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Correlation between semantic compatibility and frequency: A usage-based approach*

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Yoon, Soyeon. 2013. Correlation between semantic compatibility and frequency: A usage-based approach. *Linguistic Research* 30(2), 243-272. This study investigates the nature of semantic compatibility between constructions and lexical items that occur in them, in relation with language use. The usage-based model, proposed by Langacker (1987), assumes that linguistic knowledge (grammar) is grounded in language use. However, the relation between the linguistic knowledge and usage has not been empirically tested. This study shows that semantic compatibility between linguistic elements is a gradient phenomenon, and that speakers' knowledge about the degree of semantic compatibility is intimately correlated with language use, specifically frequency of use. To show this, I investigate linguistic knowledge of the semantic compatibility between the English ditransitive construction (DC) and various verbs that occur in the DC. I set up five semantic compatibility categories, and categorized various verbs according to the degree that the verb implies "successful transfer of possession" (Goldberg 1995). Then, I obtained frequency pattern of the verbs and the DC by using collexeme analysis (Stefanowitsch and Gries 2003), which is a method of measuring relative frequency of co-occurrences of a lexical item and a particular construction. I finally correlated the semantic compatibility of various verbs and the result of collexeme analysis. My findings specifically show that the more compatible a verb is with the construction, the more frequent it will be used in the construction. The empirical data support the assumption of the usage-based model that grammar and usage are closely related. **(Incheon National University)**

Keywords semantic compatibility, frequency, usage-based model, collexeme analysis, English ditransitive construction

1. Introduction

This study investigates the relationship between speakers' linguistic knowledge

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about semantic compatibility among linguistic items and frequency of their co-occurrence in language use, from the usage-based approach proposed by Langacker (Kemmer 2008; Kemmer 2005; Kemmer and Barlow 2000; Langacker 1987, 1988). Following Kemmer (2005), I specifically predict that linguistic knowledge about the different degrees of semantic compatibility between a construction and a lexical item that occurs in the construction is closely correlated with how frequently the construction and the lexical item are used together.

The current study attempts to provide evidence for this predicted relation, which has not been empirically tested. First, this study examines semantic properties of various verbs and semantic properties of English ditransitive construction[1] (DC, henceforth), and based on these semantic properties, it sets up the degrees of semantic compatibility of these verbs used in the construction. Second, in order to examine relative frequency of the co-occurrences of the verbs that occur in the DC, I analyze corpus data by means of **collexeme analysis** (Stefanowitsch and Gries 2003). Finally, I correlate the degree of semantic compatibility and frequency.

By demonstrating the correlation, this study supports the general assumption of the usage-based model that semantic compatibility is related directly, not only to knowledge of grammar and lexicon, but also to linguistic usage as well, i.e., what has traditionally been called *performance*.

2. The usage-based model: The relationship of semantic compatibility and frequency

In this study, "semantic compatibility" between two or more linguistic components is defined as the following: The prototypical semantic specifications of the two linguistic components must be conceptually consistent (Yoon 2012). For "the prototypical semantic specification" in this definition, I adopt the prototype model (Rosch 1977) in which a category is defined with reference of a prototype, i.e. a

[1] Since English DC has relatively concrete sense compared to other constructions (e.g. a transitive construction which has the meaning that X acts on Y, or a sentential complement construction which has the meaning that the event in the complement is a predication that is independent of the event designated by the main verb), we can relatively easily compare the meaning of the construction with various verbs. I also expect that the DC has dynamic interaction with various verbs that have different degrees of semantic compatibility.

schematized representation of typical instances (Langacker 1988: 133). Therefore, when I discuss the semantic compatibility between a construction and various verbs, I compare the prototypical semantics of the construction and the verbs when they are abstracted from specific instances. In order to identify the prototypical semantics, I refer to *Collins Cobuild English Language Dictionary* (Sinclair et. al. 1987) (CCELD) and *Collins Cobuild English Language Dictionary for Advanced Learners* (2001, an electronic version) (CCED_AL). The multiple senses of one entry in these dictionaries are organized based on frequency, independence of meaning (the meaning of a word in isolation regardless of its environment), and concreteness. "[I]n this dictionary the first sense is a common one and a central one; also an independent one and if possible it is concrete" (CCELD, xix). For the prototypical sense of a verb, therefore, I will refer to the senses that appear early in the entry. Based on these senses of the verbs, as identified by the dictionary, I will discuss how compatible the verbs are with the construction.

In Construction Grammar (Goldberg 1995; Michaelis 2005), a **construction**, as the basic unit of linguistic organization, is defined as a conventionalized pairing of form and meaning (Goldberg 1995, 2006). On this view, not only individual lexical items but also a schematic syntactic frame is a construction, which has its own conventionalized meaning and contributes to the meaning of the whole expression. For example, in the case of the "caused-motion construction" (Goldberg 1995: 152) as in (1), the form of the construction, [$SUBJ_i$ [V OBJ_j OBL_{dir}]], conveys the meaning that 'an entity *i* causes *j* to move along a path designated by the directional phrase.'

(1) I *pushed* the box into the room.

On the Construction Grammar view, since a construction has a meaning, when lexical items occur in the construction, the semantic properties of the verb should fit those of the construction. In other words, the semantics of the verb and the construction should be compatible.

For example, in (1) *push* denotes the meaning of 'moving an object to another place by means of pushing' and this lexical meaning fits the constructional meaning. Therefore, the verb *push* is considered semantically compatible with the caused-motion construction.

However, the verb *remember* is not likely to be used in the caused-motion construction, as in (2).

(2) *I *remembered* the box into the room.

In (2), the verb *remember* prototypically does not involve any motion or direction. This lexical meaning mismatches the constructional meaning. Thus, *remember* is not very compatible with the caused-motion construction.

Interestingly, however, in (3) and (4), the use of *sneeze* and *grow* with the caused-motion construction is somewhat acceptable.

(3) She *sneezed* the foam off the cappuccino. (Goldberg 2006: 42)
(4) ??Farmer Joe *grew* those vines onto his roof. (Goldberg 1995: 169)

The verbs *sneeze* and *grow* typically do not have to require a patient (Goldberg 1995: 154) and they do not entail a motion and a path. Thus, in this sense, we would not expect *sneeze* and *grow* to occur in the caused-motion construction, because the verb and the construction are not very semantically compatible. However, this semantic conflict can be resolved: in the case of (3), the conventional meaning of the construction provides the meaning of "moving an entity along a path" while *sneeze* is construed as the manner of moving an entity; in the case of (4), we imagine a situation where Joe used wires and bars to support the vines so they can reach the roof. However, (3) is considered more acceptable than (4) because we can easily imagine a conventional scene where the force generated by sneezing (Goldberg 1995: 27) causes the foam to move from the top of the cappuccino cup, while the situation of growing plants onto the roof is not very typical.

