

# An HPSG-based Analysis of Resultative Compounds in Chinese

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## 1 Introductory Remarks

Commonly in the Chinese languages (Cheng et al., 1997), two lexical items (typically verbs and adjectives) can form a compound, as exemplified in (1). The sequence of predicates syntactically behaves as a single unit and semantically involves a resultative interpretation.

- (1) 张三 跑 累 了  
Zhāngsān pǎo lèi le  
Zhangsan run tired ASP

‘Zhangsan got tired from running.’ (Li, 1990, p. 182)

The first component (henceforth,  $V_1$ ) expresses an event, and the second component (henceforth,  $V_2$ ) is a resulting state. For instance, the predicate given in (1) denotes “running causes being tired as a result”. Li (1990) formulates the relation as (2), which indicates that the event expressed by  $V_1$  causes the state expressed by  $V_2$  as a result.

- (2)  $V(\dots) \Leftrightarrow V_1(\dots) \text{ CAUSE } V_2(\dots)$

With respect to constructing the causal relation, the resultative compounds in Chinese exhibit some intriguing properties which we describe below.

## 2 Basic Properties

First, the  $V_2$  can be predicated of either the subject or the object of  $V_1$ , as shown in (3) and (4), respectively.

- (3) a. 张三 下 输 了 棋  
Zhāngsān xià shū le qí  
Zhangsan play lose ASP chess  
‘Zhangsan played chess and as a result he lost it.’  
b. 他/她 玩 忘 了 自己的 职责  
tā wán wàng le zìjǐ de zhízé.  
(s)he play forget ASP own DE duty  
‘(S)he played (in such an absorbed way that (s)he) forgot her/his duty.’ (Cheng, 1997, p. 168–169)

- (4) 张三 洗 干净 了 衣服  
Zhāngsān xǐ gānjìng le yīfu  
Zhangsan wash clean ASP clothes

‘Zhangsan washed the clothes clean.’ (Li, 2009, p. 27)

Resultative compounds in Chinese are thus different from resultative constructions in English-like languages where the result cannot be predicated

on the subject. Lee (2013) classifies the two types of resultatives in Chinese into subject-oriented resultatives (exemplified in (3)) and object-oriented resultatives (exemplified in (4)).

Second, resultative compounds in Chinese sometimes involve ambiguity, as shown in (5).

- (5) 张三 追 累 了 李四  
Zhāngsān zhuī lèi le Lǐsì  
Zhangsan chase tired ASP Lisi

a. ‘Zhangsan chased Lisi to the extent of making Lisi tired.’

b. ‘Zhangsan chased Lisi and Zhangsan got tired.’ (Li, 1995, p. 256)

In (5), the individual supposed to be tired is either the object *Lǐsì* or the subject *Zhāngsān* depending on which reading is chosen, though the first reading is more natural (Her, 2007). This ambiguity has to be resolved somewhere in the semantic representation of the sentence.

Third, in terms of thematic role assignment, resultative compounds in Chinese are restricted to having at most two roles (Her, 2007). If either  $V_1$  or  $V_2$  (or both) takes two arguments, there must be one or two shared arguments. For the same reason, the ditransitive verbs that inherently bear three arguments cannot participate in compounding with the exception of *gěi* ‘give’ (Li, 1990). There are two more points to be considered about argument sharing. On the one hand, not all compounds necessarily involve argument sharing.

