ARTICLE

OPEN

Check for updates

Meaning patterns of the NP *de* VP construction in modern Chinese: approaches of covarying collexeme analysis and hierarchical cluster analysis

Jiangping Zhou [1]✉

The NP *de* VP construction in modern Chinese has been of constant interest to theoretical linguists. Previous studies foregrounded word classes of lexical items in the VP slot, semantic relationships between the VP and the NP, and lexical items that could fill both the VP and the NP slots of the construction. However, in this research, we highlighted typical meanings of this construction and the denoted meaning patterns of lexical items in both the VP and the NP slots by drawing on the covarying collexeme analysis and the hierarchical cluster analysis, respectively. The findings demonstrate that typical meanings of this construction generally include the pairing of "regulations" in the NP slot and "implementation" in the VP slot, the pairing of "systems" in the NP slot and "establishment" in the VP slot, and the pairing of "results" in the NP slot and "achievement" in VP slot. Meaning patterns of the lexical items with significant attraction in the VP slot briefly incorporate such clusters as "cognition", "augmentation", "implementation", "achievement", "establishment", and "report"; and those in the NP slot generally include such patterns as "internal traits", "medical names", "regulations", "results", "systems", and "business". The significance of this study lies in that it scientifically identified instances that are capable of expressing the typical meaning of the NP *de* VP construction and uncovered objectively and precisely the denoted meaning patterns of lexical items in the VP slot and the NP slot of the construction.

[1] China West Normal University, Nanchong, China. ✉email: zhoujp@pku.org.cn

Introduction

The NP *de* VP construction in modern Chinese has long been investigated in academia. It has been discussed no less frequently than other Chinese expressions such as *taishang zuo zhe zhuxituan* 'on the platform sits the presidium' and *wangmian qisui si le fuqin* 'Wang Mian's father died when he was seven'. The employment of the concept "construction" in this research underlies Goldberg's definition that construction is "a form-meaning pair that some aspect of the form or the meaning is not strictly predictable from the construction's component parts" (Goldberg, 1995, p. 4); and constructions themselves are meaningful (Goldberg, 1995, 2006). The NP *de* VP construction is a grammatical pattern in which the NP in the first slot represents a nominal phrase and the VP in the third slot represents a verbal phrase; the two types of phrases are threaded by the possessive particle *de*. This construction could be typically instantiated by *mubiao de shixian*[1] 'realization of target' in example (1), in which *mubiao* 'target' is a nominal phrase or NP and *shixian* 'realize' is a verbal phrase or VP. The construction itself is generally regarded as a nominal phrase as a whole (e.g., Guo, 2000; Lu, 2003; Jin, 2019; Yang and Xiong, 2021; Li, 2021, etc.).

(1)法学教育以人权为教育理念，无疑有助于法治目标的实现。[2]

faxue jiaoyu yi renquan wei jiaoyu linian, wuyi

law education on human rights be education idea undoubtedly
youzhuyu fazhi mubiao de shixian

helpful legal target DE realization

'It is undoubtedly helpful to realize the legal targets that legal education takes human rights as its educational idea.'

Previous studies have generally centered on discussions of word classes of the VP (e.g., Wang, 1954; Zhang, 1957; Li and Liu, 1960; Zhu et al., 1961; Zhu, 1982; Wu, 2006; Shen, 2009, 2015; Yuan, 2010; Zhou, 2012; Yang and Xiong, 2021, etc.), heads of the NP *de* VP construction (cf. Lu, 1985, 1993; Jin, 1987, 1992; Hu and Fan, 1994; Cheng, 1999; Li, 2002; Lu, 2003; Si, 2002, 2004; Chen, 2009; Shen, 2009; Wang and Yang, 2017), and semantic relationships between the NP and the VP (cf. Chen, 1987; Zhang, 1993; Wang, 2002, 2010; Wu and Guo, 2018; Fang and Liu, 2021). There is also research investigating the meaning patterns of the construction in terms of the VP slot (cf. Zhan, 1998; Wang, 2002) and the NP slot (cf. Shen and Wang, 2000). Although the aforementioned research have uncovered different aspects of the NP *de* VP construction, e.g., the grammatical category of the VP, the head of the NP *de* VP construction, the semantic relationship between the NP and the VP in the construction, and even the meaning patterns that could enter the NP slot and the VP slot, respectively, there is no study, according to my knowledge, that considers the meaning patterns of the VP and the NP in the NP *de* VP construction drawing on significantly attracted instances to this construction by means of statistic measures such as the statistical significance and/or the association strength based on the real data from a large corpus. It is still unknown what typical meanings of the NP slot and the VP slot denote respectively, leading further to the uncertainty of the meaning patterns of the NP *de* VP construction because construction itself is meaningful (cf. Goldberg, 1995, 2006). Consequently, this paper, drawing on the covarying collexeme analysis (cf. Stefanowitsch and Gries, 2005; Gries and Stefanowitsch, 2010; Hilpert, 2014) and the hierarchical cluster analysis (cf. Gries and Stefanowitsch, 2010; Desagulier, 2017; Zhou, 2021), aims at uncovering instances that are significantly attracted to the NP *de* VP construction so as to identify typical meanings of the construction and meaning patterns of the VP and the NP in this construction. Accordingly, the following research questions are proposed.

1)What are the typical meanings of the NP *de* VP construction?

2)What are the meaning patterns of the VP in the NP *de* VP construction?

3)What are the meaning patterns of the NP in the NP *de* VP construction?

Literature review

Elements in different slots of the NP *de* VP construction were examined by previous research, for example, lexical items in the VP slot, the semantic relationship of lexical items between the NP slot and the VP slot, and meaning patterns of both the VP slot and the NP slot of the construction. Therefore, this section briefly reviews these respects.

In relation to word classes of the VP in the NP *de* VP construction, there are generally two theoretical hypotheses. One hypothesis assumes that the VP in the NP *de* VP construction has been nominalized (cf. Lu, 1985; Chen, 1987; Ye, 2020 for nominalization from the word rank; and Guo, 2000; Xiong, 2001, 2006; Shi, 2008; Lu abd Pan, 2013 for nominalization from the phrase rank). The argument of nominalization of the VP is in accordance with the overall grammatical class of the construction which is universally accepted as a nominal phrase; it also sufficiently explains the linguistic phenomenon that the VP is grammatically pre-modified by the possessive particle *de*. However, the argument of nominalization with respect to the VP in the construction could not persuasively expound the grammaticality and acceptability of the expression *mubiao de chichi bu shixian* 'delayed realization of target', in which the VP *shixian* 'realize' still keeps its verbal syntactic feature of being modified by adverbials such as *chichi* 'with delays' and negative markers such as *bu* 'not'. This leads to the other theoretical hypothesis that word classes of the VP in the NP *de* VP construction are still verbs (cf. Zhu et al., 1961; Zhu, 1982; Wu, 2006). Verbs pre-modified by adverbials are intrinsic natures in the language system, which sufficiently expounds the grammaticality of the expression *mubiao de chichi bu shixian* 'delayed realization of target'. Both arguments are to some extent reasonable in that the former complies with the category agreement between the nominal nature of the VP and that of the construction, and the latter complies with the simplicity of language systems (Jin, 2019). The VP in the NP *de* VP construction is simply regarded as verbs in this research in that they are in line with the tagging system of the BCC corpus. As a matter of fact, treating the VP as nominalized items or verbs does not influence this research to achieve its purposes because we specifically highlight the meaning patterns of the VP and the NP in the NP *de* VP construction.

Chen (1987), Zhang (1993), Wang (2002, 2010), and Wu and Guo (2018) have examined the semantic relationship between the NP and the VP in the NP *de* VP construction. They argued that the NP could be either the agent or the patient of the VP. Concerning *mubiao de shixian* 'realization of target' in example (1), the NP *mubiao* 'target' functions as the patient of the VP *shixian* 'realize'. There are also cases that the NP functions as the agent of the VP in the NP *de* VP construction; this could be exemplified by *lingdao de tiba* 'promotion by leaders' (Wang, 2002, p. 62), in which the NP *lingdao* 'leaders' functions as the agent of the VP *tiba* 'promote'. Significantly attracted instances to the NP *de* VP construction demonstrate that most instances belong to the former kind while only a rather small proportion of these instances belong to the latter kind. Although researchers as such have uncovered the semantic relationship between the NP and the VP in the construction, they do not count on the typical meanings

Table 1 Contingency table of the covarying collexeme analysis of the NP *de* VP construction.		
	M in slot of VP	**M in slot of VP**
L in slot of NP	$freq_1$ (L in slot of NP + M in slot of VP)	$freq_3$ (L in slot of NP + M in slot of VP)
L in slot of NP	$freq_2$ (L in slot of NP + M in slot of VP)	$freq_4$ (L in slot of NP + M in slot of VP)

that these elements could denote or how these meanings could be patterned.

