To Coerce or Not to Coerce: A Corpus-based Exploration of Some Complement Coercion Verbs in Chinese

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Abstract

This study takes a corpus-based approach to examine twenty Chinese verbs that have been found to coerce their NP complements into an event type (cf. Lin et al. 2009), with an aim of creating a coercion profile for each verb. A cluster analysis is further conducted on the coercion profiles. The resulting clusters in our analysis show a bi-directional distribution: the verbs in Cluster 1 are found to coerce their complements more frequently, while the verbs in Cluster 2 are found to coerce more noun types. Moreover, many lexical pairs (e.g., antonyms and near-synonyms) are identified in the two clusters. Our quantitative analysis suggests that semantically related verbs can have similar coercion profiles. The empirical findings of the present study complement intuition-based studies on the complement coercion operation in Chinese (e.g., Lin and Liu 2004, Liu 2003) and shed new light on the theoretical framework of the Generative Lexicon.

1 Introduction

our daily language, there are many mismatches in the surface form. A common example that is intriguing to semanticists is John began a book. Though the verb begin is supposed to take an event as its argument, the entity complement a book is also allowed for begin. The intended meaning can be that John began reading or writing a book. An enumerative approach may postulate another sense for begin. However, an economical proposal in the of framework the Generative (Pustejovsky 1995) is the complement coercion operation, which leaves the meaning of the verb

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intact in different contexts by shifting the semantic type of its complement. In the above example, *a book* is shifted from an entity type to an event type.

Such an operation also works in Chinese, as Lin et al. (2009) have demonstrated using the web as a corpus. Nevertheless, the complement operation in Chinese is coercion under-researched through a corpus-based approach. The present study thus uses corpus data to explore twenty coercion verbs in Chinese, aiming to create a coercion profile for each verb. We believe that the empirical findings of the present study will greatly enrich the explanatory power of the Generative Lexicon.

This paper is organized as follows. Section 2 reviews the coercion operations proposed in the Generative Lexicon, and Section 3 reviews some previous studies on the complement coercion operation in Chinese. Section 4 introduces the methodology of the present study. Section 5 presents the results. Section 6 discusses how the results can provide a revealing insight into lexical semantics. Section 7 provides a summary, highlights the contribution of the present study, and suggests potential directions for future studies.

2 Coercion as a Generative Mechanism in the Generative Lexicon

In the framework of the Generative Lexicon, a type coercion operation is defined as "a semantic operation that converts an argument to the type which is expected by a function, where it would otherwise result in a type error" (Pustejovsky 1995:111), and two coercion mechanisms are proposed.

First, consider the sentence in (1), which is perhaps the simplest case of coercion (Pustejovsky 1995:113):

(1) Mary drives a Honda to work.

This example is a case of **subtype coercion**: if an expression α of the type σ_1 is a subtype of σ_2 , then between σ_1 and σ_2 is a possible coercion that allows the expression α to change its type from σ_1 to σ_2 . In (1), *a Honda* is typed as a subtype of car. Further, car is a subtype of vehicle, which fulfills the selectional requirement of the governing verb drive.¹ A coercion chain (i.e., Honda \rightarrow car \rightarrow vehicle) is formed, and it is the subtype coercion that makes a *Honda* a legitimate argument for the verb drive.

Now, consider the following sentences (Pustejovsky 1995:115):

- (2) a. John began a book.
 - b. John began <u>reading a book</u>.
 - c. John began to read a book.

In the above sentences, the complements of the verb began come in different forms. To capture their semantic relatedness and avoid treating begin in such a paradigm as a polysemous verb, Pustejovsky (1995) proposes a complement coercion operation. In the lexical representation of the verb begin (Pustejovsky 1995:116), the second argument of begin is explicitly typed as an event. Therefore, for the sentence (2a) to be semantically well-formed, the NP complement a book needs to be coerced into an event. This can be done by reconstructing an event reading from the qualia structure of book, where the values of the AGENTIVE role and the TELIC role are given as WRITE and READ, respectively. That is, a book in (2a) can be interpreted as an event of writing a book or an event of reading a book. Such a complement coercion is triggered by the governing verb. Moreover, without a qualia value appropriate in the context, such a complement coercion would be impossible. This proposal has two major consequences. First, an enumerative approach to the semantics of a verb can be avoided—that is, the meaning of begin in begin a book, begin a movie, etc. remains identical. Second, the semantic load is spread more evenly between a verb and its complement.