- (6) a. 我 哭 红 了 双眼  
wǒ kū hóng le shuāngyǎn  
I cry red ASP eyes  
‘I cried so much that my eyes turned red.’  
b. 我 双眼 哭 红 了  
wǒ shuāngyǎn kū hóng le  
my eyes cry red ASP  
‘My eyes turned red because I cried.’ (Li, 2011, p. 34)

The predicate in (6) conveys a combination of two event structures, such as “I cried.” and “(My) eyes were red.” Note that both  $V_1$  and  $V_2$  are intransitive. In (6a), the semantic subject of  $V_1$  (*kū* ‘cry’) is the external argument of the sentence (i.e. AGENT), whereas that of  $V_2$  (*hóng* ‘red’) is realized as the complement. In (6b), the semantic argument of  $V_1$  is missing. On the other hand, not

all semantic subjects of  $V_1$  occupy the subject position of the whole sentence. In (7),  $V_1$  lexically takes two arguments (*nǐ* ‘you’ as the subject and *yào* ‘drug’ as the object) and  $V_2$  takes only one argument (*nǐ*).

- (7) 这种药会吃死你  
 zhè zhǒng yào huì chī sǐ nǐ  
 this kind drug will eat die you

‘Eating this kind of drug will make you die.’ (Her, 2007, p. 232)

In the surface form, the subject of the whole sentence is originally the second argument of  $V_1$ , and the internal argument is co-constrained by  $V_1$  and  $V_2$ . That is to say, in this type of resultative compounds, the argument structure is inverted (Lee, 2013): The first argument of  $V_1$  (i.e., SUBJ) is demoted to the second argument of the entire compound (i.e., COMPS) just as with passivization. In other words, argument sharing may or may not happen, and sometimes the semantic subject of  $V_1$  can be realized VP-internally.

Fourth, the compounding is not perfectly cohesive in that some lexical items can intervene between  $V_1$  and  $V_2$ , as exemplified below. The items that can occur between them include the *de* marker, the negative operator *bu*, and intensifiers such as *hěn*.

- (8) 我读不懂你的书  
 wǒ dú bu dǒng nǐ de shū  
 I read not understand you DE book

‘I cannot understand your book.’

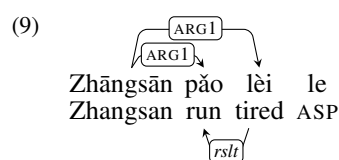
The sentence shown in (8) presupposes that the speaker has already read the book, delivering a meaning such as “I truly have read your book, but I cannot understand it.” This implies that the scope of the negative operator *bu* ranges only over  $V_2$ . Given such a presupposition,  $V_1$  contributes to the truth condition of the whole sentence more than  $V_2$ . If what  $V_1$  denotes is false, the entire preposition is always false irrespective of whether what  $V_2$  denotes is true or not. This implies that  $V_2$  is truth-conditionally subordinated to  $V_1$ , and this should also be reflected in the semantic representation.

Other than the major properties discussed hitherto, there is one minor but significant constraint on resultative compounds. Verbal items consisting of two or more characters (e.g., *xǐ.huan* ‘like’) seldom participate in compounding, especially as  $V_1$  (Thompson, 1973). This is mainly because

the non-monosyllabic verbal items can be thought of as already undergoing compounding, and one compound seldom forms another compound.

### 3 Basic Constraints

Most previous studies account for the patterns of argument composition based on thematic roles (e.g., AGENT, PATIENT, etc.) and/or event structures (e.g., CAUSER, CAUSEE, etc.). However, our analysis uses only the bleached roles standardly used in the Minimal Recursion Semantics (Copestake et al., 2005). The arguments in MRS are labelled as ARG0 (the EP itself), ARG1, ARG2, and ARG3. The current study represents semantic structures as a dependency graph for ease of exposition, as sketched out in (9) for (1).



In (9), the arrows from *Zhāngsān* to *pǎo* ‘run’ and from *Zhāngsān* to *lèi* ‘tired’ are both labelled as ARG1. This means that  $V_1$  and  $V_2$  compositionally share one argument and the two components take the argument as the semantic subject ARG1. On the other hand, the arrow underneath is labelled as *rslt*, which stands for the binary relation between  $V_1$  and  $V_2$ . The arrow direction indicates that  $V_2$  *lèi* is semantically dependent on  $V_1$  *pǎo*.