There is also research investigating the meaning patterns of the construction that could enter the VP slot (cf. Zhan, 1998; Wang, 2002) and the NP slot (cf. Shen and Wang, 2000). Zhan (1998) argued that the VP in Chinese could denote the senses of either strong "action" and weak "event" (e.g., *pao* 'run'), or weak "action" and strong "event" (e.g., *shixian* 'realize' and *zhaokai* 'convene'), or weak "action" and weak "event" (e.g., *baokuo* 'include'); however, only lexical items that denote weak "action" and strong "event" are capable of entering the VP slot of the NP *de* VP construction. Zhan's (1998) argument is further corroborated by Wang (2002) who summarized that the weaker the transitivity of a verb possesses, the more likely the verb enters the VP slot of the construction; in other words, the VP in NP *de* VP construction usually denotes a comparatively weak sense of "action". However, Zhan's (1998) and Wang's (2002) conclusions underlie the examples that are not based on large corpora and thus need further testified by examples sourced from a large corpus such as BCC. Concerning the meaning patterns of the NP in the NP *de* VP construction, Shen and Wang (2000) argued that the NP in this construction must have a sense of prominence, which combines two factors, i.e., informativity that refers to "the prompting information" (Shen and Wang, 2000, p. 29) and accessibility that refers to "the difficulty of a relevant concept being retrieved from the memory or the environment" (Shen and Wang, 2000, p. 30). Precisely, the NP with high informativity and accessibility are extremely likely to enter the NP slot of the construction. Nevertheless, Shen and Wang's (2000) argument is not frequency- and/or statistical significance-based, hence it also needs further testification in that their conclusion may underlie peripheral instances which do not represent typical meanings of these NPs.

Methodology

Corpus. This research retrieved data from the corpus of the Beijing Language and Culture University Corpus Center or BCC. Reasons for considering the BCC are three-fold. First, it is presently one of the largest online corpora free of charge, covering ~9.5 billion tokens from various disciplines. Second, it is part-of-speech or POS tagged, which caters to the purpose of this research very well to highlight occurrences of nouns and verbs in the NP slot and the VP slot of the NP *de* VP construction. Third, data in the BCC are taken from different genres, incorporating Newspapers (2 billion), Literature (3 billion), Micro-Blog and film (0.6 billion), Classical Chinese (2 billion), and Miscellaneous (1.9 billion).

Data collection. The search query "../n 的../v", which reads as a construction in the sequence of a 2-character noun, a possessive particle *de*, and a 2-character verb, is implemented to retrieve sufficiently relevant hits of the construction at issue. The purpose of restricting instances of the NP slot and VP slot within 2-character lexical items is to preclude those lexical items with 1-character in that a large proportion of 1-character items retrieved are not typical cases of NP *de* VP construction by means of a pilot study, although some legitimate hits will be wrongly precluded from the analysis such as (这本)书的出版(zheben) shu

de chuban 'publication of this book'; in addition, those items with more than two characters will also be successfully retrieved. Another purpose is motivated by the fact that meaning patterns of the NP *de* VP construction considered in this research are based on association strengths between specific lexical items and constructions, which correlates significantly positively with the observed frequencies of these lexical items (cf. Desagulier, 2017; Zhou, 2021). Precisely, although attested hits of this construction with low frequencies in the BCC enter the computation of covarying collexeme analysis (cf. subsection "Approaches"), they will be regarded as repelled ones by this approach and the produced results will not influence the findings of this research because what is highlighted is the *typical* meaning pattern that the construction possibly denotes.

Approaches. Two approaches are employed to facilitate the fulfillment of the purposes in this study: the covarying collexeme analysis and the hierarchical cluster analysis. Drawing on the covarying collexeme analysis, we could statistically identify lexical items that are capable of entering the VP slot and the NP slot in the NP *de* VP construction, respectively; drawing on the hierarchical cluster analysis, we could objectively cluster these significantly attracted lexical items according to their shared semantic meanings. Therefore, their operationalizations and motivations for selection are further expounded.

Covarying collexeme analysis is one of the three members in collostructional analysis, the other two being the collexeme analysis (cf. Stefanowitsch and Gries, 2003; Hilpert, 2014; Desagulier, 2017; Zhou, 2021) and the distinctive collexeme analysis (cf. Gries and Stefanowitsch, 2004, 2005; Hilpert, 2014; Zhou, 2021). The covarying collexeme analysis identifies "the association strength between pairs of lexical items occurring in two different slots of the same construction" (Stefanowitsch and Gries, 2005, p. 9) or investigates which lexical items in one slot covary with those in another slot. Specifically, this determines which potential lexical items in slot 2 cooccur with each potential lexical item occurring in slot 1 significantly more often than expected or vice versa. Its operationalization could be illustrated by the NP *de* VP construction demonstrated in the contingency Table 1. Table 1 shows that, for the purpose of computing the association strength between the lexical item (L) in the slot of NP and that (M) in the slot of VP in the NP *de* VP construction, four numbers are required; that is, the frequency of cooccurrences of L in the slot of NP and M in the slot of VP (i.e., $freq_1$), the frequency of cooccurrences of other lexical items rather than L in the slot of NP and M in the slot of VP (i.e., $freq_2$), the frequency of cooccurrences of L in the slot of NP and other lexical items rather than M in the slot of VP (i.e., $freq_3$), and the frequency of cooccurrences of other lexical items rather than L in the slot of NP and other lexical items rather than M in the slot of VP (i.e., $freq_4$).

Computation of the association strength between the VP and the NP in the NP *de* VP construction is finished by performing the function *coll.analysis* scripted by Gries (2014) in R language. In this study, by drawing on the Fisher–Yates exact test[3], results of the association strength between the NP and the VP in NP *de* VP construction are transformed by means of negative base-10 logarithm of their *p* values[4]. Values of association strengths that

are larger than 1.301 indicate the statistical significance at the level of $p < 0.05$; 2 at the level of $p < 0.01$; 3 at the level of $p < 0.001$; and Inf indicates that the association strength is infinite and could not be measured by numbers.

Selection of covarying collexeme analysis is directly motivated by the fact that it is an approach that testifies the probability of mutual prediction between the NP and the VP in the NP *de* VP construction. By so doing, we could easily identify instances that are significantly attracted to the NP slot and the VP slot in the construction. Drawing on these significantly attracted instances that could enter both the NP and the VP slots in the NP *de* VP construction, it is possible for us to further pattern the lexical items that are similar in meanings by means of the hierarchical cluster analysis.

Hierarchical cluster analysis is a member of cluster analysis[5] which is an umbrella term for a number of related agglomerating analyses. It depicts a series of multifactorial methods to examine the structure in data for the purpose of identifying clusters of similar objects (cf. Everitt et al., 2011; Desagulier, 2014). It agglomerates individuals based on their distances which rely on the parameters that characterize them. This approach has been widely used in linguistics, particularly in corpus linguistics (cf. Divjak and Gries, 2006, 2008; Gries and Stefanowitsch, 2010; Divjak and Fieller, 2014; Desagulier, 2017). Hierarchical cluster analysis requires the data be a table T of I observations or individuals and K variables. Numbers of the dependent variable could be continuous (real numbers), discrete (integers), or both. It converts the table into a distance object by implementing an amalgamation rule (e.g., Ward's method which, by employing an analysis of variance, evaluates the distances between clusters) which determines in what ways elements in the distance object could be clustered into groups. This method is performed by the function *hclust* or *pvclust* in R language.

Hierarchical cluster analysis is chosen in this study in that it could cluster lexical items that are significantly attracted to the VP slot and the NP slot in the NP *de* VP construction according to their meanings. In addition, the clustering of lexical items in both slots underlies one another's covarying collexemes; precisely, the clustering of lexical items in the VP slot generally relies on those that are significantly attracted to the NP slot of the NP *de* VP construction, and the clustering of lexical items in the NP slot chiefly relies on those that are significantly attracted to the VP slot of the construction. This means of clustering, i.e., relying on

covarying collexemes, is initially proposed by Gries and Stefanowitsch (2010) who argued that it is more objective and precise than previous clustering that relies only on a linear context or certain word classes within a specific window around the node word. In so doing, it will "shed light on the most typical senses of a construction as well as sub-senses instantiated by coherent semantic classes of words occurring in it" (Gries and Stefanowitsch, 2010, p. 73).

Covarying collexeme analysis of the NP *de* VP construction
Implementation of the covarying collexeme analysis produced the results that are presented in Table 2. Instances of the NP *de* VP construction are ranked according to their association strengths between lexical items and the construction, which are presented in the first column; column name 'NP *de* VP' profiles typical instances of this construction; column name 'obs. freq.' stands for observed frequencies of the construction in the corpus; column name 'exp. freq.' means the expected frequency that a certain instance of the construction should occur in the corpus; column name 'relation' demonstrates whether a certain instance is attracted or repelled to the NP *de* VP construction; column name 'Coll.s' shows values of the association strength.

Table 2 shows that there are 515 instances that are significantly attracted to the NP *de* VP construction, the 515th one being the *shuiping de zengjia* 'increasement of levels' (Coll.s = 1.71 > 1.303, $p < 0.05$). Among the 515 significantly attracted instances to the construction, there are 71 instances whose association strengths reach the infinite level (i.e., Coll.s = Inf). Those instances are typical cases that are capable of representing meanings of the NP *de* VP construction and thus are chiefly employed to analyze the meaning patterns of the VP slot and the NP slot in sections 5 and 6, respectively. Scrutinization of those typical cases demonstrates that typical meanings of the NP *de* VP construction briefly include the pairing of "regulations" in the NP slot and "implementation" in the VP slot, the pairing of "systems" in the NP slot and "establishment" in the VP slot, and the pairing of "results" in the NP slot and "achievement" in VP slot.