As we can see in the example from (1) to (4), the semantic compatibility between a verb and a construction is gradient depending on the similarities of their semantic specifications: *push* as the most compatible, *sneeze* as less compatible, *grow* as even less compatible, and *remember* as the least compatible with the DC.

Knowing that certain verbs are semantically compatible with a particular construction is a part of a speaker's linguistic knowledge, or "grammar" in linguistic theory.

According to the usage-based model of language, as proposed by Langacker

(1988), linguistic knowledge or grammar is fundamentally grounded in instances of linguistic usage (Kemmer and Barlow 2000: viii), as shown in Figure 1.

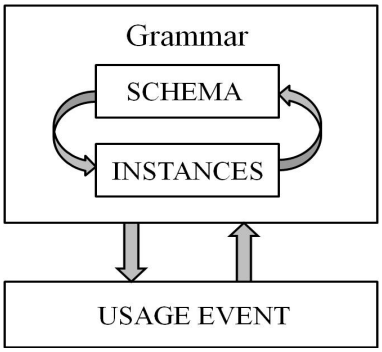

Figure 1. The interaction of the linguistic usage and grammar proposed by the usage model (Kemmer 2008)

In the usage-based model, **instances** used in speech are a part of grammar, as represented in Figure 1. The instances that speakers hear and use are specific in context, but if they experience similar instances repeatedly, they can extract commonalities and generalize a pattern, called a **schema**. For example, people may hear similar instances of the same pattern where directional motion verbs occur in the syntactic form [$SUBJ_i$ [V OBJ_j OBL_{dir}]], such as *I pushed the box into the closet*, and *John dragged the cat into the basket.* If they hear instances similar with this pattern frequently, from the instances, the pattern will be entrenched as a schema of the caused-motion construction that occurs with directional motion verbs (e.g. *push* and *drag*). Likewise, a schema of a directional motion verb will be entrenched as occurring with the caused-motion construction. Then, the directional motion verbs will be considered semantically compatible with the caused-motion construction. Also, this more entrenched pattern will be used more frequently, in turn.

On the other hand, it is possible that they hear the co-occurrence of non-directional non-motion verbs, such as *sneeze* or *grow,* used in the caused motion construction, but very few times. Therefore, the use of non-directional non-motion verbs with the caused-motion construction may be hard to be entrenched as a schema. These verbs will be considered less compatible than the verbs like *push*. Less compatible patterns will be used less frequently, in turn. The linguistic

knowledge of semantic compatibility between linguistic units is constructed in this way.

Consequently, according to the usage-based model, the frequency of linguistic instances is important when constructing a grammar. If a certain verb is used in a particular construction more frequently, the instance in which the verb and the construction co-occur will be considered semantically more compatible. In turn, more semantically compatible items will be used more frequently together.

This study supports this hypothesized relation of the usage-based model by showing that semantic compatibility between linguistic elements is a gradient phenomenon, and this degree of semantic compatibility is correlated with frequency of the verb-construction co-occurrence.

3. Semantic compatibility between the DC and various verbs

The semantic compatibility discussed in this section is the semantics of the English ditransitive construction, i.e. DC ([V NP1 NP2]) and the main verb underlined in (5).

(5) He handed me a little rectangle of white paper.

Goldberg (1995: 141) proposes that the sense of the DC is 'successful transfer between a volitional agent and a willing recipient.' In addition, Pinker (1989) regards the notion of "possession" as one of the important semantic properties of the DC. On the basis of their observation, I claim that the meaning of the DC is 'successful transfer of possession between a volitional agent and a willing recipient.'

In the meaning of the DC defined by Goldberg and Pinker, the conditions of the meaning of the arguments such as "volitional" and "willing" are generally conveyed by the NPs. To focus on the verb meaning, I assume that the conditions of the arguments are met: The agent is volitional, the patient is an entity that can be transferred, and the recipient is willing to receive the patient. Then, the only meaning at issue is "successful transfer of possession" and this semantic property is attributed to the verb meaning. I will focus on the verb meaning, therefore.

Note that there are several levels of abstraction in the concept "transfer." First,

the least abstract transfer is "physical transfer" as in (5). This concept of transfer designates a situation in which an agent possesses a concrete entity (i.e., the patient) and the agent transfers the patient to the recipient, and the recipient physically possesses the patient in the end.

The second level of abstraction is metaphorical transfer, as in (6).

(6) He *bequeathed* his son the mansion in Hampshire. (CCELD)

In this case, it is not the mansion itself that is transferred, but the ownership of the mansion is transferred.

A third type of transfer is another type of metaphorical transfer, but it does not involve ownership or possession, as in (7).

(7) Will you *tell* me the story? (CCED_AL)

In (7), via conduit metaphors, COMMUNICATED INFORMATION IS AN OBJECT and COMMUNICATION IS SENDING (Reddy 1979, as cited by Goldberg 1995), *the story* is understood as if it were a transferable entity and the action of "telling the story" is understood as if it were the action of transfer. Consequently, it is understood that the recipient receives information.

Lastly, the most abstract concept of transfer is the concept of benefactive, as in (8).

(8) She *danced* us a waltz. (Pinker 1989: 115)

(8) is different from (7) because in (7) the recipient metaphorically receives the patient, *a story,* while in (8), what is transferred is the whole action performed by the agent. For example, in (7) the agent gives information in the form of the story to the recipient, whereas in (8) the agent does not give *a waltz*: rather, the agent gives the recipient the whole action of dancing a waltz for the benefit of the recipient. This benefactive meaning involves the metaphor "actions which are performed for the benefit of a person are objects which are transferred to that person" (Goldberg 1995: 150). The last level of transfer, which is the benefactive meaning, is subsumed in transfer throughout all levels of abstractness (Pinker 1989: 117). Pinker pointed out that "the cognitive content of the notion of 'benefactive'

and ‘gaining possession’ may be similar” (Pinker 1989: 117). Through the event of transfer, the recipient is benefited because he/she obtains the patient either physically or metaphorically.