#### 3.1 Headedness

One of the main discussions about resultative compounds is which component behaves as the head. Logically, there are three possibilities, viz.  $V_1$  (Li, 1990; Cheng and Huang, 1994),  $V_2$  (Shen, 2004), and headless (Li, 2009). The current study follows the first position.

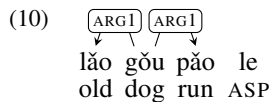
Since resultative compounds are not coordinated constructions, the claim that neither  $V_1$  nor  $V_2$  is the head (i.e. headless) is not applicable to the current analysis. The components in headless constructions are typically interchangeable, at least in Chinese, not altering the meaning structure (McCawley, 1994). However,  $V_1$  and  $V_2$  in resultative compounds are not interchangeable at all. Müller and Lipenkova (2009) regard the serial verb construction in Mandarin Chinese as a type of headless phrase, but the resultative compound in Chinese differs from it. While the two components in the serial verb construction equally con-

tribute to the meaning of the sentence, those in resultative compounds are in a subordinate relation, as discussed earlier, and a constructional meaning (i.e. *rslt*) is introduced as shown in (9). On the other hand, the claim that  $V_2$  is the head is largely grounded upon the fact that the aspect marker *le* in Mandarin Chinese is attached to  $V_2$  in the linear order. However, the present study argues that the two verbal items are combined with each other to form another V, and then *le* attaches to the whole as defined in (2). This operation is similar to how complex predicates build up.

Cheng and Huang (1994) argue that  $V_1$  is solely responsible for the syntactic behaviour of resultative compounds:  $V_1$  is either active or stative whereas  $V_2$  is usually ergative. If  $V_1$  is active, the entire compound is either unergative or transitive, depending on whether there is an object. If  $V_1$  is stative, the entire compound is either ergative or causative, depending on whether there exists an overt causer. Deferring to this argument, the current study treats  $V_1$  as the head.

### 3.2 Compound Relation

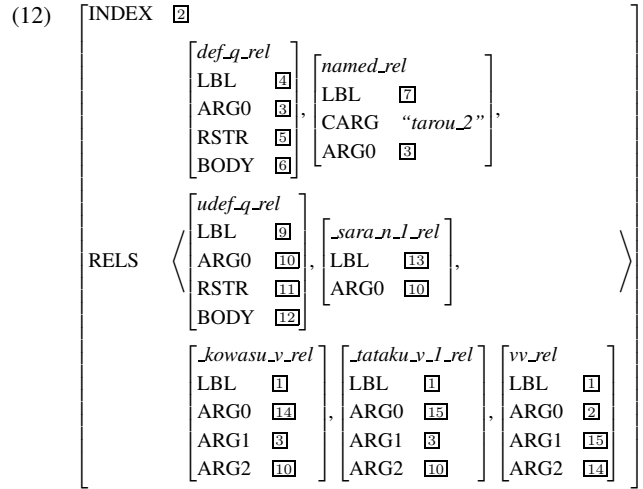
Resultative compounds are not the same as the ordinary modification phrases in that the valency of the entire compound hinges on how arguments of the two components are composed (Zhang et al., 2011). However, since semantic representation accessed in MRS does not directly have to do with the valency structure, such a difference cannot be represented well enough to distinguish the meanings until an extra element is introduced. For instance, (10) meaning “The old dog ran.” involves only the normal modification, but the subject *gǒu* ‘dog’ has an ARG1 relation to both verbal items simultaneously. If it were not for the *rslt* relation between  $V_1$  and  $V_2$ , the semantic representation provided in (9) is constructed in almost the same manner as the structure provided in (10).



Along this line, Hashimoto and Bond (2005) analyze the VV compounds in Japanese with a phrase structure rule that introduces a constructional EP into the RELS list: namely, *vv\_rel*. For instance, (12) is part of the MRS representation for a Japanese sentence (11) in which a VV compound appears (cf. Jacy (Siegel and Bender, 2002)).