The pairing of "regulations" in the NP slot and "implementation" in the VP slot. The first typical meaning pattern of the NP *de* VP construction pairs the lexical items in the NP slot that denote the sense of "regulation" and those in the VP slot that

Table 2 Results of covarying collexeme analysis of the NP *de* VP construction[6].

Rows	NP *de* VP	Obs. freq.	Exp. freq.	Relation	Coll.s
1	*mubiao de shixian* 'realization of targets'	2344	131.74	attraction	Inf
2	*shijian de yanchang* 'prolonging of time'	990	19.17	attraction	Inf
3	*zeren de chengdan* 'undertaking of responsibility'	142	0.56	attraction	Inf
4	*tizhi de jianli* 'establishment of regulation'	938	67.85	attraction	Inf
5	*tixi de jianli* 'establishment of systems'	876	71.18	attraction	Inf
6	*kecheng de kaishe* 'setting up of subjects'	118	0.24	attraction	Inf
7	*wenti de jiejue* 'resolution of issues'	842	35.73	attraction	Inf
8	*bufa de jiakuai* 'speeding up of steps'	781	22.79	attraction	Inf
9	*zuoyong de fahui* 'performance of functions'	751	35.28	attraction	Inf
10	*huiyi de zhaokai* 'convening of meeting'	750	12.54	attraction	Inf
11	*xingwei de fasheng* 'taking place of behaviors'	733	168.14	attraction	Inf
12	*guimo de kuoda* 'expanding of scales'	714	11.6	attraction	Inf
13	*chengji de qude* 'achievement of results'	666	8.72	attraction	Inf
14	*shigu de fasheng* 'occurrence of accidents'	1893	309.93	attraction	Inf
15	*yishi de zengqiang* 'increasement of awareness'	652	15.18	attraction	Inf
16	*zhishi de zhangwo* 'commanding of knowledge'	619	17.21	attraction	Inf
17	*shuiping de tigao* 'improvement of levels'	536	19.38	attraction	Inf
...	...	...	...	...	...
515	*shuiping de zengjia* 'increasement of levels'	73	56.97	attraction	1.71

denote the sense of "implementation". The former is briefly realized by such lexical items as *zhengce* 'policy', *zhidu* 'regulation', *gongneng* 'function', and *zuoyong* 'function', and the latter is generally realized by verbs such as *zhiding* 'enact', *guanche* 'implement', *lvxing* 'perform', and *xingshi* 'perform'. This pairing could be exemplified by the sentence in (2), in which *zhengce* 'policy' which expresses the sense of "regulations" significantly covaries with *zhiding* 'enact' which expresses the sense of "implementation".

(2)公共行政就是公共政策的制定。

gonggongxingzhengjiushigonggongzhengcedezhiding

publicadministrationbepublicpolicy<small>DE</small>enact

'Public administration is the enactment of public policy.'

The pairing of "systems" in the NP slot and "establishment" in the VP slot. The second typical meaning pattern of the NP *de* VP construction pairs the sense of "systems" in the NP slot with the sense of "establishment" in the VP slot. Lexical items that realize the former sense include *jigou* 'organization', *tizhi* 'regulation', *tixi* 'system', and *jizhi* 'mechanism', and those that realize the latter include *jianli* 'establish', *sheli* 'set up', and *kaishe* 'set up' (cf. rows 4 and 5 in Table 2). This pairing is evidenced by the example (3), in which the typical meaning regarding the pairing of "systems" and "establishment" in both slots of the NP *de* VP construction is realized by the significant covarying between *tizhi* 'regulation' and *jianli* 'establish'.

(3)这必然阻碍市场体制的建立。

zhebiranzhu'aishichangtizhidejianli

thismusthindermarketregulation<small>DE</small>establish

'This will definitely hinder the establishment of the market regulations.'

The pairing of "results" in the NP slot and "achievement" in the VP slot. The third typical meaning pattern of the construction under consideration pertains to the pairing of lexical items that denote the sense of "results" in the NP slot and those that denote the sense of "achievement" in the VP slot. The sense of "results" in the NP slot of the construction is briefly realized by such lexical items as *mubiao* 'targets', *chengji* 'results' and *chengjiu* 'achievements', and that of "achievement" in the VP slot is generally realized by items such as *qude* 'achieve', *shixian* 'realize' and *wancheng* 'accomplish' (cf. rows 1 and 13 in Table 2). Considering the instantiated clause in (1), *shixian* 'realize' in the VP slot significantly covaries with *mubiao* 'targets' in the NP slot of the NP *de* VP construction, and therefore the third typical meaning pattern is formulated.

A cursory survey of those top cases in Table 2 will simply demonstrate that lexical items in the VP slot by and large denote senses of achieving something (e.g., *shixian* 'realize', *qude* 'achieve', etc.), augmenting something (e.g., *jiakuai* 'speed up', *jiada* 'expand', and *zengqiang* 'enhance'), etc. Lexical items in the NP slot generally denote senses of organization or system (e.g., *tizhi* 'regulation', *tixi* 'system', etc.), personal traits (e.g., *zeren* 'responsibility', *zhenxin* 'sincerity'), etc. However, this way of semantically patterning the lexical items in both slots of the NP *de* VP construction will unavoidably impose researchers' subjectivity into the meaning patterns; furthermore, the results are usually problematic and unsuccessful at length (cf. Gries and Stefanowitsch, 2010). The most appropriate way to avoid researchers' subjectivity and to achieve objective and successful meaning patterns is to cluster these lexical items by implementing a hierarchical cluster analysis.

Meaning patterns of the VP in the NP *de* VP construction
Subsequent manual processing of those overlapping lexical items (e.g., *jianli* 'establish' cooccurs with both *tizhi* 'regulation' and *tixi* 'systems' in rows 4 and 5 of Table 2, respectively) yields 40 types of items in the VP slot. Taking their covarying collexemes in the NP slot of the construction into consideration, we finally formed a 40 (types of verbs in the VP slot) × 211 (types of covarying collexemes in the NP slot) contingency table. Inputting the.txt formatted contingency table and subsequently performing the function *hclust* in R language produced a cluster dendrogram as shown in Fig. 1. According to Fig. 1, verbs that fall into the scope of 9 clusters are extremely likely to be particularly preferred in the VP slot of the construction. Specifically, these clusters, except for clusters 1 and 9 could not capture a common sense, generally denote senses of "cognition", "augmentation", "implementation", "achievement", "establishment", and "report", which are to be detailed in the following paragraphs of this section.

Meaning pattern of "cognition". The first typical meaning pattern denoted by the typical senses of the VP in the NP *de* VP construction pertains to the sense of "cognition", which is typically realized by mental verbs *juede* 'think' and *xihuan* 'like'. They are clustered in that they generally cooccur with lexical items in the NP slot such as *zhenxin* 'sincerity' and *neixin* 'heart' that denote people's internal traits. The finding that such mental verbs could enter the VP slot is also in accordance with Qi, et al.'s (2004, pp. 219-220) argument that verbs of the conjoining type could enter the VP slot of the construction such as *lijie* 'understand' and *sikao* 'think' that are typical of metal verbs.

Meaning pattern of "augmentation". The second meaning pattern that could uncover the intrinsic nature of the VP in the construction pertains to the sense of "augmentation". Members of this cluster chiefly incorporate *kuoda* 'expand', *zengjia* 'augment', *zengqiang* 'enhance', *tigao* 'improve', *jiakuai* 'speed up', *jiada* 'increase', and *zengda* 'magnify'. All these verbs denote more or less a sense of augmentation of degrees and/or amounts. This is partially exemplified by sentences in (4), in which *zengjiang* 'enhance' in (4a) denotes the addition of degrees in terms of economic power and *zengjia* 'augment' in (4b) denotes the addition of amounts in terms of information channels in question.

(4) a. 今后，随着国家经济实力的增强，教育经费会逐年增加。

jinhou suizhe guojia jingji shili de zengqiang jiaoyu jingfei

in the future with nation's economy power <small>DE</small> enhance education fund

hui zhunian zengjia

will year-by-year increase

'In the future, education funds will increase year by year with the enhancement of national economic strength.'