The complement coercion operation in the Generative Lexicon is not just a theoretical construct, but has also been empirically supported (e.g., Baggio et al. 2009, Delogu et al.

¹ For the lexical representation of the verb *drive*, refer to Pustejovsky (1995:114).

2010, Traxler et al. 2002, and Traxler et al. 2005). The hypothesis is that in processing an expression such as *began the book*, we adopt the following strategies (Traxler et al. 2005:4):

"When encountering the noun book, comprehenders access the word's lexical entry and attempt to integrate various stored senses of this word into the evolving semantic representation of the sentence. The mismatch between the verb's selectional restrictions and the stored senses of the coercion noun triggers a process. Comprehenders use salient properties associated with the complement noun and other relevant discourse elements (including but not necessarily limited to the agent phrase) to infer a plausible action that could be performed on the noun. Comprehenders incorporate the event sense into their semantic interpretation of the VP by reconfiguring the semantic representation of the complement, converting $\lceil \beta began \rceil_{\alpha} The$ book]] into $[\beta began[\alpha reading the book]]$. (Conceivably, this could also require reconfiguration of an associated syntactic representation.)"

The results of various experiments (e.g., eye-tracking experiments, ERPs) have shown that the processing cost is associated with the last stage, i.e., reconstructing an event reading for the NP complement.

3 Studies on the Complement Coercion Operation in Chinese

There has been a lack of empirical studies exploring the coercion operations in Chinese. To our knowledge, the only study from the psycholinguistic perspective is Wang (2008), where the aspectual coercion operation in Chinese was investigated. Additionally, corpus-based studies are also rare. One of them is Huang and Ahrens (2003). It is suggested that some classifiers in Chinese (e.g., tang 'a journey' and hui ʻa round') can coerce individual-denoting noun to represent an event (Huang and Ahrens 2003:368). Specifically, regarding the complement coercion operation in psycholinguistic/neurolinguistic Chinese, no study has been conducted, and a corpus-based study waits until Lin et al. (2009).

The reason why the complement coercion operation in Chinese has not received adequate attention is that it is generally held that there is no true complement coercion in Chinese. This claim is based on the observation that while *John began a book* is grammatical, its literal translation into Chinese *Yuehan kaishi yi-ben shu* is unacceptable (Lin and Liu 2004, Liu 2003)—a Chinese speaker must say *Yuehan kaishi du yi-ben shu* 'John began to read a book'. Such an argument appears to be shaky (Lin et al. 2009): there are many English sentences in the literature of the complement coercion operation, but only *began a book* is translated into Chinese in Lin and Liu (2004).

To answer whether the complement coercion operation works in Chinese, Lin et al. (2009) used the web as a corpus. After collecting a set of control verbs in Chinese, they googled these verbs and randomly examined their objects. For example, one of the verb-object pairs from Google was *zhizai daxue* 'aim (at) college'. Next, the pairs were put in the template "V * O", where the asterisk enabled the search engine to get anything between the verb and its object. With the template *zhizai* * *daxue*, the following is one of the sentences retrieved from the web:

(3) ta zhizai shang daxue he aim to attend college 'He aimed to attend college.'

In (3), the complement daxue is coerced with an event reading (i.e., attending college) for the phrase *zhizai* daxue to be semantically well-formed. Cross-linguistically, example shows that the complement coercion operation does work not only in English but also in Chinese. The phrase zhizai daxue is acceptable, and its non-coercive counterpart is also attested. Methodologically, the asterisk in the template can help to automatically identify the agentive role or the telic role of an NP complement (e.g., shang 'attend' for daxue 'college'). The method proposed in Lin et al. (2009) can be applied to further studies on the complement coercion operation in Chinese.