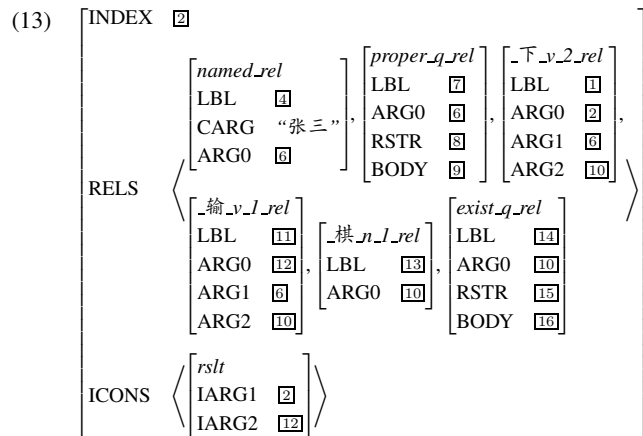
- (11) 太郎-が\* 皿-を 叩き-壊し-た  
 Tarou-ga sara-o takaki-kowashi-ta  
 Tarou-NOM dish-ACC hit-break-PAST

‘Tarou battered down the dish.’ [jpn] (Hashimoto and Bond, 2005, p. 149)



The last element in the RELS list (*vv\_rel*) serves as the semantic head of the entire sentence as indicated by the co-indexation between INDEX and the EP’s ARG0. The EP’s ARG1 and ARG2 are co-indexed with the two verbal items’ ARG0, respectively.

The current work does not add such a predicate into the RELS list but represent the relation between  $V_1$  and  $V_2$  via Individual CONSTRAINT (ICONS, (Song, 2014)). This is mainly because compounding is a relational property between two individuals, rather than an element that contributes to semantic composition. ICONS is used to represent a binary relation between two individual elements into semantic representation for producing better performance in language processing. Using the same mechanism, the relation between  $V_1$  and  $V_2$  can be explicitly and properly represented via ICONS. For instance, the MRS representation for (3a) is given in (13).



(13) does not have any extra EP in the RELS list, but an element named *rslt* is included in the ICONS list. The IARG1 and IARG2 are respectively co-indexed with the ARG0 of the EPs responsible for  $V_1$  and  $V_2$ . Notably, the semantic head of the entire sentence is still  $V_1$  as indicated on the co-reference [2]. Note that the rest elements are composed in the same manner as (12).

### 3.3 Basic Structure

The phrase structure rule that constitutes resultative compounds is constrained as shown in (14).

$$(14) \left[ \begin{array}{l} \text{rslt-compound} \\ \text{DTRS} \left\langle \begin{array}{l} \mathbf{H} \left[ \begin{array}{l} \text{HEAD} \quad +vj \\ \text{LIGHT} \quad - \\ \text{LENGTH} \quad one \\ \text{LTOP} \quad \boxed{1} \\ \text{INDEX} \quad \boxed{2} \end{array} \right] \left[ \begin{array}{l} \text{HEAD} \quad +vj \\ \text{LIGHT} \quad - \\ \text{INDEX} \quad \boxed{3} \end{array} \right] \end{array} \right\rangle \\ \text{C-CONT} \left[ \begin{array}{l} \text{LTOP} \quad \boxed{1} \\ \text{INDEX} \quad \boxed{2} \\ \text{ICONS} \quad \left\langle ! \left[ \begin{array}{l} \text{rslt} \\ \text{IARG1} \quad \boxed{2} \\ \text{IARG2} \quad \boxed{3} \end{array} \right] ! \right\rangle \end{array} \right] \end{array} \right]$$

First, [HEAD +vj] means that only verbs and adjectives can take part in compounding, [LIGHT -] means the two components must be non-phrasal (Abeillé and Godard, 2001), and [LENGTH one] of the first daughter places the length constraint on  $V_1$  (i.e., monosyllable). Second, **H** indicates that  $V_1$  is the syntactic head, and the co-references on LTOP and INDEX indicate that  $V_1$  functions as the semantic head. Finally, the *rslt* element is constructionally introduced into C-CONT|ICONS, of which IARG1 and IARG2 are co-indexed with the daughters' INDEXes. Notice that all specific rules that place a constraint on argument composition inherit from (14).