b. 信息渠道的增加原本可以淡化校园网站的重要性。

xinxi qudao de zengjia yuanben keyi danhua xiaoyuan

information channel <small>DE</small> augment originally might dilute campus

wangzhan de zhongyaoxing

internet <small>DE</small> importance

'The augmentation of information channels might originally dilute the importance of campus internet.'
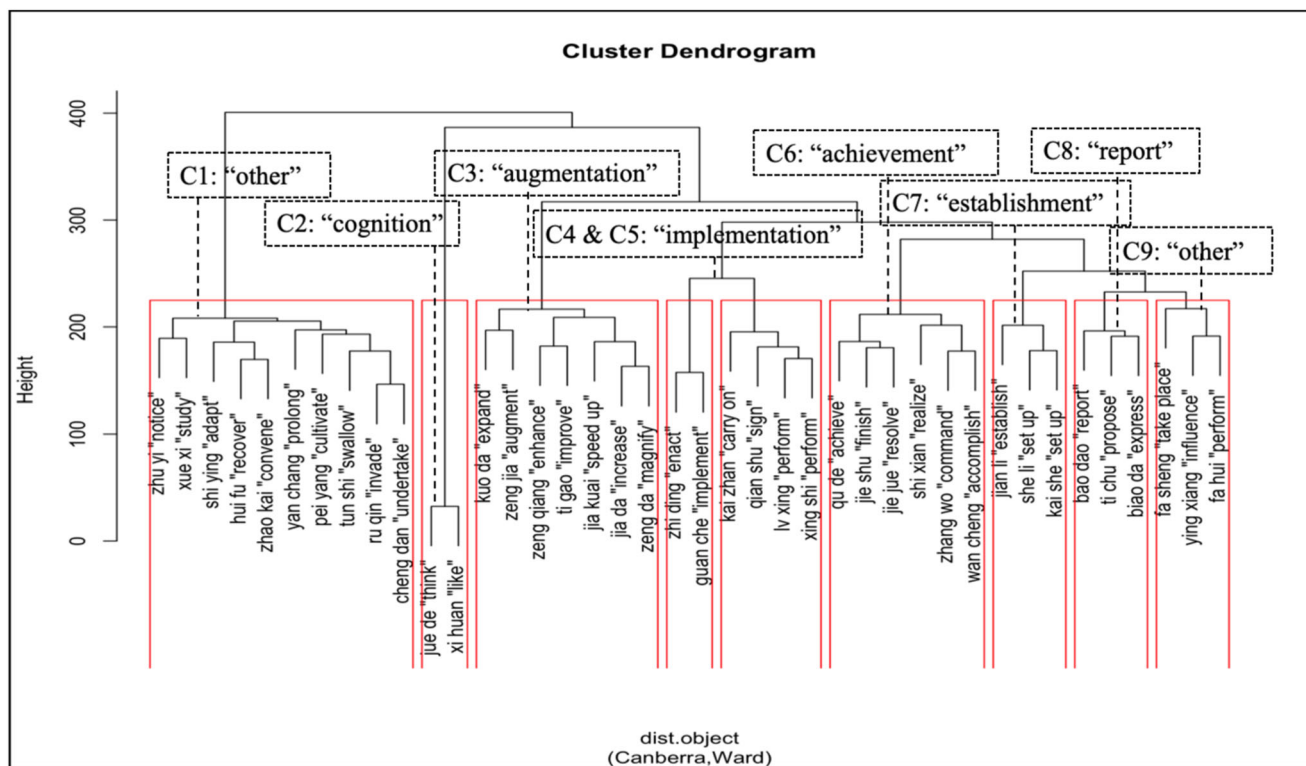
Fig. 1 Dendrogram of meaning patterns of the VP in the NP *de* VP construction.

Meaning pattern of "implementation". The third meaning pattern is about the sense of "implementation", which is typically realized by such verbs as *zhiding* 'enact', *guanche* 'implement', *kaizhan* 'carry on', *qianshu* 'sign', *lvxing* 'perform', and *xingshi* 'perform'. They are clustered in that their covarying collexemes in the NP slot are generally *biaozhun* 'standard', *zhengce* 'regulation', and *quanli* 'rights'. Consider examples in (5), in which *zhengce* 'policy' is a covarying collexeme of both *guanche* 'implement' in (5a) and *zhiding* 'enact' in (5b) which is rewritten from example (2).

(5) a. 产业政策的贯彻、实施无法有力执行。

chanye zhengce de guanche shishi wufa youli zhixing

industry policy DE implement perform cannot effectively carry out

'The implementation of industrial policy cannot be carried out effectively.'

b. 公共行政就是公共政策的制定。

gonggong xingzheng jiushi gonggong zhengce de zhiding
public administration be public policy DE enact

'Public administration is the enactment of public policy.'

Meaning pattern of "achievement". Verbs in the VP slot of the construction also denote a sense of "achievement", indicating reaching specific results with efforts. These verbs generally include *qude* 'achieve', *jieshu* 'finish', *jiejue* 'resolve', *shixian* 'realize', *zhangwo* 'command', and *wancheng* 'accomplish'. Their covarying collexemes chiefly pertain to positive targets such as *mubiao* 'target', *chengji* 'result', *chengjiu* 'achievement', and *jiazhi* 'value'. Example (6) will demonstrate the sense of "achievement" that is realized by one of these verbs.

(6) 它们从不同的角度来保障公正价值的实现。

tamen cong butongde jiaodu lai baozhang gongzheng jiazhi de

they from different angles come guarantee justice value DE *shixian*
realize

'They guarantee the realization of justice value from different angles.'

Meaning pattern of "establishment". The meaning pattern of "establishment" in the VP slot of the construction is denoted by such verbs as *jianli* 'establish', *sheli* 'set up', and *kaishe* 'set up'. The clustering of these verbs is primarily attributed to the covarying collexemes (e.g., organization names and regulations) in the NP slot they cooccur with. Consider examples in (7), in which *caigou zhongxin* 'purchasing center' in the NP slot is the significant cooccurrence of *sheli* 'set up' in the VP slot as shown in (7a) and *dongbao fagui* 'regulations of animal protection' is that of *jianli* 'establish' as shown in (7b). *caigou zhongxin* 'purchasing center' in (7a) represents the name of an organization and *dongbao fagui* 'regulations of animal protection' in (7b) is the name of a regulation.

(7) a. 跨国采购中心的设立, 拉动了深圳的出口增长。

kuaguo caigou zhongxin de sheli ladong le Shenzhen

international purchase center DE set up promote TENSE PART NAME

de chukuo zengzhang

DE export increase

'The setting up of international purchasing center promoted the increment of export in Shenzhen'.

b. 中国动保法规的建立, 不只依靠任何组织或团体。
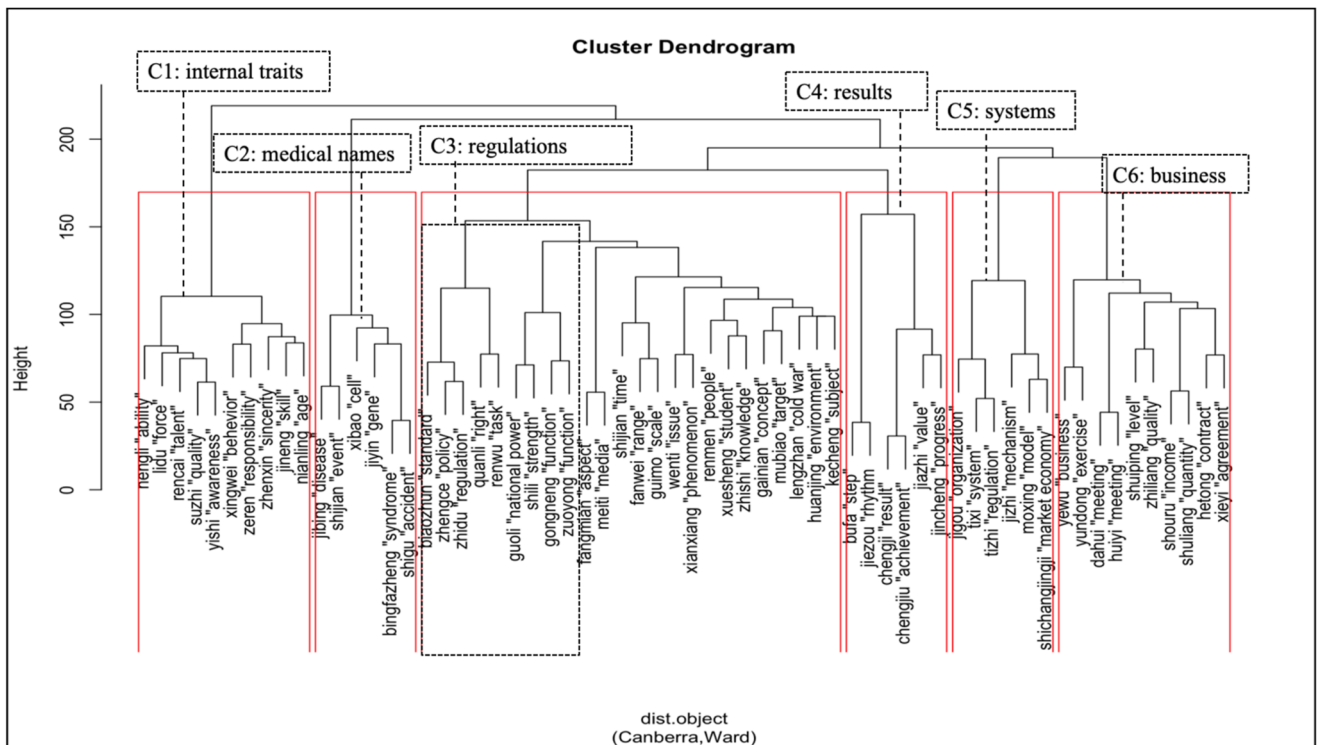
zhongguo dongbao fagui de jianli buzhi yikao

Fig. 2 Dendrogram of meaning patterns of NP in the NP *de* VP construction.

China's animal protection rules DE establish not only rely upon *renhe zuzhi huo tuanti*

any organization or groups
'The establishment of regulations of China's animal protection relies not solely on any organization or group.'

Meaning patterns of "report" and "others". Another important prototypical meaning pattern with respect to the VP in the NP *de* VP construction is concerned with the reporting verbs. In other words, reporting verbs are also likely to enter the VP slot of the construction. Typical reporting verbs of this type include *baodao* 'report', *tichu* 'propose', and *biaoda* 'express'. The contents that are reported are generally about news media, issues or questions, opinions, which constitute the covarying collexemes in the NP slot to attribute the meaning pattern of "report". This will be instantiated by examples in (8), in which contents of the reporting verbs *baodao* 'report' and *tichu* 'propose' are *zhongdong wenti* 'middle east issues' as shown in (8a) and *wenti* 'question' as shown in (8b) respectively.