Understanding that the salient meaning of the DC is transfer of possession and the benefactive meaning is implied in all levels of abstractness of transfer, I will discuss the semantics of verbs and their compatibility with the DC. When discussing the verb meaning, I will consider the event scene prototypically evoked by the verb, which is generalized from specific instances.

In order for a verb to be semantically more compatible with the construction, the verb meaning should overlap with the constructional meaning as much as possible. In other words, the event scene prototypically evoked by the verb should involve “transfer of possession of the patient from the agent to the recipient” to a greater extent. If a verb involves transfer to a less great degree, the verb will be less compatible with the construction.[2]

The first criterion to determine the degree of involving transfer of possession is “how many salient participants are involved in the event that the verb designates.” In the most prototypical event of transfer of possession, three participants are salient: the person who transfers, the entity that is transferred, and the person who receives the entity. If the number of participants salient in the event is less than three, the verb will be less compatible with the transferring event. For example, in the event scene of *make*, there are typically two salient participants: a person who makes and the object which is made.[3] When there is no recipient to receive the entity, transfer of possession cannot occur at all. Moreover, if there is one participant, it is even less compatible with the DC. For example, the verb *sleep* involves only one participant in the sleeping event. Since there is no person to receive an entity and no entity to be transferred, the transfer cannot happen. Therefore, *sleep* is the least compatible with the DC.

The second criterion is “whether or not the action designated by the verb makes

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[2] As one of the reviewer pointed out, DC and a dative construction in English are closely related. It is worth comparing the meaning of the DC with that of the dative construction. However, my research question is not about alternation and comparison with the dative construction. Bringing the dative construction into the discussion of this article will make the scope of this study larger. I will put this issue for the future study.

[3] It is possible to imagine that there might be the third person who will receive the object made by the agent, but this person is not salient in the event of *make*.

the patient transferable or not, if the patient is to be transferred." The most prototypical scenario of the transferring event is that the transferred entity is not damaged or, more generally speaking, negatively affected by any other actions before the entity leaves agent's dominion, or sphere of control (Langacker 2008: 242). As I discussed above, it is subsumed that the recipient is benefited through transfer, but the recipient is not likely to be benefited if the patient is damaged. Therefore, if a verb describes an event where the agent damages or negatively affects an entity, the verb is less compatible with the meaning of the DC.

Based on the criteria above, I categorized various verbs into five as in Table 1 (see the column "Category based on the degree of transfer"). For the verbs in the first three categories, I subclassified them, following Goldberg (1995) and Pinker (1989)'s subclassification of verbs that can occur in the DC (see the column "verb subclasses"). In addition, I added more verbs and subclassified them into damaging, emotion, cognition, and intransitive verbs and categorized them based on the criteria.

Table 1. Summary of verbs in different degrees of transfer involvement

Category based on the degree of transfer	Verb subclasses	Number of participants			Possibility of transfer
		3	2	1	
Verbs of inherent transfer	Inherently signifying giving (*give*)	Y			
	Communication (*tell*)	Y			
	Instrument of Communication (*fax*)	Y			
	Future having (*allow*)	Y			
	Sending (*send*)	Y			
	Deictic (*bring*)	Y			
Verbs of possible transfer	Ballistic motion (*throw*)		Y		The patient is intact, potentially transferable.
	Creation (*cook*)		Y		
	Obtaining (*find*)		Y		
Verbs of prevented transfer	Refusal (*refuse*)		Y		Attempted but failed
Verbs of impossible transfer	Damaging (*break*)		Y		impossible

Verbs of events internal to the agent	Emotion/cognition (*think*)		Y		impossible
	Intransitive (*run*)			Y	impossible

In Table 1, the most compatible verbs are those in which transfer is inherent. The transfer denoted by the verb can metaphorical (i.e., *tell* and *fax*) as well. These verbs involve three participants in the prototypical event scene and the patient is not negatively affected by the action designated by the verb.

The second most compatible verbs typically involve two participants (agent and patient) and are used in a simple transitive construction, as in (9a). However, the patient can be transferred if a recipient is involved, as in (9b), when it occurs in the DC.

(9) a. I have to go and *cook* the dinner. (CCED_AL)
b. We'll *cook* them a nice Italian meal. (CCED_AL)

The third most compatible verbs are refusal verbs.

(10) The French *refused* to consider the proposal. (CCELD)

In (10), there are two participants: the person who refuses (the French) and the entity that is refused (the action of considering the proposal) while the person who is refused is backgrounded. The verb *refuse* can be used in the DC as in (11), however.

(11) The USA *refused* John a visa. (CCED_AL)

John may have requested to receive the visa as a recipient, so we can say that there might have been an attempt for transfer, but because of the central sense of *refuse*, which is 'choose not to do an action desired by another,' transfer fails. Because the recipient is not required in the event scene, it does not meet the first criterion. The second criterion is not satisfied either because transfer, which could have occurred, becomes impossible due to the refusing action. Therefore, I claim that the verbs in this category are less compatible than the verbs of possible transfer.

The forth most compatible verbs are the verbs of damaging. For example, *kill* involves two participants, as in *John killed the lion*. Since the patient is damaged by the action of killing, the recipient is not likely to be benefited. Therefore, damaging verbs are not very compatible with the DC. If the verb is ever used in the DC, the sentence is interpreted as benefactive meaning as in *John killed Mary a lion*: Mary wanted the lion to be killed, so John killed a lion for the benefit of Mary. However, physical or metaphorical transfer is hard to occur.

Lastly, if an event designated by the verb occurs only within the dominion of the agent, it is the least compatible with the DC. For example, the events of staying or thinking do not affect other participants. On the other hand, transfer can occur only when three participants interact. Therefore, these verbs are incompatible with the DC.

Note that there are verbs that have been claimed not to occur in the DC (Goldberg 1995; Pinker 1989; Bresnan and Nikitina 2009; Krifka 2004). Those are *present, donate, provide, push, whisper, say,* and *choose*. Although these verbs are known as not occurring in the DC, I categorize them into the verbs of inherent transfer (e.g., *present, donate*, and *provide*) or verbs of possible transfer (e.g., *push, whisper, say,* and *choose*) depending on their semantics, on the basis of the criteria. I will see if these verbs can actually be used in the DC in the corpus and if they ever occur in the DC, I will examine how frequently they are associated with the DC.