## 4 Argument Composition

There are two points to be considered in computing argument composition: (i) the members of arguments that participate in the compounding, and (ii) the direction in which the arguments are composed amongst subject-oriented, object-oriented, and inverse (Lee, 2013). With respect to first type of constraints, *rslt-compound* schematized in (14) has three subtypes, viz. *rsl-1\_1-compound*, *rsl-12\_1-compound*, and *rsl-x\_12-compound*. They have to do with just how many arguments  $V_1$  and  $V_2$  involve. The third type *rsl-x\_12-compound* places a constraint on compounds in which  $V_1$  has

either one or two arguments. The second type of constraints is independently defined so as to allow the specific subtypes to inherit multiply from both *rslt* and *oriented*.

$$(15) \begin{array}{c} \begin{array}{c} \text{rslt} \\ \begin{array}{ccc} 1\_1 & 12\_1 & x\_12 \end{array} \\ \begin{array}{l} \text{rslt-1\_1-compound} \\ \text{HD} \mid \text{COMPS} \langle \rangle \\ \text{NHD} \mid \text{COMPS} \langle \rangle \\ \text{rslt-12\_1-compound} \\ \text{HD} \mid \text{COMPS} \langle \boxed{1} \rangle \\ \text{NHD} \mid \text{COMPS} \langle \rangle \\ \text{rslt-x\_12-compound} \\ \text{SUBJ} \langle \boxed{1} \rangle \\ \text{COMPS} \langle \boxed{2} \rangle \\ \text{HD} \mid \text{SUBJ} \langle \boxed{1} \rangle \\ \text{NHD} \left[ \begin{array}{l} \text{SUBJ} \langle \boxed{1} \rangle \\ \text{COMPS} \langle \boxed{2} \rangle \end{array} \right] \end{array} \end{array} \\ \begin{array}{c} \text{oriented} \\ \begin{array}{ccc} \text{sbj} & \text{obj} & \text{inv} \end{array} \\ \begin{array}{l} \text{sbj-oriented} \\ \text{SUBJ} \langle \boxed{1} \rangle \\ \text{NHD} \mid \text{SUBJ} \langle \boxed{1} \rangle \\ \text{obj-oriented} \\ \text{COMPS} \langle \boxed{1} \rangle \\ \text{NHD} \mid \text{SUBJ} \langle \boxed{1} \rangle \\ \text{inverse} \\ \text{SUBJ} \langle \boxed{1} \rangle \\ \text{COMPS} \langle \boxed{2} \rangle \\ \text{HD} \left[ \begin{array}{l} \text{SUBJ} \langle \boxed{2} \rangle \\ \text{COMPS} \langle \boxed{1} \rangle \end{array} \right] \\ \text{NHD} \mid \text{SUBJ} \langle \boxed{2} \rangle \end{array} \end{array} \end{array}$$

In the *sbj-oriented* and *obj-oriented* readings, the ARG1 of  $V_2$  is associated with the subject and the object of the sentence, respectively. The argument composition constrained by *inverse* differs from these two in that the subject of the daughters is promoted to the complement in the mother node.

Eight subrules inheriting from *rslt-compound* are presented in the following subsections, considering whether or not argument sharing happens.