(8) a. 西方媒体对中东问题的报道最清楚不过地表明了这一点。

xifang meiti dui zhongdong wenti de baodao zui qingchu buguo

west media to middle east issue DE report most obvious PART
di biaoda le zheyidian

ADV. MARKER express TENSE MARKER this point

'Nowhere is clearer than the report delivered by west media concerning middle east issues.'

b. 一个好的问题的提出，具有更加重要的意义。

yige haode wenti de tichu juyou gengjia zhongyaode yiyi

a good question DE propose have more important meaning
'The proposing of a good question has more important meanings.'

In addition to the abovementioned meaning patterns that verbs in the VP slot of the construction could denote, there are also some other verbs that could not be patterned into a single meaning group. However, they are also equally important to represent the typical meanings of lexical items in the VP slot. Those verbs mainly include *zhaokai* 'convene', *chengdan* 'undertake', *yingxiang* 'influence', etc.

In summary, the typical meanings that could be patterned in the VP slot of the NP *de* VP construction generally incorporate senses of "cognition", "augmentation", "implementation", "achievement", "establishment", and "report", which are abstracted by referring to their covarying collexemes in the NP slot of the construction. In the same vein, the meaning patterns of NP in the NP *de* VP construction could also be clustered by referring to their corresponding covarying collexemes in the VP slot of the construction. This will be enunciated in the following section.

Meaning patterns of the NP in the NP *de* VP construction
After manually processing those overlapping lexical items in the NP slot of the NP *de* VP construction, we finally confirmed 62 types of nouns. Considering their covarying collexemes in the VP slot of the construction, a 62 (types of nouns in the NP slot) × 99 (types of covarying collexemes in the VP slot) contingency table is subsequently formatted. Running the function *hclust* in R language yields a cluster dendrogram presented in Fig. 2. Figure 2 demonstrates that, except for the difficulty of patterning some lexical items that are significantly attracted to the NP slot of the construction (e.g., *shijian* 'time', *wenti* 'issue', *kecheng* 'subject', etc.), six types of meaning patterns could be abstracted from those items in the NP slot; specifically, lexical items in the NP slot denote senses of "internal traits", medical names", regulations", "results", "systems", and "business", which are to be further expounded in the following paragraphs.

Meaning pattern of "internal traits". The first typical meaning pattern that lexical items in the NP slot clustered pertains to the description of people's internal traits. Those lexical items generally include *nengli* 'ability', *rencai* 'talent', *suzhi* 'quality', *yishi* 'awareness', *zeren* 'responsibility', *zhenxin* 'sincerity', *jineng* 'skill'. In this cluster, there seem to be some other lexical items (e.g., *lidu* 'force', *xingwei* 'behavior', and *nianling* 'age') that are not directly related to the meaning pattern of "internal traits". Those lexical items prompt the suggestion that hierarchical cluster analysis by means of referring to the covarying collexemes needs to be further improved, which is precluded from further discussion because of the purpose of this study. Concerning the covarying collexemes in the VP slot, corpus data reveal that these verbs by and large incorporate *tigao* 'improve', *peiyang* 'cultivate', and *zengqiang* 'enhance'. This could be illustrated by the covarying collexemes *zengqiang* 'enhance' in (9a), *peiyang* 'cultivate' and *tigao* 'improve' in (9b), which significantly cooccur with *nengli* 'ability' in (9a), *rencai* 'talent' and *sushi* 'quality' in (9b), respectively in the NP slot of the NP *de* VP construction.

(9) a. 感悟水平的提高, 意味着审美体验能力的增强。

ganwu shuiping de tigao yiweizhe shenmei tiyan nengli de

inspiration level DE increase mean esthetics experience ability DE

zengqiang

enhance

'The increment of inspiration levels means the enhancement of esthetic ability.'

b. 人才的培养一定要注重全面素质的提高。

rencai de peiyang yiding yao zhuzhong quanmian sushi de

talent DE cultivate must be highlight all quality DE

tigao

improve

'The cultivation of talents must highlight the improvement of all kinds of qualities.'

Meaning pattern of "medical names". Another topic that lexical items in the NP slot of the construction considered are about items that are used in the medical field, including such terms as *jibing* 'disease', *xibao* 'cell', *jiyin* 'gene', and *bingfazheng* 'syndrome'. Some others such as *shijian* 'event' (denoting a negative sense) and *shigu* 'accident' are clustered with the meaning pattern of "medical names" because of their denoted negative senses. With respect to their covarying collexemes in the VP slot, verbs such as *fasheng* 'occur', *chuxian* 'appear', and *cunzai* 'exist' are significantly preferred by lexical items that realize the meaning pattern of "medical names". Examples in (10a) and (10b) suffice to illustrate this point.

(10) a. 并发症的出现与创伤的严重程度有关。

bingfazheng de chuanxian yu chuangshan de yanzhong chengdu youguan

syndrome DE appear and trauma DE seriousness degree related

"The appearance of the syndrome is related to the seriousness of traumas.'

b. 基因的存在已得到了许多研究的证实。

jiyin de cunzai yi dedao le xuduo yanjiu de zhengshi

gene de exist already get TENSE PART many study DE testify

'The existence of gene has already been testified by numerous studies.'

Meaning pattern of "regulations" and "systems". The third typical meaning pattern that the NP in the NP *de* VP construction denotes pertains to *zhidu* 'regulations' and *tixi* 'systems' (except for some irrelevant ones in either of the two meaning patterns). The former further incorporates *biaozhun* 'standard', *zhengce* 'policy', *zhidu* 'regulation', *quanli* 'rights', *gongneng* 'function', and *zuoyong* 'function'; the latter incorporates such members as *jigou* 'organization', *tixi* 'systme', *tizhi* 'regulation', and *jizhi* 'mechanism'. Investigation of their covarying collexemes in the VP slot demonstrates that they cooccur significantly with verbs that denote senses of "implementation" and "establishment" such as *guanche* 'enact', *zhiding* 'implement', *xingshi* 'perform', and *jianli* 'establish', etc. This could be exemplified by the significant cooccurrences of *zhidu* 'regulation' and *guanche* 'enact' in (11a), and *tizhi* 'regulation' and *jianli* 'establish' in (11b) which is rewritten from example (3).

(11) a. [我们]要认真检查各种制度的贯彻落实。

[women] yao rezhen jiancha gezhong zhidu de guanche luoshi

[we] must carefully check various regulation DE enact complete '[We] must carefully check the enactment of various regulations.'

b. 这必然阻碍市场体制的建立。

zhe biran zhu'ai shichang tizhi de jianli

this must hinder market regulation DE establish

'This will definitely hinder the establishment of the market regulations.'

Meaning pattern of "results". It might be a little farfetched to term this meaning pattern as "results". Another term such as "achievement" might serve this purpose very well. However, all these lexical items denote a sense of moving towards an ending, and thus "results" is employed. Members in this meaning pattern include *bufa* 'step', *jiezhou* 'rhythm, *chengji* 'result', *chengjiu* 'achievement', *jiazhi* 'value', and *jincheng* 'progress'. Covarying collexemes in the VP slot that are significantly preferred by these lexical items in the NP slot generally incorporate *qude* 'achieve' and *shixian* 'realize'. Consider examples in (12), in which covarying collexemes *qude* 'achieve" in (12a) and *shixian* 'realize' in (12b) in the VP slot cooccur significantly with *chengji* 'result' and *jiazhi* 'value' in the NP slot respectively.

(12) a. 上述成绩的取得不是偶然的。

shangshu chengji de qude bu shi ourande

abovementioned result DE achieve not COPULAR opportunistic 'The abovementioned achievement of results is not opportunistic.'

b. 言论自由有利于自我价值的实现。

yanlun ziyou youliyu ziwo jiazhi de shixian

speech freedom helpful self-value DE realize

'Freedom of speech is helpful for the realization of self-values.'

Meaning pattern of "business". The last typical meaning pattern that lexical items in the NP slot could be abstracted is "business" in that these items are concerned with various aspects of the business. For example, the manner that decisions are made in business (i.e., *dahui* 'meeting' and *huiyi* 'meeting'), the means that agreements are reached (i.e., *hetong* 'contract' and *xieyi* 'agreement'), etc. Concerning the covarying collexemes in the VP slot, these lexical items in the NP slot frequently cooccur with verbs such as *zhaokai* 'convene', *qianshu* 'sign', and *lvxing* 'perform'.

Lexical items denoting the meaning pattern of "business" and their covarying collexemes in the VP slot are exemplified by (13a) and (13b).

(13) a. 这次会议的召开为今后两国经贸关系的发展打下了基础。

zheci huiyi de zhaokai wei jinhou liang guo jing mao

this meeting DE convene for afterwards two nations business trade

guanxi de fazhan daxia le jichu

relation DE develop found TENSE PART basis

'The convening of this meeting laid a foundation for the future development of bilateral economic and trade relations.'

b. 和平协议的签署为两国关系的发展开辟了新的前景。

heping xieyi de qianshu wei liangguo guanxi de fazhan kaipi

peace agreement DE sign for two nation relation DE develop open

le xinde qianjing

TENSE PART new prospect

'The signature of the peace agreement opens a new era for the development of the two nations.'