The semantic analysis of compatibility in this section assumes that the semantic compatibility is not binary, i.e. divisible into "compatible" and "incompatible." Instead, there are different degrees of compatibility. Depending on the degree of compatibility, the likelihood that the verb can occur with the DC will also be gradient. Based on the usage-based model, I claim that the observations on semantic compatibility will be correlated with the usage as well. In the next section, by using collexeme analysis (Stefanowitsch and Gries 2003), I will examine which verbs are more frequently associated with the DC relative to other verbs.

4. Corpus analysis of the ditransitive construction and its co-occurring verbs

In order to examine the frequency pattern of the use of the DC and various

verbs, I will use a part of the British National Corpus (Tagged) (BNC, henceforth). I selected a part of spoken data of the BNC, since spoken language is likely to be less strict and less sensitive to "prescriptive grammar" than written language. According to the prescriptive grammar, unusual instances in which *kill* or *dance* used in the DC should not occur. However, I expected that the spoken data would show various co-occurrences of verbs and the DC. Among the spoken data, I specifically selected a part of spoken data of the BNC containing casual conversation, of which I selected one third of the files. The number of words in the corpus selected from the BNC for this study was about 1,450,000.

The software that I used to search for instances of the DC was *MonoConc Pro* (Barlow 1996, 2004). From this part of corpus, I selected the instances of the DC. For the detailed method of searching for the instances, see Yoon (2012).

Note that some of the word strings of [V NP1 NP2] are not related to the DC. A few are presented in (12) and (13).

(12) a. …he would *call* a spade a spade (BNC_KB0).
b. …would you like to take that resolution first and *make* this an extra resolution. (BNC_KB0)

(13) a. it *cost* **her** fifteen pound. (BNC_KB6)
b. we won't *charge* **you** a pound for this (BNC_KP1)
c. I *bet* **you** any money you like. (BNC_KPA)

In the examples in (12), the NP2 functions as a predicate nominative: the NP1 and NP2 refer to the same entity. On the other hand, NP1 and NP2 in the DC refer to different entities, specifically the recipient and the patient. Also, there is no sense of transfer at all in (12). Thus, I excluded these instances because they were clearly not instances of the DC.

Regarding the examples in (13) Bresnan and Ford (2010) included *charge* and *bet* when discussing the dative alternation between the double object construction (the DC in this study) and *to/for*-preposition construction. Pinker (1989: 111) regarded verbs such as *cost, charge*, and *bet* as "verbs of future not having," and suggested that they can occur in the double object construction, [V NP1 NP2]. However, Bresnan and Ford (2010) and Pinker (1989) neither examined the specific meaning of the verbs nor considered the constructional meaning of the double object

construction. Considering the constructional meaning of the DC, we can say that the DC is one type of double object construction, which specifically has the meaning, "successful transfer between a volitional agent and a willing recipient". Even though *cost, charge*, and *bet* occur in the double object construction, the instances where these verbs are used in the double object construction are not examples of the DC because the constructional meaning and the thematic roles are different. Therefore, I exclude the instances in (13).

Specifically, in (13a), the subject is the transferred object (patient), and NP2 is the money transferred to the other unexpressed participant (i.e. a seller) in exchange for the patient. The NP1 (*her*) is the person who loses, rather than gains, the amount stated as the patient. Therefore, NP1 is not considered to be a recipient. In addition, *bet* in (13c) can be discussed within the frame of RISK proposed by Fillmore and Atkins (1992). The subject, *I*, can win or lose the money by the action designated by *bet*. Therefore, *I*, in (13c), is both simultaneously the actor of the betting and the victim or a potential loser of the money. NP1, *you*, can be a person who may win or lose the money (i.e. beneficiary or victim). NP2, *any money*, is the valued object. Since the participants' roles in (13) are different from those in the DC, the instances of *bet* are set aside. In short, the thematic roles of the arguments and the constructional meaning differ from the DC. Therefore, I excluded the examples in (12) and (13).

(14) summarizes the important information of the corpus described above.

(14) a. the total number of words in the corpus: 1,450,000
b. the number of instances of the DC (token frequency): 1,374
c. the number of verbs used with the DC (type frequency): 49

4.1 Collexeme analysis

Since I attempt to claim that semantic compatibility between a verb and the DC is strongly associated with the frequency of their co-occurrence, I assume that the verb and the construction are frequently used together because there is a strong association between them. In other words, their frequent co-occurrence is not because of coincidence, but because of their strong association derived from semantic compatibility, and their frequent use can lead to higher semantic compatibility, in

turn.

Relative frequency has often been measured in the following way: We count the total number of instances in which a particular construction is used; we count the number of instances in which a particular verb is used in the construction; we calculate the percentage of the instances in which the verb is used in the construction; we repeat the same procedure for other verbs; then we compare the percentage of each verb. For example, in the corpus data that I used for this study, there were 1,374 instances in which the DC was used. Among these instances *get* was used as a main verb in the DC 139 times. The percentage of use of *get* was 10.11% ([139 /1,374] × 100). On the other hand, *tell* was used 123 times, which was 8.95% ([123 / 1,374] × 100). In this way, we can see that *get* is relatively more frequently used in the DC than *tell* is.

However, this method of obtaining relative frequency only shows the following relativity: a verb (V) is more frequently used in the construction (C) compared to the case in which other Vs are used in this C. It ignores another relativity: the V is more frequently used in the C compared to the case in which this V is used with other Cs. For example, *get* was used 16480 times in other constructions than the DC, meaning that only 0.84% of *get* were used in the DC and majority of the instances of *get* were used in other constructions. On the other hand, *tell* was used 1885 times in other constructions, meaning that 6.53% of *tell* were used in the DC. In other words, it is possible that *tell* is more strongly attracted by the DC than *get*. The number of *get* used in the DC was larger than *tell* (139 vs. 123) because *get* is more frequent verb than *tell* in general as the number of *get* and *tell* not used in the DC shows (16480 vs. 1885), not because there is stronger association between *get* and the DC. Then, can we say that *get* tends to be more strongly associated and more frequently used with the DC than *tell*? Consequently, simply obtaining the percentage that a verb is used in the DC cannot be used to measure the frequency pattern derived from the association between the verbs and the DC.

Instead, I used collexeme analysis (Stefanowitsch and Gries 2003; as applied by Gries et al. 2010). The analysis attempts to show which lexical items are more strongly attracted by a construction relative to other lexical items. At the same time, it also shows which lexical items are more attracted by a particular construction than by other constructions.