### 4.1 When $V_2$ is Transitive

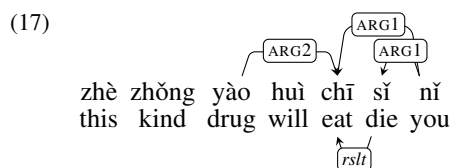
If  $V_2$  takes more than one argument (i.e., not intransitive), only the *subject-oriented* reading is available. In this case, arguments are straightforwardly composed. There are two rules depending on whether  $V_1$  is intransitive or transitive, viz. *rslt-1\_12-sbj* and *rslt-12\_12-sbj*. In the former, the head daughter (i.e.,  $V_1$ ) has an empty COMPS list, while in the latter it has one element in the COMPS list co-indexed with the mother's COMPS list. These two rules are responsible for the compounds given in (3), in which  $V_2$  is transitive: *wán wàng* 'play-forget' as an instance of *rslt-1\_12-sbj* and *xià shū* 'play-lose' as an instance of *rslt-12\_12-sbj*. For instance, the semantic structure of (3a) is represented in (16).

$$(16) \begin{array}{c} \begin{array}{c} \text{ARG1} \quad \text{ARG2} \\ \swarrow \quad \searrow \\ \text{ARG1} \quad \text{ARG2} \\ \swarrow \quad \searrow \\ \text{Zhāngsān} \quad \text{xià} \quad \text{shū} \quad \text{le} \quad \text{qí} \\ \text{Zhangsan} \quad \text{play} \quad \text{lose} \quad \text{ASP} \quad \text{chess} \\ \uparrow \\ \text{rslt} \end{array} \end{array}$$

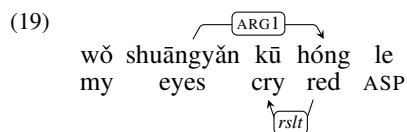
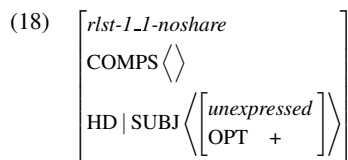
## 4.2 When $V_2$ is Intransitive

When  $V_2$  is intransitive, there are two possible argument structures for  $V_1$ .

**(ARG12) + (ARG1):** If  $V_1$  is transitive, all the three types of orientedness can occur, though the object-oriented type is the most frequently used and the inverse type rarely occurs. The three types commonly inherit from *rslt-1-1-compound* and also respectively inherit from *sbj-oriented*, *obj-oriented*, and *inverse*. The ambiguous sentence shown in (5) is constructed by the two different rules, such as *rslt-12-1-obj* and *rslt-12-1-sbj*. The former is responsible for the first reading (i.e. causative), and the latter is responsible for the second reading in which the subject is affected by the event denoted by  $V_1$ . On the other hand, *rslt-12-1-inv* is responsible for the least frequently occurring type, the instance of which is provided in (7). The semantic object (i.e. ARG2) of  $V_1$  is realized as the subject, while the semantic subject (i.e. ARG1) is demoted to the complement in surface form. The dependency graph for (7) is sketched out in (17).

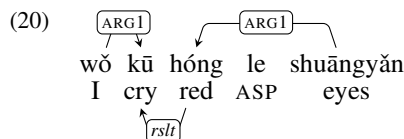


**(ARG1) + (ARG1):** In this case, since both  $V_1$  and  $V_2$  lack a complement, *inverse* cannot be the supertype. Nonetheless, this pattern results in three subrules because the *arg1* of  $V_1$  and that of  $V_2$  can be non-shared. (6b) is an instance of this type, in which the syntactic subject is associated with only  $V_2$  and  $V_1$ 's argument is not realized in surface form. This composition type is constrained by *rslt-1-1-noshare* whose AVM is presented in (18). The sample dependency graph representing (6b) is also provided below.



(6a) is an instance of *rslt-1-1-obj* in which the complement is assigned ARG1 solely by  $V_2$ , and (1) is an instance of *rslt-1-1-sbj* in which  $V_1$  and  $V_2$

share ARG1 and the argument is simply realized as the syntactic subject. The dependency graph of (6a) is presented in (20).