Discussion

Firstly, meaning patterns of the VP in the NP *de* VP construction identified in this study and Zhan's (1998) argument that only the VP that denotes weak "action" and strong "event" could enter the VP slot of the construction, together with Qi et al.'s (2004) argument that verbs of the conjoining type could enter the VP slot of the construction, will be discussed in this section; in addition, meaning patterns of the NP in the NP *de* VP construction observed in this study and Shen and Wang's (2000) argument that lexical items in the NP slot expressing the prominence that combines informativity and accessibility will also be compared and expounded. Secondly, the principle of linguistic meaning conservation is employed to explain the findings uncovered in this research[7]. Finally, relevant theories in Construction grammar are further elaborated by means of drawing on features from the NP *de* VP construction.

In relation to previous studies. Findings in this research, with respect to meaning patterns that lexical items in the VP slot of the NP *de* VP construction most probably denote, are partially in accordance with those uncovered by Zhan (1998). According to Zhan (1998, p. 25), verbs in terms of their ideational meanings are subcategorized into three types. Verbs of the first type are of a strong sense of "action" but a weak sense of "event"; those of the second type are of a weak sense of "action" but a strong sense of "event"; and those of the third type are both weak in terms of "action" and "event". Of the three types of verbs, only the ones that denote a sense of weak "action" and strong "event" are capable of entering the VP slot of the NP *de* VP construction; this argument is also corroborated by Wang (2002) who draws on the numbers of participants in the transitivity system of the verbal processes; that is, the more participants involved in the verbal processes, the stronger the senses of "action" denoted by verbal processes will be. However, concerning the verbs that significantly attracted to the VP slot of the construction, we identified verbs with a sense of strong "action" and weak "event" (e.g., *tunshi* 'swallow', *ruqin* 'invade', *qianshu* 'sign", *jianli* 'establish', etc.) and those with a sense of weak "action" and strong "event" as well (e.g., *juede* 'think', *zhaokai* 'convene', *tichu* 'propose', etc.),

although the latter takes a larger proportion than the former (i.e., 82.5% for the latter and 17.5% for the former in terms of verbs that reach the Infinite level of significance). Reasons for the disagreement between the findings of this study and those of previous ones are possibly three-fold. First, different sources of the instances that we counted upon prompt the findings that are not fully in agreement with each other. Zhan (1998) considered verbs from a Dictionary for Usages of Verbs (Meng, 1987) and exemplified his argument with invented examples, while this research considers examples from real data of BCC. It does not indicate that invented grammatical examples are not sufficient to uncover certain features of particular constructions; however, real data from corpus speak more expressly in terms of the intrinsic nature of language phenomena (e.g., meaning patterns of constructions) than those that are particularly made up by researchers. Second, instances that are considered by the two studies differ significantly. Zhan (1998) considered instances of the NP *de* VP construction in general without taking their probabilities of entering the construction into consideration, while we, by drawing on covarying collexeme analysis considered those instances that are extremely significantly attracted to this construction; by so doing, the typical meanings that this construction could denote will be uncovered. It is inappropriate to regard instantiated verbs with very low occurrences in the construction, if they are considered as a whole, as the typical meaning of this construction; this inappropriateness will be sufficiently avoided by means of covarying collexeme analysis and is regarded as repelled cases to the NP *de* VP construction. It should be noted that I am not meant to downplay Zhan's research without considering probabilities of instances with the construction at issue. What he primarily highlights are instances that probably fill the NP and the VP slots of the NP *de* VP construction, while this research aimed at uncovering the most typical meaning patterns of the construction which will definitely turn to statistical measures such as probabilities of lexical items with the considered construction. Third, the purposes of the two studies are different. Zhan (1998) intended to identify certain types of verbs that could enter the VP slot of the construction, while this research highlights the typical meanings that verbs in the VP slot of the construction could denote. Differences in the purposes also render the different findings between this study and that conducted by Qi et al. (2004). In addition, we approached the same phenomenon with more delicacy than their study. That is to say, although all instantiated verbs in the VP slot identified by this study could be subsumed to those identified by Qi, et al. (2004), we further identified meaning patterns that verbs in the VP slot could denote by means of the hierarchical cluster analysis. Accordingly, with respect to verbs that could enter the VP slot of the construction, this study is significant in that it investigated the typical meanings that instantiated verbs in the VP slot could denote and how these typical meanings could be patterned into different clusters, which is perspicuously absent from these aforementioned studies.

In relation to lexical items in the NP slot of the construction, Shen and Wang (2000) argued that NPs that denote a sense of prominence (i.e., high informativity and/or high accessibility), could enter the NP slot of the construction. Their argument is further corroborated by the findings of this study which has identified such meaning patterns as "internal traits", "medical names", "regulations", "results", "systems", and "business". According to Shen and Wang (2002, p. 30), specific nouns are more accessible than abstract nouns. Therefore, examining the meaning patterns of the NP in the construction identified in this study, we found that these meaning patterns, except for "internal traits", are actually of some degree of high accessibility. Although lexical items denoting "internal traits" are not of high accessibility (because their meanings are comparatively more abstract than

those of other meaning patterns), their meanings are by and large of high informativity. Admittedly, the high informativity of the meaning pattern of "internal traits" is also determined by the context. Consider the example in (14). *nengli* 'ability' is modified by *lijie* 'understanding' and *yuedu* 'reading' in the linguistic context which provide extra information to make the lexical item *nengli* 'ability' in the NP slot of the construction possess a high degree of informativity; in so doing, this lexical item also becomes more specific than the one without such modifiers as *lijie* 'understanding' and *yuedu* 'reading', and thus is also of high accessibility.

(14) 现在对语法不那么重视了，关键是理解能力、阅读能力的培养。

xianzai dui yufa bu name zhongshi le guanjian shi

now to grammar not so highlight TENSE PART important COPULAR
liji nengli yuedu nengli de peiyang

understanding ability reading ability DE cultivate

'Now grammar is no so important; what matters is the cultivation of understanding and reading ability.'

This paper proceeds further than Shen and Wang's (2002) study in at least two respects. On the one hand, we considered not only lexical items that could enter the NP slot of the NP *de* VP construction but also the ones that are representative of the typical meanings of the NPs. By so doing, it will further facilitate our understanding of the typical meaning that the NP *de* VP construction could denote. On the other hand, we clustered the meaning patterns that lexical items could enter the NP slot by means of the hierarchical cluster analysis, which will objectivize the final meaning groups.

In relation to the principle of linguistic meaning conservation. The range of prototypical meanings for the NPs and VPs of the NP *de* VP construction, along with the non-prototypical meanings, uncovered in this research appears to be a good example of informational conservation by way of collocational variation. The more variation one finds in lexical items and their types, the more ways there are in conserving information. This is the crux of the Principle of Linguistic Meaning Conservation (Mondal, 2019). The upshot of this is that the variation in patterns of meaning is a function of the variation in lexical items and their types. This is compellingly clear in the wide range of meanings of NPs for the NP *de* VP construction: "internal traits", "medical names", "regulations", "results", "systems", and "business", and meanings of VPs for the NP *de* VP construction: "cognition", "augmentation", "implementation", "achievement", "establishment", and "report". Given the greater types of NPs and VPs considered in this research, this does not seem to be a surprise.

In relation to construction theories. This subsection mainly discusses the meaning patterns of the NP de VP construction in terms of construction theories: compositionality, prototypicality, and conventionality.

Meaning patterns of the NP *de* VP construction uncovered in this research reflect the compositionality in terms of the construction grammar. Compositionality highlights the degree of transparency of association between forms of constructs (i.e., specific NPs and VPs in the construction) and meanings (Traugott and Trousdale, 2013). A construct with compositionality in terms of semantics means that the meaning of a construct could be understood if the meanings of each unit are known. The opposite case is true if the combination of meanings of each unit could not unpack the meaning of the construction. In relation to

the NP *de* VP construction at issue, this construction is of a high degree of compositionality. This viewpoint is evidenced by the three pairings of meaning patterns of the NP de VP construction, i.e., the pairing of "regulations" in the NP slot and "implementation" in the VP slot, the pairing of "systems" in the NP slot and "establishment" in the VP slot, and the pairing of "results" in the NP slot and "achievement" in the VP slot. For instance, if the NP slot is confined to lexical items denoting "regulations", then the meanings of lexical items in the VP slot are predictable and so is the typical meaning of the NP *de* VP construction.

Meaning patterns of the construction under investigation also accord with the theory of prototypicality. Prototypicality originally means the degree of category membership (Goldberg, 1995), and in this research, it means the identified meaning patterns are the most typical ones or the most representative of the meaning denoted by the NP *de* VP construction. Meaning patterns of the NP slot and the VP slot are confirmed by referring to the semantic features of these NPs and VPs. Those lexical items with statistically significant association strengths represent core members of the NP *de* VP construction. The meanings of these core members in turn represent the prototypical meaning of this construction. Core members of NPs in this construction briefly include *zhidu* "regulation", *tixi* "system", *yewu* "business", etc., and thus the typical meaning patterns are "regulations", "systems" and "business" (cf. Fig. 2). In a similar vein, meanings of core members of VPs are summarized as such meaning patterns as "implementation", "achievement", and "establishment" (cf. Fig. 1).