In summary, the study on the complement coercion operation in Chinese is still in its infancy, and corpus-based methods is worth pursuing because it can provide a language-specific insight into the complement coercion operation as a generative mechanism.

4 Method

The database for the present study was the Academia Sinica Balanced Corpus of Modern Chinese (i.e., the Sinica Corpus, for short), which can be accessed through the Chinese Word Sketch Engine.²

Generally, the selection of the verbs for our analysis was based on the appendix in Lin et al. (2009), where 36 complement coercion verbs in Chinese are listed.³ First, disyllabic verbs were selected. Second, verbs with a low frequency (i.e., no more than 100 tokens in the Sinica Corpus) were not considered. Third, the present study focused on the prototypical case of the complement coercion operation in the literature, i.e., coercing an NP complement into an event type. Thus, verbs that seemingly take a proposition (i.e., zancheng 'approve' and tongyi 'agree') were not examined in the present study. Finally, 20 verbs in the appendix of Lin et al. (2009) were selected for further analysis. They are presented in the appendix of this paper.

For each of the 20 verbs, 120 sentences were randomly sampled from the Sinica Corpus. Of all the 2,400 sentences, those in which the verb was nominalized or did not take a complement were not analyzed. Here is an example:

(4) rang haizi jinliang de qu duofang tansuo yu <u>changshi</u>
let child as.much.as.possible DE go
in.many.ways explore and try
'let children explore and try as much as possible'

In (4), the complement of the verb *changshi* is missing and hard to recover from the context. Therefore, such sentences were not analyzed in the present study. In total, 1,586 sentences were analyzed.

For each sentence analyzed in the present study, whether there was a complement coercion operation was manually checked. Consider the following example:

(5) wei jiankang er pao, zai zuotian shunli wancheng disan zhan

² The Chinese Word Sketch Engine is available at http://wordsketch.ling.sinica.edu.tw/. For more details about the Sinica Corpus, refer to http://db1x.sinica.edu.tw/cgi-bin/kiwi/mkiwi/mkiwi/mkiwi.sh.

³ Note that the complement coercion verbs listed in the appendix of Lin et al. (2007) are not exhaustive.

for health ER run, on yesterday smoothly finish third stop

'(someone) ran for the sake of health and successfully finished the third stop yesterday'

In (5), it is the task of arriving at the third stop that is completed. This sentence was coded as showing a complement coercion operation in Chinese. The complement *disan zhan* 'the third stop' was recorded as a noun *type* that could be coerced. The distance between the coercing verb and the coerced complement was coded as 1 because the complement occurs in the first word right to *wancheng*.

5 Results

Overall, of the 1,586 sentences analyzed in the present study, 264 sentences (16.64%) show a complement coercion operation. The results are presented in the appendix. The columns (D), (E), (F), and (G) are used to represent the complement coercion profiles of the verbs examined in the present study. First, the higher the value in (D) is, the more frequently the verb coerces its complement. Second, the higher the value in (E) is, the more the verb is preferred in a complement coercion operation. Generally, there is a linear relationship between the values in (D) and (E), as illustrated in Figure 1. However, it is noted that though some verbs coerce their complement often, the degree to which they are preferred in a complement coercion operation can be relatively lower. For instance, as shown in the appendix, kangju 'resist' (29.2%, i.e., 12 out of 41 sentences featuring kangju) coerces a complement marginally more often than xuvao 'need' (28.5%, i.e., 24 out of 84 sentences featuring xuyao), but the former (4.5%, i.e., 12 out of 264 sentences featuring a complement coercion operation) is slightly less preferred in a complement coercion operation than the latter (9.0%, i.e., 24 out of 264 sentences featuring a complement coercion operation). representation of the coercion profile of a verb, such a difference should be taken into account

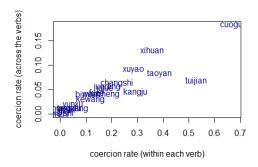


Figure 1. The coercion rates within each verb and across the verbs

Third, the higher the value in (F) is, the more noun types the verb coerces. Fourth, the higher the value in (G) is, the stronger the coercion power of the verb is—in the sense that the verb can coerce a noun that does not syntagmatically adjoin. In brief, the four columns (D), (E), (F), and (G) in the appendix are regarded as reflecting the complement coercion profile of a verb in Chinese.