Collexeme analysis exploits a statistical significance test, called Fisher's Exact

Test.[4] Fisher's Exact Test determines whether two different factors are associated or not. This statistical analysis is useful when the data are categorical. We can apply this statistical method to the corpus analysis in order to see if the occurrence of *tell* is associated with the occurrence of the DC, for example. An expression where a particular verb is used in a particular construction can be analyzed as having two factors: "Verb" and "Construction." Each factor can be analyzed as having binary properties: whether or not the Verb is a particular verb (e.g. "*tell*" or "not *tell*") and whether or not the Construction is a particular construction (e.g. "DC" or "not DC"). For example, the sentence, *John told him a story*, is analyzed as the Verb, "*tell*" and the Construction, "DC." The sentence, *John runs fast*, is analyzed as "not *tell*" and "not DC." In this way, we analyze all the sentences in the corpus with regard to whether or not the verb is *tell* and whether or not the construction is the DC.

For the collexeme analysis, we need four frequencies as in Table 2: the number of instances where the target lexeme (e.g. *tell*) is used with the target construction (e.g. DC), which is (a) in Table 2, the number of instances where other (non-target) lexemes are used in the same slot in the target construction is (b), the number of instances where the target lexeme is used with other (non-target) constructions is (c), and the number of instances where other (non-target) lexemes are used with other (non-target) constructions is (d).

Table 2. Frequency information necessary for the collexeme analysis

	Target lexeme (e.g. *tell*)	Other lexemes (e.g. not-*tell*)
Target construction (e.g. DC)	**a** (e.g., *I told him the truth.*)	**b** (e.g., *I sent him a letter.*)
Other constructions (e.g. not-DC)	**c** (e.g., *I told you.*)	**d** (e.g., *I ran fast.*)

With the numbers in a, b, c, and d, supplied by the corpus search, collexeme analysis employs the *p*-value of the Fisher's Exact Test for each verb that occurs with the construction. By means of Fisher's Exact Test, we can tell whether there is a significant association between the target lexeme and the target construction. If the probability (*p*-value) is small enough, we can conclude that the occurrence of the

[4] There are websites that provide a free Fisher's Exact Test calculator. For this study, I used the following website.
http://research.microsoft.com/en-us/um/redmond/projects/mscompbio/fisherexacttest/

lexeme with the construction is not accidental, in other words, that there is an association between the lexeme and the construction.

Then, the collexeme analysis exploits log-transformation to make the *p*-value easily identifiable. This transformed value is the indicator of **collostruction strength**. For example, after taking $-\log_{10}$, the *p*-value 0.0000147291 is transformed to 4.9820769205 while 0.0001463395 is transformed to 3.8346384095. Now, with these transformed values, we can easily tell that the former is more strongly attracted by the DC than the latter. The larger the value is, the stronger the collostruction strength is. Based on the collostruction strength of each verb, we can rank them to indicate which verb is more associated with the construction than others.

Note that collexeme analysis does not necessarily require a cut-off *p*-value to decide strictly whether or not the lexical item and the construction are associated, because the aim of this analysis is not to categorically determine whether or not they are related. Rather, it aims to show which lexical items tend to be more strongly associated with a particular construction. Also, note that the ranking of the collostruction strength is not absolute across different corpora, but is a general tendency that a particular lexeme is likely, or not, to be used frequently with a particular construction.

4.2 Result

As a result of collexeme analysis, the verbs are ordered and ranked by their collostruction strength: the first one as the most attracted by the DC (i.e. the most frequently associated with the DC) and the last one as the least attracted by the construction (i.e. the least frequently associated with the DC). Table 3 presents ten verbs that are the most frequently associated with the DC and ten verbs that are the least frequently associated with the DC.

Table 3. Verbs that occur with the ditransitive construction, ordered by the collostruction strength

Rank	Verb	Uses in DC	Number of Instances	*p*	Collo_Strength
1	*give*	710	1825	0	∞[5]
2	*tell*	123	2008	1.11E-65	64.95539
3	*show*	50	368	6.67E-44	43.17604
4	*send*	44	372	3.9E-36	35.40936
5	*buy*	65	1127	1.47E-33	32.83304
6	*owe*	16	62	9.26E-20	19.03328
7	*lend*	13	46	6.85E-17	16.16459
8	*offer*	10	63	1.32E-10	9.879097
9	*take*	3	2916	1.46E-07	6.837137
10	*put*	7	3221	8.46E-06	5.072527
…	…	…	…	…	…
40	*pour*	1	45	0.3134	0.503901
41	*chuck*	1	54	0.3632	0.439854
42	*earn*	1	55	0.3685	0.433563
43	*serve*	1	77	0.4746	0.323672
44	*throw*	2	200	0.6844	0.16469
45	*run*	4	457	0.7948	0.099742
46	*get*	139	16619	0.9283	0.032312
47	*allow*	1	172	1	0
47	*drop*	1	139	1	0
47	*sort out*	1	155	1	0

The verb that has the strongest collostruction strength is *give*, meaning that it is the most strongly associated with the DC, or the verb which occurs most frequently in the DC. Other verbs that are strongly associated with the DC are *tell, show, send,* and *buy*. Verbs that are the least strongly associated with the DC are *allow, drop,* and *sort out*. Since the collostruction strength of these verbs is the same as 0, they are equally ranked at 47.

I plotted the verbs in Figure 2 in order of collostruction rank. Even though the cut-off point in which the *p*-value .05 is not very important in collexeme analysis, I divided the verbs that are more strongly associated with the DC and those that are less strongly associated with the DC by drawing the line with a gray vertical line, which is located between the rank of 26 and 27 (cf. Table 3).

[5] The collostruction strength of *give* was so strong that the strength was almost infinity.