These meaning patterns reflect the theory of conventionality as well. Both NPs and VPs with significant attraction to the construction are the conventionality of frequently using these lexical items. The higher the observed frequencies of these lexical items or the association strengths between these lexical items and the NP de VP construction (because of the significant correlation between observed frequencies and association strengths (cf. Zhou, 2021)), the higher the degree of the conventionality of these lexical items which in turn leads to the higher degree of conventionality of the meaning patterns of the construction at issue.

Significance
This research is significant in at least two respects. For one thing, lexical items uncovered in this research are representative of those that could fill the VP and the NP slots of the construction. The covarying collexeme analysis highlights lexical items that are significantly attracted to specific constructions, which indicates that these lexical items are the potential to be typical members of the constructions. More importantly, this research considered a fuller scope of the NP *de* VP construction than previous ones which investigated lexical items that could enter either the NP slot or the VP slot, in that it considered both cases concurrently; apart from that, lexical items in the NP slot and the VP slot respectively are mutually dependent (due to the nature of this research method employed). For another, the meaning patterns of both the NP slot and the VP slot are scientifically and objectively clustered, which is further attributed to the meaning patterns of the NP *de* VP construction. This research employed cluster analysis which aims at identifying the meaning patterns of the construction. Previous research unveiled possible lexical items that could be the components of the construction, but they did not inform us what the meaning patterns of this construction are because constructions themselves are meaningful (Goldberg, 1995, 2006).

This research is also of pedagogical significance. Studies have shown the first collexemes in each construction learned by students tend to be those distinctively associated with that

construction in the input (Ellis and Ferreira-junior, 2009). In this sense, core lexical items that constitute the typical meaning patterns of the NP de VP construction are firstly learned ones in the input. The findings of this study could feed into the design of pedagogical materials not only for native speakers of Chinese but also for others who study Chinese as a foreign language.

Conclusion

Drawing on the frequency of cooccurrences between lexical items in the NP slot and those in the VP slot in the NP *de* VP construction in modern Chinese, we identified typical instances that are extremely significantly attracted to the NP *de* VP construction by implementing a covarying collexeme analysis. Underlying those significantly preferred instances, we further investigated the meaning patterns of those lexical items in the VP slot and confirmed that the most typical meaning patterns are "cognition", "augmentation", "implementation", "achievement", "establishment", and "report" by means of the hierarchical cluster analysis. By employing the same cluster analysis, we further confirmed that the most typical meaning patterns of lexical items that are capable of entering the NP slot of the construction incorporate "internal traits", medical names", regulations", "results", "systems", and "business". This study is significant in that it scientifically identified typical instances of the NP *de* VP construction in modern Chinese, and objectively and precisely uncovered meaning patterns that lexical items in both the VP slot and the NP slot of the NP *de* VP construction could denote.

Findings uncovered in this study are based on the corpus data in general without referring to genres or text types, such as fiction, magazines, newspapers, and academic discourses, which might display differences in significantly attracting instances to the NP *de* VP construction and/or meaning patterns that lexical items in both NP and VP slots of the construction could denote. Accordingly, future studies are suggested to highlight the denoted differences of significantly attracted instances and meaning patterns of NP *de* VP construction in modern Chinese.

Data availability

All data analyzed in this study are cited in this article and available in the public domain.

Notes

1 Previous discussions of the NP *de* VP construction are by and large initiated by the employment of the nominal phrase *zheben shu de chuban* 'publication of this book'. However, real data in the corpus do not support the popularity of this nominal phrase; instead, the most significantly associated covarying collexeme pair is *mubiao de shixian* 'realization of target'.

2 Examples used in this study are all sourced from Beijing Language and Culture University Corpus Center or BCC, which is a corpus of 9.5 billion Chinese characters of different genres.

3 Fisher–Yates exact test is employed in that it, compared with other tests such as X^2, Mutual Information or MI, or G^2, does not rely too much on the corpus size and/or normal distribution of frequency numbers (cf. Wiechmann, 2008). Based on frequencies in Table 1, probability of Fisher–Yates exact test is obtained by carrying out the formula $p = \frac{(freq1+freq2)!(freq3+freq4)!(freq1+freq3)!(freq2+freq4)!}{freq1!freq2!freq3!freq4!}$

4 It is a means of indicating attraction or repulsion between lexical items and the construction.

5 Typical members of cluster analysis include hierarchical cluster analysis (cf. Evert, et al., 2011; Desaguliar, 2014, 2017; Zhou, 2021), correspondence analysis (cf. Glynn, 2014), and variability-based neighboring cluster analysis (cf. Gries and Hilpert, 2008; Zhou, 2021).

6 It should be noted that relying on the observed frequency is sometimes misleading because it does not consider the occurrence of a certain lexical item in the corpus. For

instance, *shigu de fasheng* 'occurrence of accidents' ranks No. 14 in Table 2, while it should rank No. 2 if its observed occurrence (1893) is considered.

7 I would like to extend my thanks to one of the anonymous reviewers who suggested taking this point into consideration.

References

Chen Guohua陈国华 (2009) Cong "de" kan zhongxinyu gouzao yu zhongxinyu de cilei 从"的"看中心语构造与中心语的词类 (Centre construction and the word class of its centre: an analysis of *zhe ben shu de chuban*). Waiyu jiaoxue yu yanjiu 外语教学与研究 41(2):92–98

Chen N 陈宁萍 (1987) Xiandai hanyu mingcilei de kuoda 现代汉语名词类的扩大 (Expansion of nouns in modern Chinese). Zhongguo yuwen 中国语文 5

Cheng G程工 (1999) Mingwuhua yu xiangxin jiegou lilun xintan 名物化与向心结构新探 (A new exploration of nominalizations and endocentric structures). Xiandai waiyu 现代外语 84(2):131–144

Desaguliar G (2014) Visualizing distances in a set of near synonyms: rather, quite, fairly, and pretty. In: Glynn D, Robinson J (eds) Corpus methods for semantics: quantitative studies in polysemy and synonymy. John Benjamins, Amsterdam, pp 145–178

Desaguliar G (2017) Corpus linguistics and statistics with R: Introduction to quantitative methods in linguistics. Springer, Cham, Switzerland

Divjak D, Fieller N (2014) Finding structure in linguistic data. In: Glynn D, Robinson J (eds) Corpus methods for semantics: quantitative studies in polysemy and synonymy. John Benjamins, Amsterdam, pp. 145–178

Divjak D, Gries ST (2006) Ways of trying in Russian: clustering behavioral profiles. Corpus Linguist Linguist Theory 2(1):23–60

Divjak D, Gries ST (2008) Clusters in the mind?: Converging evidence from near synonymy in Russian. Mental Lex 3(2):188–213

Ellis N, Ferreira-junior F (2009) Constructions and their acquisition: Islands and the distinctiveness of their occupancy. Annu Rev Cogn Linguist 1:187–220

Everitt BS, Landau S, Leese M, Stahl D (2011) Cluster analysis, 5th edn. Wiley-Blackwell, Oxford

Fang Z方绪军, Liu H刘华 (2021) Jiyu goushi jiazhu guanniao de "NP de VP" ji xiangguan jiegou 基于构式家族观念的"NP的VP"及相关结构 (A view on "NP de VP" and some related constructions in light of the concepts of construction family). Hanyu xuexi 汉语学习 2:3–12

Glynn D (2014) Correspondence analysis: exploring data and identifying patterns. In: Glynn D, Robinson JA (eds) Corpus methods for semantics: quantitative studies in polysemy and synonymy. John Benjamins, Amsterdam/Philadelphia, pp. 443–486

Goldberg AE (1995) Constructions: a construction grammar approach to argument structure. University of Chicago Press, Chicago

Goldberg AE (2006) Constructions at work: the name of generalization in language. Oxford University Press, Oxford

Gries ST, Stefanowitsch A (2004) Extending collostructional analysis: a corpus-based perspective on 'alternations'. Int J Corpus Linguist 9(1):97–129

Gries ST, Stefanowitsch A (2010) Cluster analysis and the identification of collexeme classes. In: Rice S, Newman J (eds) Empirical and experimental methods in cognitive/functional research. CSLI Publications, Stanford, CA, pp. 73–90

Gries ST, Hilpert M (2008) The identification of stages in diachronic data: variability-based neighbor clustering. Corpora 3(1):59–81

Gries ST (2014) Coll. analysis 3.5. A script for R to compute perform collostructional analyses. http://www.linguistics.ucsb.edu/faculty/stgries/teaching/groningen/index.html

Guo Rui郭锐 (2000) Biaoshu gongneng de zhuanhua he "de"zi de zuoyong 表述功能的转化和"的"字的作用 (The conversion of the expressional functions and an analysis of the particle *de* in Mandarin Chinese). Dangdai yuyanxue 当代语言学 1:37–52

Hilpert M (2014) Collostructional analysis: measuring associations between constructions and lexical elements. In: Glynn D, Robinson JA (eds) Corpus methods for semantics: quantitative studies in polysemy and synonymy. John Benjamins, Amsterdam/Philadelphia, pp. 39–404

Hu Y 胡裕树, Fan X 范晓 (1994) Dongci xingrongci de "mingwuhua" he "mingcihua" 动词形容词的"名物化"和"名词化"(Nominalizations of verbs and adjectives). Zhongguo yuwen 中国语文 2

Jin L 金立鑫 (1987) Guanyu "xiangxin jiegou" dingyi de taolun 关于"向心结构"定义的讨论 (On the discussion of endocentric structure). Yuwen daobao 语文导报 7