The four columns (D), (E), (F), and (G) in the appendix were scaled and then used to perform a partitioning around medoids (Kaufman and Rousseeuw 1990).⁵ Such a multivariate analysis is exploratory. Many variables are taken into account, and we are allowed to get a panorama of how the twenty verbs in Chinese are organized in terms of the complement coercion operation. No specific pattern is expected, but the one actually obtained with our data can be interesting and revealing to a certain degree.

In our multivariate analysis, the optimal clusters for the twenty verbs examined in the present study were estimated to be three. The results are presented in (6):

6) Cluster 1 (8 in total): changshi 'try', cuoguo 'miss (fail to do something)', jujue 'refuse', kangju 'resist', taoyan 'dislike', tuijian 'recommend', xihuan 'like', xuyao 'need'
Cluster 2 (11 in total): bimian 'avoid', fuze 'be responsible for', jixu 'continue', jueding 'decide', kaishi 'begin', kewang 'long for', mianqiang 'force', tingzhi 'stop', wancheng 'finish', yaoqiu 'require', yunxu 'allow'

⁴ The term *type* is used here as in *type frequency* (i.e., opposed to *token frequency*), not used to refer to a semantic type (e.g., an individual, an event, etc.).

⁵ The analysis was conducted in R. The pamk function in the package fpc was used.

Cluster 3 (only 1): jinzhi 'forbid'

To reveal the differences between Cluster 1 and Cluster 2, the Mann-Whitney test was performed on the means of the four columns (D), (E), (F), and (G) in the appendix. Table 1 summarizes the results.

	Cluster 1	Cluster 2	<i>p</i> -value
Column (D)	0.365	0.082	0.000053 *
Column (E)	0.090	0.025	0.000106 *
Column (F)	0.799	0.992	0.000026 *
Column (G)	2.620	3.076	0.177400

Table 1. Differences between Cluster 1 and Cluster 2

The verbs in Cluster 1 coerce their complements more frequently. Moreover, they are also characterized by their greater extent to which they are preferred in a complement coercion operation. On the other hand, the verbs in Cluster 2 coerce more noun types than those in Cluster 1. Finally, the distance between a verb and its coerced complement is not found to be a statistically significant variable that distinguishes the two clusters.

Though Lin et al. (2009) found that *jinzhi* 'forbid' could coerce its complement, such a use was not attested in the Sinica Corpus. Therefore, the verb *jinzhi* itself forms a cluster.

6 Discussion

Generally, on the basis of their coercion profiles, the verbs examined in the present study can be grouped into two major clusters. In the following discussion, we will further zoom in to see how the verbs in each cluster are semantically related. Moreover, we will show that the empirical findings of the present study can shed new light on the framework of the Generative Lexicon.

Of the eight verbs in the first cluster, five denote enjoyment and volition: *xihuan* 'like', *taoyan* 'dislike', *tuijian* 'recommend', *jujue* 'refuse', and *kangju* 'resist'. They are compatible with referentially opaque nouns (cf. Pustejovsky 1995:181), i.e., nouns that are weakly constrained by their qualia roles (the AGENTIVE role and the TELIC role, in particular). For such a noun, an event reading can be reconstructed from the context. Here is an example:

(7) wo dangran xiwang guanzhong xihuan wo I definitely hope audience like I 'I definitely hope that the audience like (to watch) me'

In (7), though wo 'I; me' is referentially opaque, an event reading (i.e., watching me) can be reconstructed from guanzhong 'audience'. A referentially opaque noun such as wo 'I; me' can have a relatively higher frequency. The semantic compatibility between a enjoyment/volition-denoting verb and a referentially opaque noun may explain why the verbs in Cluster 1 coerce a complement more frequently but coerce fewer noun types.