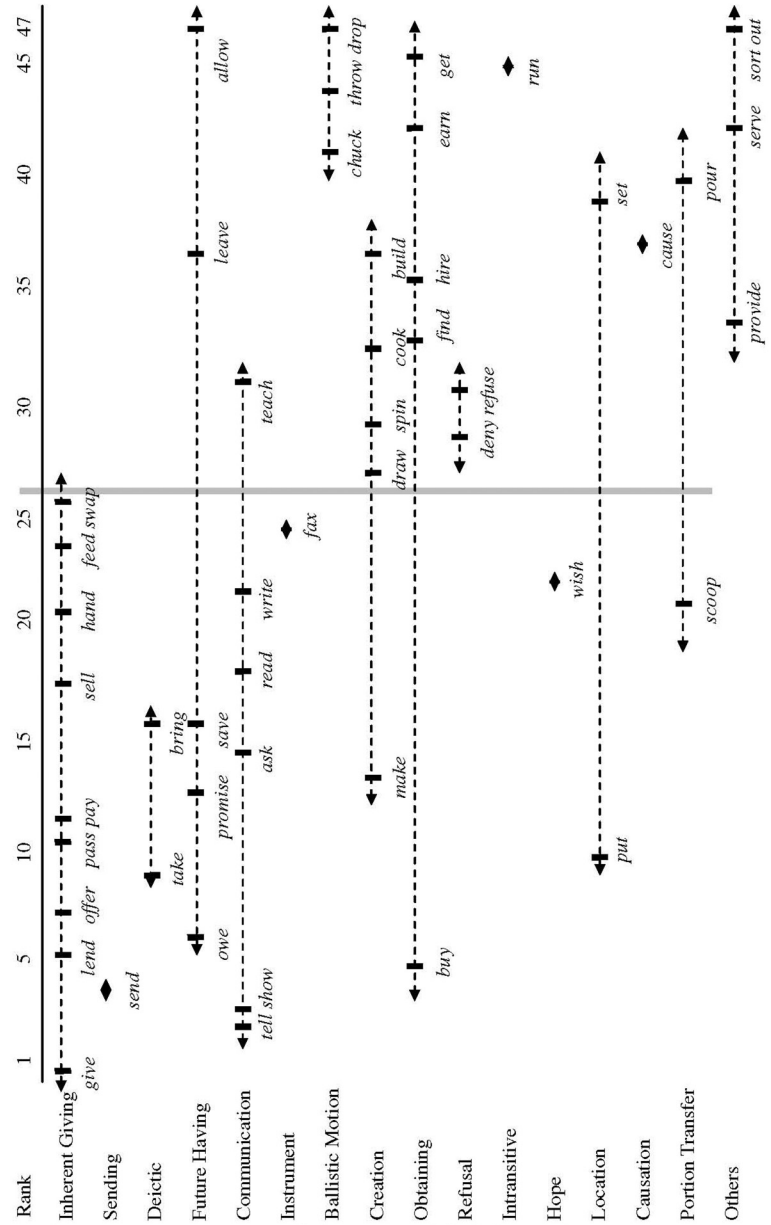

Figure 2. Verbs that occur with DC, plotted in the chart in order of collostruction strength

As we can see in Figure 2, almost half of the verbs that occur in the DC in the corpus belong to the verbs inherently signifying transfer (e.g., *give, tell, send*, etc). Moreover, they are ranked above 26, meaning that they are relatively more frequently associated with the DC than other verbs. On the other hand, the second most compatible verbs, i.e., verbs of possible transfer (e.g., *make, find, throw*, etc) and the third most compatible verbs, i.e., verbs of refusal (e.g., *refuse* and *deny*) are relatively less frequently associated with the DC. The forth most compatible verbs, i.e. verbs of impossible transfer (e.g., *break* and *cut*) did not occur in the DC at all. Among the least compatible verbs, only *run* and *wish* occurred in the DC.

In the corpus, there were some verbs that were not discussed as occurring in the DC by Goldberg (1995) and Pinker (1989), which were *put* and *set* (termed as location verbs in this study), *cause* (a verb of general causation), *scoop* and *pour* (verbs of portion transfer), and some other verbs (*provide, serve*, and *sort out*). Note that *provide* has been reported as not occurring in the DC by researchers (cf. Section 3). However, it is actually used in the DC. In general, however, these verbs are not strongly associated with the DC.

The collostruction ranks of the verbs that occurred in the DC in the part of BNC show a general tendency that the verbs that are more semantically compatible with the DC are frequently used in the DC. In the next section, I will test if this tendency is statistically significant.

5. Correlation between semantic compatibility and frequency

5.1 Correlation

In order to examine if the degree of semantic compatibility set up in Section 3 is correlated with the frequency of the verb-DC co-occurrence, I selected twenty-five verbs from various verb subclasses in Table 1. Some of them were mentioned by Goldberg (1995) and Pinker (1989) as occurring in the DC, and categorized them into five semantic compatibility categories, on the basis of the criteria introduced in Section 3. On the other hand, some of the verbs were not explicitly mentioned by Goldberg and Pinker, but occurred in the DC. They could be subclassified into the proposed subclasses. For example, *drop* and *rent* were not explicitly mentioned by

Goldberg and Pinker but I could subclassified them into the ballistic motion verb and obtaining verb, respectively. Some verb subclasses were not mentioned as occurring in the DC at all (verbs of damaging, emotion/cognition/hope, and intransitive), but I also tested them.

The selected verbs are presented in Table 4. For convenience of discussion, I labeled the most compatible categories as SemCom1, the least compatible categories as SemCom5, and the intermediate categories as 2, 3, and 4, respectively.

Table 4. The verbs selected for the correlation

Semantic Compatibility Category	Verb Subclass	Selected verbs
Verbs of inherent transfer (the most compatible) **SemCom1**	Inherently signifying giving	*give*
	Communication	*tell*
	Instrument of communication	*fax*
	Future having	*owe, promise, leave, allow*
	Sending	*send*
	Deictic	*bring*
Verbs of possible transfer (2nd most compatible) **SemCom2**	Ballistic motion	*throw, drop*
	Creation	*create, cook*
	Obtaining	*find, buy, rent* (*hire* in BE)
Verbs of refused transfer (3rd most compatible) **SemCom3**	Refusal	*refuse, deny*
Verbs of impossible transfer **SemCom4**	Damaging	*break, cut*
Verbs of events internal to the agent (the least compatible) **SemCom5**	Emotion/cognition/hope	*think, want, wish*
	intransitive	*stay, sneeze*

In addition to these verbs, I added three more verb subclasses which were actually found to be occurring in the DC in the corpus. They were *put, set*, and

cause.

Cause generally means to 'make something happen' (CCELD). This verb can occur in a monotransitive construction as in (15). Since there is no other participant than *he* and the caused event *chaos*, transfer does not occur.

(15) … he's gonna *cause* chaos… (BNC_KP1)

Also, for the case of *put* in (16), even though there are three arguments, the third argument is a location rather than a recipient. The transfer, inherent in the meaning of *put*, is simply transfer of location rather than transfer of possession.