## References

- Anne Abeillé and Daniele Godard. 2001. A Class of “Lite” Adverbs in French. In Joaquim Camps and Caroline R. Wiltshire, editors, *Romance Syntax, Semantics and L2 Acquisition: Selected papers from the 30th Linguistic Symposium on Romance Languages, Gainesville, Florida, February 2000*, pages 9–26. John Benjamins Publishing Company, Amsterdam/Philadelphia.
- Lisa Lai-Shen Cheng and C-T James Huang. 1994. On the Argument Structure of Resultative Compounds. In Matthew Y. Chen and Ovid J. L. Tzeng, editors, *In Honor of William S-Y. Wang: Interdisciplinary Studies on Language and Language Change*, pages 143–157. Pyramid Press, Taipei.
- Lisa Cheng, C-T James Huang, Y-H Audrey Li, and C-C Jane Tang. 1997. Causative Compounds across Chinese Dialects: A Study of Cantonese, Mandarin and Taiwanese. *Chinese Languages and Linguistics*, 4:199–224.
- Lisa Lai-Shen Cheng. 1997. Resultative Compounds and Lexical Relational Structures. *Chinese Languages and Linguistics III: Morphology and Lexicon*, pages 167–197.
- Ann Copestake, Dan Flickinger, Carl Pollard, and Ivan A. Sag. 2005. Minimal Recursion Semantics: An Introduction. *Research on Language & Computation*, 3(4):281–332.
- Chikara Hashimoto and Francis Bond. 2005. A Computational Treatment of V-V Compounds in Japanese. In Stefan Müller, editor, *Proceedings of the 12th International Conference on Head-Driven Phrase Structure Grammar, Department of Informatics, University of Lisbon*, pages 143–156. Stanford, CA. CSLI Publications.
- One-Soon Her. 2007. Argument-Function Mismatches in Mandarin Resultatives: A Lexical Mapping Account. *Lingua*, 117(1):221–246.
- Leslie Lee. 2013. *Event Structure and Grammatical Patterns: Resultative Constructions*. Ph.D. thesis, University of California, San Diego.
- Yafei Li. 1990. On VV Compounds in Chinese. *Natural Language & Linguistic Theory*, 8(2):177–207.
- Yafei Li. 1995. The Thematic Hierarchy and Causativity. *Natural Language & Linguistic Theory*, 13(2):255–282.
- Chao Li. 2009. On the Headedness of Mandarin Resultative Verb Compounds. *Concentric: Studies in Linguistics*, 35(1):27–63.
- Fengqi Li. 2011.  $\theta$ -structures of Mandarin Resultative Verb Compounds. *Linguistik online*, 50(6):31–42.
- James D McCawley. 1994. Remarks on the Syntax of Mandarin Yes-No Questions. *Journal of East Asian Linguistics*, 3(2):179–194.
- Stefan Müller and Janna Lipenkova. 2009. Serial Verb Constructions in Chinese: An HPSG Account. In Stefan Müller, editor, *Proceedings of the 16th International Conference on Head-Driven Phrase Structure Grammar, University of Göttingen, Germany*, pages 234–254. Stanford. CSLI Publications.
- Li Shen. 2004. Spect Agreement and Light Verbs in Chinese: A Comparison with Japanese. *Journal of East Asian Linguistics*, 13(2):141–179.
- Melanie Siegel and Emily M. Bender. 2002. Efficient Deep Processing of Japanese. In *Proceedings of the 3rd Workshop on Asian Language Resources and International Standardization*, Taipei, Taiwan.
- Sanghoun Song. 2014. *A Grammar Library for Information Structure*. Ph.D. thesis, University of Washington.
- Sandra Annear Thompson. 1973. Resultative Verb Compounds in Mandarin Chinese: A Case for Lexical Rules. *Language*, pages 361–379.
- Yi Zhang, Rui Wang, and Yu Chen. 2011. Engineering a Deep HPSG for Mandarin Chinese. In *Proceedings of the 9th Workshop On Asian Language Resources*, Chiang Mai, Thailand.