The verbs in the second cluster are also semantically related to some extent: four verbs denote the beginning or the ending of an event, i.e., *kaishi* 'begin', *wancheng* 'finish', *tingzhi* 'stop', and *jixu* 'continue'. Thus, they prefer referentially transparent nouns (cf. Pustejovsky 1995:181) that are given a process in the AGENTIVE role or the TELIC role, and an event reading is reconstructed from the qualia structure of a complement. Here is an example:

(8) wancheng le geng duo xin dianying finish LE more many new movie '(someone) has finished (shooting) more new movies'

The AGENTIVE role of *dianying* 'movie' can be SHOOT, which is a process that someone can start, finish, stop, or continue.

Furthermore, as can be observed in our quantitative data presented in the appendix, antonyms and near-synonyms may have similar profiles in terms of the complement coercion operation, and they can be clustered together accordingly - e.g., the antonym pair xihuan 'like'/taoyan 'dislike' and the near-synonym pair jujue 'refuse'/kangju 'resist' in Cluster 1; the anontym pairs kaishi 'begin'/wancheng 'finish' and jixu 'continue'/tingzhi 'stop' in Cluster 2. Note that though the antonyms yunxu 'allow' and jinzhi 'forbid' are in different clusters (i.e., Cluster 2 and Cluster 3, respectively), they are similar in that neither coerces a complement frequently. There are some intriguing cases, though. For example, xuyao 'need' and yaoqiu 'require' can be seen as near-synonyms in Chinese, but they are not clustered together.

In Chinese, the verb *jinzhi* 'forbid' is often used in a fairly formal style, and its context

usually leaves little room for a misinterpretation. A misinterpretation can arise from the process of reconstructing an event reading, for the process is inferential. This may explain why the verb *jinzhi* is not found in our data to occur in a complement coercion operation. However, note that the semantics of *jinzhi* does not inherently keep the verb from coercing its complement. Lin et al. (2009), using the web as a corpus, have attested *jinzhi* in a complement coercion operation.

In the exploration of the complement coercion operation in Chinese, the present study makes one step more abstract in co-selectional terms. When checking whether a context features a complement coercion operation, we did not simply sort out the frequent collocations of a verb as we usually do to identify collocational patterns of a lexical item. Rather, we needed to manually assign a semantic type (i.e., entity, event, etc.) to each complement to construct the complement coercion profile of a verb. Though many attempts have been made to investigate the abstract dimensions of a lexical profile (e.g., the semantic preference of a lexical item), few have incorporated the coercion profile of a verb into a verbal profile. The present study shows that the behavioral profile of a verb can include a more abstract dimension, i.e., how the verb interacts with the complement coercion operation. This suggests that the Generative Lexicon can provide a fresh insight into co-selectional/collocational studies.

On the other hand, the findings of the present study have shed new light on the Generative Lexicon. First, the present study is corpus-based, thus offering empirical support for theoretical operations in the Generative Lexicon. Second, the present study examines Chinese data, thus providing cross-linguistic support for Generative Lexicon. The findings here echo Lin et al. (2009), demonstrating that the complement coercion operation is truly a useful mechanism in Chinese. Third, the present study shows that lexical relations antonymy (e.g., near-synonymy) can be revealed through the interaction between the qualia structure and the complement coercion operation, and suggests that the Generative Lexicon achieves its goal to capture the global organization of a lexicon (Pustejovsky 1995:61).

Finally, the theory of norms and exploitations (Hanks 2009, 2013) can be related to the Generative Lexicon (Pustejovsky 1995), though the two theories take different approaches to our language use. They are similar in two ways. First, in the two theories, semantics is given precedence over syntax. Second, the two theories attempt to account for novel usages which may seem unusual or abnormal at first sight. The type mismatch examined in the present study is an example. As have been discussed, the Generative Lexicon deals with type mismatches through the qualia structure and the complement coercion operation. In Hank's theory, two systems primary collaborate: the one governs conventional usages (i.e., norms), and the secondary one governs the exploitation of conventional usages (i.e., exploitations). The two systems cannot be sharply distinguished because a repeated exploitation may finally become a norm. Hanks suggests that the normality of an utterance depends on statistical analyses. In Chinese, the type mismatch between a verb and its complement can be seen as an exploitation: the surface form is a conventional usage in Chinese (i.e., a verb followed by a nominal complement), and it is exploited for economical reasons (i.e., the speaker does not need to explicitly specify the event). However, with the quantitative data from the Sinica Corpus, we have found that the complement coercion operation in Chinese is more dominant for some verbs (e.g., cuoguo 'fail to do something') than for others (e.g., jixu 'continue'). In other words, the complement coercion operation in Chinese can be seen as a norm for some verbs yet as an exploitation for others. This is exactly the insight that such a data-based model as the theory of norms and exploitations can provide for a generative model. While the Generative Lexicon can provide mechanisms to account for how a complement can be coerced, the theory of norms and exploitations can focus on how compatible an individual word is with the complement coercion operation. In short, the former is a model of rules and restrictions, while the latter is a model of preferences and probabilities. The two models can thus complement each other.