(16) I'll *put* them [sausages] in the freezer. (BNC_KB0)

Since transfer of possession is not inherent in *put, set*, and *cause*, I categorized them as SemCom2. However, in the corpus data, these verbs were used in the DC as in (17).

(17) a. Well what I do with Matthew is, I *put* him the lettuce and tomato and celery in one portion… (BNC_KDW)
b. I hope this doesn't *cause* you a problem (BNC_KE3)

I also added the verbs, which has been reported as not occurring in the DC in the correlation in order to see the association strength pattern.

As a result, the added ten verbs are summarized in Table 5.

Table 5. Verbs that are added for the corpus analysis

Verbs occurring only in the corpus	Location General causation	*put, set* *cause*
Verbs that are expected not to occur in the DC	*present, donate, provide, push, whisper, say, choose*	

Consequently, thirty-five verbs in total were selected for correlation.

Each of these verbs was given a score of semantic compatibility: SemCom1 verbs were given the score of 1, and SemCom2, SemCom3, SemCom4, and

SemCom5 were given 2, 3, 4, and 5, respectively.

As a result, the compatibility scores and collostruction ranks of thirty-five verbs are presented in Table 6.

Table 6. Semantic compatibility scores and collostruction ranks of the verbs selected for the experiment

Verb	Compatibility Score	Collostructional Rank	Verb	Compatibility Score	Collostructional Rank
give	1	1	*create*	2	50
tell	1	2	*deny*	3	28
send	1	4	*refuse*	3	30
owe	1	6	*break*	4	50
promise	1	13	*cut*	4	50
bring	1	16	*wish*	5	23
fax	1	25	*sneeze*	5	50
leave	1	36	*stay*	5	50
allow	1	47	*think*	5	50
buy	2	5	*want*	5	50
put	2	10	*provide*	1	34
find	2	32	*donate*	1	50
cook	2	33	*present*	1	50
rent	2	35	*push*	2	50
cause	2	38	*whisper*	2	50
set	2	39	*say*	2	50
throw	2	44	*choose*	2	50
drop	2	47			

Then, these compatibility scores were correlated with the collostruction rank of the verbs. For the correlation[6], I obtained Spearman's ρ. I do not assume any causality between semantic compatibility and frequency because, according to the usage-based model, grammar and usage interact (cf. Figure 1) with each other. Therefore, obtaining Spearman's ρ is more appropriate than linear regression. Moreover, since I deal with the data of ranks and discrete scores, Spearman's ρ is more appropriate than Pearson's r.

As a result of the correlation, the degree of semantic compatibility from

6 I used SPSS for the statistical analysis.

linguistic analysis was correlated with how frequently the verbs and the DC were used together (ρ = .45, p < .01).

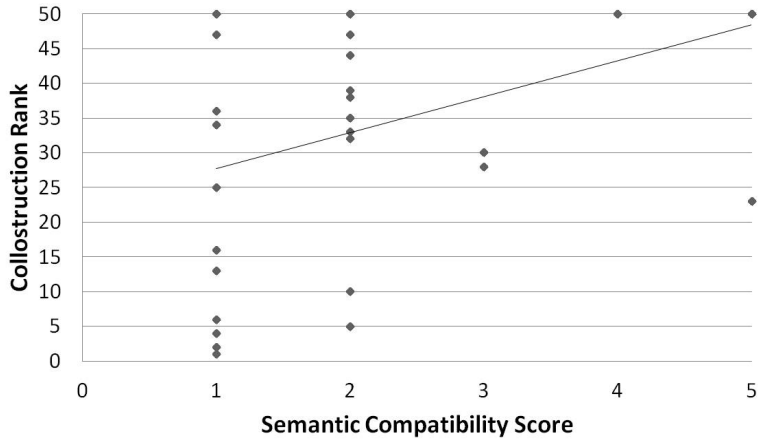

Figure 3. Correlation between semantic compatibility scores and collostruction rank

In Figure 3, note that the collostruction ranks of several verbs, especially the verbs in the forth and the least compatible category (e.g., *break, cut, sneeze*, *stay*, and *think*), are equally presented as 50 because they did not occur in the corpus at all. More than half of the most compatible verbs are relatively more frequently associated with the DC, while more than half of the second, forth, and least compatible verbs are relatively less frequently associated with the DC.

The result of the correlation showed that the verbs that are semantically more compatible with the construction occur more frequently in the construction.

5.2 Discussion

The corpus result presented in Figure 2 showed a general pattern that semantically more compatible verbs tend to occur in the DC more frequently, as most SemCom1 verbs are plotted before the tentative cut-off point. However, as we can see in Figure 3, when we select 35 verbs that occur in the corpus or that have been discussed by linguists as occurring / not-occurring in the DC, there are some

verbs that deviate from the expected correlation.

In the case of *leave* and *allow*, Goldberg (1995) considered them as "future having" verbs, which belong to the most compatible verbs according to the criteria in Section 3. These verbs can occur in the DC, as Goldberg observed, but they were ranked low in the collostruction analysis (36 and 47, respectively) possibly because they are more frequently associated with other construction. For example, *leave* often occur in a simple transitive construction as in (18a), while *allow* can be used with a *to*-infinitive clause as in (18b).

(18) a. I simply couldn't bear to *leave* my little girl. (CCED_AL)
b. The Government will *allow* them to advertise on radio and television. (CCED_AL)

The verbs *provide, present*, and *donate* are known as not occurring in the DC, because of the morpho-phonemic reason that the verbs are Latinate verbs (Pinker 1989). Also, according to Pinker, the morpho-phonemic criterion may be correlated with verb semantics. Mostly, Latinate verbs have more specific meaning than native verbs (Pinker 1989:119) and the relation between the agent and the patient are relatively indirect. However, according to my criteria, there are agent, patient, and recipient, and the patient can be transferred. Therefore, they are categorized in SemCom1. In the corpus data, *provide* was used in the DC. The corpus result shows that the morpho-phonemic criterion may be still applicable because *present* and *donate* are not used in the DC at all. Nevertheless, as *provide* is actually used in the DC, the general semantics of the verbs also affect the usage in the DC.

The verb *wish* can be categorized in SemCom5, because the wishing event occurs in the agent's mind. However, *wish* occurs in the DC in the corpus as in (19).

