not completely an argument. MacDonald et al. (1994) go even further and argue that there is no distinction of argument and adjunct and both are lexically specified. Instead, the apparent difference between arguments and adjuncts can be reduced to frequency: namely, arguments appear more frequently with heads (e.g. verbs) than adjuncts. The current study of instruments clearly shows that there are cases that the categorical distinction of argumenthood cannot explain and therefore call for the gradient notion of argumenthood. Yet, how it should be represented in grammar and how it relates to degrees of grammaticality needs to be studied further.

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