7 Concluding Remarks

Our corpus-based study explores the complement coercion operation in Chinese. The present study examined twenty verbs, creating a coercion profile for each verb. A multivariate analysis was conducted on the coercion profiles to cluster the twenty verbs. There are two major clusters: the verbs in Cluster 1 coerce a complement more frequently, while the verbs in Cluster 2 coerce more noun types. The differences can be attributed to the semantics of the verbs. Moreover, many lexical pairs (e.g., antonyms and near-synonyms) are identified in the two clusters. quantitative analysis suggests semantically related verbs can have similar coercion profiles.

As suggested in our review, empirical studies on the complement coercion operation in Chinese are still rare. Our study is corpus-based, complementing intuition-based studies in Chinese (e.g., Lin and Liu 2004, Liu 2003). Additionally, the distributional patterns identified in the present study show that a data-based approach can complement a generative model that places more emphasis on rules and restrictions. The present study can be extended with more verbs analyzed and perhaps more variables taken into account.

Further studies can adopt other empirical approaches to explore the complement coercion operation in Chinese. For example, psycholinguistic/neurolinguistic studies can be conducted to see how Chinese speakers process the complement coercion operation, and acquisition studies are also needed. The framework of the Generative Lexicon can thus benefit from the integration of various empirical approaches.

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Appendix. The coercion profiles of the Chinese verbs examined in the present study

	(A) # of the sentences analyzed		(C) # of the coerced	$(\mathbf{D}) = (\mathbf{B})/(\mathbf{A})$	(E) = (B)/264		(G) The average distance
changshi 'try'	77	17	14	0.22078	0.06439	0.82353	3.52941
cuoguo 'miss'	71	48	37	0.67606	0.18182	0.77083	3.41667
fuze 'be responsible for'	84	12	11	0.14286	0.04545	0.91667	3.75000
jinzhi 'forbid'	86	0	0	0.00000	0.00000	0.00000	0.00000
jixu 'continue'	116	2	2	0.01724	0.00758	1.00000	4.50000
jueding 'decide'	82	15	15	0.18293	0.05682	1.00000	2.60000
jujue 'refuse'	80	14	11	0.17500	0.05303	0.78571	2.00000
kaishi 'begin'	78	1	1	0.01282	0.00379	1.00000	3.00000
kangju 'resist'	41	12	11	0.29268	0.04545	0.91667	1.83333
kewang 'long for'	68	8	8	0.11765	0.03030	1.00000	2.87500
mianqiang 'force'	87	3	3	0.03448	0.01136	1.00000	1.00000
taoyan 'dislike'	57	22	16	0.38596	0.08333	0.72727	2.22727
tingzhi 'stop'	86	3	3	0.03488	0.01136	1.00000	2.00000
tuijian 'recommend'	34	18	14	0.52941	0.06818	0.77778	2.94444
wancheng 'finish'	69	11	11	0.15942	0.04167	1.00000	3.09091
xihuan 'like'	98	35	28	0.35714	0.13258	0.80000	2.25714
xuyao 'need'	84	24	19	0.28571	0.09091	0.79167	2.75000
yaoqiu 'require'	85	3	3	0.03529	0.01136	1.00000	3.00000
yunxu 'allow'	101	5	5	0.04950	0.01894	1.00000	4.20000