(19) We *wish* you a merry Christmas. (BNC_KDE)

A caveat is that three out of four instances were the sentence in (19), which was a repeated phrase of a Christmas carol.[7] Because of the repeated expression in the

[7] The other instance was 'But he woke me up this morning to wish me a happy anniversary.' (BNC_KDE)

carol, the collostruction strength became stronger. Therefore, when *wish* appears in other corpora, it could be associated with the DC less frequently than in this corpus.

Whatever the reason for the collostruction strength is, *wish* can occur in the DC as in (19). Let us examine the semantics of *wish* by using (20).

(20) A philosopher once said, 'Be careful what you *wish* for; you might get it.' (CCED_AL)

In (20), a philosopher said that we have to be careful when we wish for something because the wishing action has a magical power that makes the thing that we desire realized. In other words, *wish* has a performative meaning that the action of wishing invites some force that makes the desire come true. However, even in this performative sense, *wish* does not have the meaning of transfer because there is no third person who receives the wished thing.

Nevertheless, because of the performative meaning of *wish,* by wishing something for the benefit of someone, we expect that the person will receive it. In this sense, *wish* can occur in the DC as in (19). In the DC, *wish* functions as a speech act verb: by saying the expression, the event designated by the expression is performed. By uttering the expression (19), the wish of a merry Christmas is transferred to the recipient, *you*, to have or experience. When occurring in the DC, *wish* functions like a verb of communication like *tell* in that to tell means to metaphorically transfer a message to someone, and to wish means to metaphorically transfer a wish to someone. In short, due to the performative and speech act meanings, *wish* can occur in the DC.

I attempted to provide possible verb-specific semantic reasons why some of the verbs deviated from the correlation. However, the deviation may be specific to the corpus that I used for the current study. It is possible that these verbs are not deviation if I examined different corpora. Also, the collostruction ranks resulted from the collexeme analysis can be different in other corpora. This might be the limitation of the study. Therefore, examining lager size corpora will result in more reliable correlation.

Despite the deviation, there was a general tendency that semantically more compatible verbs and construction are used more frequently used together. For example, *give* is considered the most compatible with the DC, and it was the most

frequently used in the DC. On the other hand, *cook* is less compatible with the DC than *give*, and it was ranked at 33 in the collostruction rank.

The fact that semantically not compatible items can be used together implies that speakers accept using incompatible linguistic items together. Rather, they try to reconcile the semantic incompatibility and make sense out of the sentences. When there is an incongruity between the semantics of a syntactic frame and the semantics of lexical items found in it (Ziegeler 2007), "coercion" occurs in order to reconcile this incongruity. The mechanism of coercion is the Override Principle that "if a lexical item is semantically incompatible with its syntactic context, the meaning of the lexical item conforms to the meaning of the structure in which it is embedded" (Michaelis 2005: 51).

Coercion of the verb meaning into the meaning of transfer has been explained throughout the sections in this study. For example, even though *cook* is not a perfectly compatible verb with the DC, it can be used with the construction as in (9) because *cook* is interpreted as 'make food and give.' In this case, due to the constructional meaning of transfer of possession, *cook* is coerced to the meaning of transfer. Likewise, when *refuse* is used in the DC as in (11), *refuse* is coerced into the transfer meaning: 'the agent decided not to "give" the patient to the recipient.' Also, *cause* and *put* are in SemCom2, but they are used in the DC as in (17) when they mean 'to make the event occur and to metaphorically transfer the event to the recipient' or 'to transfer the patient by putting.' Lastly, *wish* in (19) is also coerced into the transfer meaning by being interpreted as speech act.

Even regarding the sentences in which incompatible verbs like *cut* is used as in (21), some of the consultants of native speakers of English reported that these sentences might be acceptable.

(21) Jane *cut* him the belt.

In (21), *cut* is the verb of impossible transfer because the patient is negatively affected by the action of cutting. Therefore, it is not compatible with the DC, and actually, there was no instance of *cut* used in the DC. However, *cut* can be used in the DC when it is coerced to the meaning of transfer: Jane made a belt and gave it to him. In this way, speakers can use somewhat incompatible linguistic items together by resolving the incompatibility even though the use may not be frequent.

It has been known that when the coercion effect occurs, more processing time is required (Piñango, Winnick, Ullah, and Zurif 2006; Traxler, McElree, Williams, and Pickering 2005; Yoon 2012) in order to resolve semantic incompatibility. This coercing process may affect frequency: If the co-occurrence of a verb and a construction is hard to process, it is not used frequently. In turn, if the co-occurrence is not frequent, the activation pattern is not entrenched as routine, and therefore, the co-occurrence is hard to process. Consequently, I claim that frequency pattern relates not only to semantic compatibility but also to processing effort, and this study highlighted the correlation of frequency and semantic compatibility. The relation between semantic compatibility and processing has been examined in another study (Yoon 2012).

6. Conclusion

From the usage-based approach, this study attempted to provide evidence regarding the correlation between linguistic knowledge and usage. I particularly examined the linguistic knowledge of semantic compatibility between the DC and various verbs and the frequency of their co-occurrence.

I categorized various verbs into five degrees of semantic compatibility based on the criteria of the number of participants in the event and whether or not the patient is transferable as a result of the action. I also conducted collexeme analysis of a part of BNC in order to examine which verbs are more frequently used in the DC. The result generally showed that semantically more compatible verbs are used more often in the DC. Then, I selected thirty five verbs that occurred in the corpus or that linguists (Goldberg 1995; Pinker 1989) have reported as occurring / not-occurring in the DC. It turned out that the frequency and semantic compatibility were significantly correlated.

This correlation supports the prediction of the usage-based model that our linguistic knowledge about semantic compatibility is closely correlated with the usage. This result implies that linguistic knowledge is not independent of language use.

The assumption of the usage-based model that linguistic knowledge is influenced by language use implies that different patterns of language use may lead to different

linguistic knowledge, and that linguistic knowledge is subject to change. This implication leads us to the diachronic change of linguistic knowledge and language use. If less compatible collocations are used repeatedly and entrenched, our knowledge about the compatibility between the linguistic units will be changed, and finally, this change will be reflected in the usage data over time. Some previous studies (Hilpert 2008; Israel 1996; Traugott 2007) showed how constructions, such as Germanic future construction, English *way*-construction, and English degree modifier construction, evolved through time by using corpora, even though they did not directly address the correlation between different degrees of semantic compatibility and coercion with language use. The diachronic study will be another piece of evidence to show that linguistic usage does affect linguistic knowledge and to show the dynamic aspect of semantic compatibility. I will leave the diachronic research on semantic compatibility and coercion for future study.

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