Jin L金立鑫 (1992) Jufa yanjiu zhong de yige jichu lilun wenti 句法研究中的一个基础理论问题 (A basic theoretical problem in syntactic study). Hanyu xuexi 汉语学习 71(5):8–11

Jin Lixin金立鑫 (2019) Putonghua "NP de VP" de jufa yuyi shizhi 普通话"NP的VP"的句法语义实质 (The essential syntactic and semantic meaning of "NP de VP" in Mandarin). Yuyan jiaoxue yu yanjiu 语言教学与研究 198(4):1–14

Li J黎锦熙, Liu S 刘世儒 (1960) Yufa zai taolun—cilei qufen he mingci wenti 语法再讨论——词类区分和名词问题 (Reconsideration of grammar: distinction of lexical category and problems of nouns). Zhongguo yuwen 中国语文 1

Li W (2021) The procedural syntax of fake modification constructions in Chinese. Can J Linguist/Rev Can Linguist 66(1):91–128

Li Y 李宇明 (2002) Yufa yanjiu lu 语法研究录 (Grammatical studies). Shangwu yinshuguan, Beijing

Lu B 陆丙甫 (1985) Guanyu yuyan jiegou neixiang, waixiang fenlei he hexin de dingyi; yufa yanjiu he tansuo (3) 关于语言结构内向、外向分类和核心的定义，语法研究和探索（三）(On the definition of internal and external classification and core of language structures; Grammatical studies and exploration (3)). Beijing daxue chubanshe, Beijing

Lu B 陆丙甫 (1993) Hexin tuidao yufa 核心推导语法 (Cores of derived grammar). Shanghai jiaoyu chubanshe, Shanghai

Lu J 陆俭明 (2003) Dui "NP de VP" jiegou de chongxing renshi 对"NP的VP"结构的重新认识 (Reconsideration of NP de VP construction). Zhongguo yuwen 中国语文 296(5):387–391

Lu S 陆烁, Pan H 潘海华 (2013) Cong yinghan bijiao kan hanyu de mingwuhua jiegou 从英汉比较看汉语的名物化结构 (Chinese nominalized structures from a perspective of Chinese English comparative study). Waiyu jiaoxue yu yanjiu 外语教学与研究 5:643–656

Meng C 孟琮 (1987) Dongci yongfa cidian 动词用法词典 (A dictionary for usages of verbs). Shanghai cishu chubanshe, Shanghai

Mondal P (2019) How linguistic meaning harmonizes with information through meaning conservation. Pragmat Cogn 26(2/3):296–320

Qi H et al 齐沪扬等 (2004) Yu mingci dongci xiangguan de duanyu yanjiu 与名词动词相关的短语研究 (Phrasal studies of related nouns and verbs). Beijing yuyan daxue, Beijing

Shen J 沈家煊, Wang D 王冬梅 (2000) "N de V" he "canzhaoti-mubiao" goushi "N 的V"和"参照体——目标"构式 ("N de V" and "reference—goal" construction). Shijie hanyu jiaoxue 世界汉语教学 54(4):25–32

Shen J 沈家煊 (2009) Wo kan hanyu de cilei 我看汉语的词类 (My view of word classes in Chinese). Yuyan kexue 语言科学 38(1):1–12

Shen J 沈家煊 (2015) Xingshilei de fen yu he 形式类的分与合 (On division of form classes). Xiandai waiyu 现代外语 2:1–14

Shi D 石定栩 (2008) "De" he "de" zi duanyu "的"和"的"字短语 ("de" and "de" phrase). Dangdai yuyanxue 当代语言学 4:298–307

Si F 司富珍 (2002) Hanyu de biaojuci "de" ji xiangguan de jufa wenti 汉语的标记词 "的"及相关的句法问题 (The Chinese complementizer "de" and the related syntactic problems). Yuyan jiaoxue yu yanjiu 语言教学与研究 2:35–40

Si F 司富珍 (2004) Zhongxinyu lilun he hanyu de DeP 中心语理论和汉语的DeP (Head theory and DeP in Chinese). Dangdai yuyanxue 当代语言学 6(1):26–34

Stefanowitsch A, Gries ST (2003) Collostructions: investigating the interaction of words and constructions. Int J Corpus Linguist 8(2):209–243

Stefanowitsch A, Gries ST (2005) Covarying collexemes. Corpus Linguist Linguist Theory 1(1):1–43

Traugott EC, Trousdale G (2013) Constructionalization and constructional changes. Oxford University Press, Oxford

Wang D 王冬梅 (2002) "N de V" jiegou Zhong V de xingzhi "N的V"结构V的性质 (Properties of V in N de V construction). Yuyan jiaoxue yu yanjiu 语言教学与研究 4:55–64

Wang D 王冬梅 (2010) "N de V" goushi yu weiyu dongci de xuanze "N的V"构式与谓语动词的选择 ("N de V" construction and the choice of predicate verbs). Haiwai huawen jiaoyu 海外华文教育 55(2):46–51

Wang L 王力 (1954) Zhongguo yuwen jianghua 中国语文讲话 (Speeches of Chinese language). Zhongguo qingnian chubanshe, Beijing

Wang R 王仁强, Yang X 杨旭 (2017) "Chuban" de cilei wenti yu xiangxin jiegou zhizheng "出版"的词类问题与向心结构之争 (The word class problem of "Chuban" and debates over endocentric constructions). Hanyu xuebao 汉语学报 60(4):26–35

Wiechmann D (2008) On the computation of collostruction strength: testing measures of association as expressions of lexical bias. Corpus Linguist Linguist Theory 4(2):253–290

Wu Chang'an 吴长安 (2006) Zhe ben shu de chuban yu xiangxin jiegou nanti 这本书的出版与向心结构难题 (Zhe ben shu de chuban: a challenge to Bloomfield's theory of endocentric construction). Dangdai yuyanxue 当代语言学 8(3):193–204

Wu Z 吴早生, Guo Y 郭艺丁 (2018) Ye tan "NP de VP" pianzheng jiegou 也谈"NP 的VP"偏正结构 (A further study on attributive noun phrases "NP de VP" in Chinese). Yuyan kexue 语言科学 17(4):382–394

Xiong Z 熊仲儒 (2001) Lingchengfen yu hanyu "mingwuhua" wenti 零成分与汉语 "名物化"问题 (Zero element and "nominalization" in Chinese). Xiandai waiyu 现代外语 3:228–236

Xiong Z 熊仲儒 (2006) Shengcheng yufaxue Zhong de "de" zi jiegou 生成语法学中的"的"字结构 (De construction in generative grammar). Jinan daxue huawen xueyuan xuebao 暨南大学华文学院学报 4:49–59

Yang Z 杨舟, Xiong Z 熊仲儒 (2021) Mingwuhua de jufa fenceng yu "NP de VP" jiegou 名物化的句法分层与"NP的VP"结构 (The syntactic stratification of nominalizations and the "NP de VP" construction). Xiandai waiyu 现代外语 44(4):470–482

Ye K 叶狂 (2020) Cong liangci kan "NP de VP" jiegou de benzhi 从量词看"NP的 VP"结构的本质 (A classifier-as-nominalizer approach to the "NP de VP" construction in Chinese). Waiyu jiaoxue yu yanjiu 外语教学与研究 52(1):64–76

Yuan Y 袁毓林 (2010) Hanyu buneng chengshou de fanyi zhi qing – cong qufanchouhua jiaodu kan hanyu dongci he mingci de guanxi 汉语不能承受的翻译之轻——从去范畴化角度看汉语动词和名词的关系 (The unbearable lightness of the translation of verbal nouns from Indo-European languages into Chinese: Rethinking of the relation between verbs and nouns in Mandarin Chinese from a perspective of the de-categorization of verbs). Yuyanxue luncong 语言学论丛 41:15–61

Zhan W 詹卫东 (1998) Guanyu "NP de VP" pianzheng jiegou 关于"NP的VP"偏正结构 (On the attributive structure of "NP de VP" construction). Hanyu xuexi 汉语学习 2:24–28

Zhang B 张伯江 (1993) "N de V" jiegou de goucheng "N的V"结构的构成 (The formation of "N de V" construction). Zhongguo yuwen 中国语文 4

Zhang, Zhigong 张志公 (1957) Yufa he yufa jiaoxue 语法和语法教学 (Grammar and teaching of grammar). Renmin jiaoyu chubanshe, Beijing

Zhou J (2021) A corpus-based study of explicit objective modal expressions in English. Studia Neophilologica

Zhou R 周韧 (2012) "N de V" jiegou jiushi "N de N" jiehou "N的V"结构就是"N的 N"结构 ("N de V" construction is "N de N" construction). Zhongguo yuwen 中国语文 5:447–457

Zhu D 朱德熙, Lu J 卢甲文, Ma Z 马真 (1961) Guanyu dongci xingrongci de "mingwuhua" wenti 关于动词形容词的"名物化"问题 (On the nominalizations of verbs and adjectives). Beijing daxue xuebao 北京大学学报 1

Zhu D 朱德熙 (1982) Yufa jiangyi 语法讲义 (Lectures on grammar). Shangwu yinshuguan, Beijing

Zhou, J 2021. A corpus-based study of explicit objective modal expressions in English. Studida Neophilologica

Competing interests

The author declares no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information