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Yilun Zhu  
*Georgetown University, yz565@georgetown.edu*

Yang Liu  
*Georgetown University, yl879@georgetown.edu*

Siyao Peng  
*Georgetown University, sp1184@georgetown.edu*

Austin Blodgett  
*Georgetown University, ajb341@georgetown.edu*

Yushi Zhao  
*Georgetown University, yz521@georgetown.edu*

*See next page for additional authors*

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Adpositional Supersenses for Mandarin Chinese

Authors
Yilun Zhu, Yang Liu, Siyao Peng, Austin Blodgett, Yushi Zhao, and Nathan Schneider
1 Introduction

Adpositions, though belonging to a closed functional category, can contribute significantly to meaning. Schneider et al. (2018b) proposed an annotation scheme called Semantic Network of Adposition and Case Supersenses (SNACS), which includes 50 supersense labels (LOCUS, TOPIC, etc.). Unlike other approaches to semantic tagging/role labeling, SNACS incorporates the construal analysis (Hwang et al., 2017) wherein the lexical semantic contribution of an adposition token (its function) is distinguished and may diverge from the underlying relation in the surrounding context or scene. For instance, (1) blends the domains of emotion (principally reflected in care, which licenses a STIMULUS), and cognition (principally reflected in about, which often marks non-emotional TOPICS). The token is therefore annotated with both supersenses; we use the notation SCENARIO~FUNCTION:

(1) I care about:STIMULUS~TOPIC you.¹

The SNACS scheme was developed for English and tested for annotation and automatic disambiguation on English corpora. Though other languages were taken into consideration in designing SNACS, no serious annotation effort has been undertaken to confirm empirically that it generalizes to other languages. Here, we adapt SNACS annotation to Mandarin Chinese and demonstrate that the same supersense categories are appropriate for Chinese adposition semantics. We annotate 20 chapters of The Little Prince in Chinese, giving an English-Chinese parallel corpus to examine similarities and differences in prepositional construal between the two languages.

2 Adposition Criteria

The first challenge is in determining which words (and multiword expressions) qualify as meriting SNACS supersenses. For example, coverbs and localizers are categories in Chinese grammar that bear some relationship to adpositions, though their precise classification is controversial. In (2), xuéshù (i.e. ‘academia’) is surrounded by a coverb zài and a localizer shàng.

(2) tā zài:LOCUS xuéshù
3SG P:at academia
shàng:TOPIC~LOCUS yòusuǒzuòwéi.
LC:on-top-of successful ‘He succeeded in academia.’

2.1 Coverbs

Coverbs usually precede the main predicate of the clause and introduce an NP argument to it (Li and Thompson, 1974). In (2), the noun surrounded by the coverb zài (functioning as a preposition) and the localizer shàng precedes the predicate yòusuǒzuòwéi. In some cases, coverbs can also occur as predicates. For example, the coverb zài heads the predicate phrase in (3), different from those occurring in a modifier position. In this project, we annotate all coverbs only when they occur pre-verbally, echoing the view that coverbs modify events introduced by the predicates, rather than establishing multiple events in a clause (Hui, 2012). Therefore, lexical items such as zài in (3) are not annotated.

(3) nǐ yào de yáng jū zài lǐmiàn.
2SG want DE sheep RES at inside ‘The sheep you want is in the box.’
(zhō_1pp_1943.92)

2.2 Localizers

Localizers are words that follow a noun phrase to refine its semantic relation. E.g., shàng in (2) denotes a contextual meaning, ‘in a particular topic’, whereas the co-occurring coverb zài only conveys a generic location. It is unclear whether localizers are syntactically postpositions, but we annotate all localizers because of their semantic significance.

Though coverbs frequently cooccur with localizers, the combinations are somewhat productive, so we treat them as separate targets for SNACS annotation. Thus, zài and shàng receive LOCUS and TOPIC~LOCUS respectively in (2).

3 Supersense Applicability

For the most part, we found that the SNACS supersenses developed for English could be applied to Chinese. However, we identified a number of dif-
ferent construals that were frequent in Chinese but rare or unattested in English. A couple of examples are noted below.

3.1 EXPERIENCER as Function
In English, some supersenses, such as EXPERIENCER, do not seem to have any prototypical adpositions (Schneider et al., 2018a). In (4), the scene role EXPERIENCER is expressed through the preposition to and construed as GOAL, which highlights the abstract destination of the air of truth. This reflects the basic meaning of to, which denotes a path towards a goal (Bowerman and Choi, 2001). In contrast, the lexicalized combination of the preposition dui and the localizer láishuò in (5) jointly establish a functionality to introduce the mental state of the experiencer, denoting the meaning “to someone’s regard’. The high frequency of such combination in the annotated corpus (11 occurrences) indicates that EXPERIENCER does have a prototypical adposition in Chinese.

(4) To:EXPERIENCER~GOAL those who understand life, that would have given a much greater air of truth to my story. (en. lpp. 1943.185)

(5) [dui:EXPERIENCER [dōngdé shènhuó P:to know-about life de rén] láishuò:EXPERIENCER], DE people LC:one’s-regard zhèyáng shuō jiǔ xiǎndé zhēnshí this-way tell RES seems real ‘It looks real to those who know about life.’ (zh. lpp. 1943.185)

3.2 Same Scene Role, Different Function
Both English to and Chinese dui have RECIPIENT as the scene role. In (6), GOAL is labelled as the function of to because it indicates the completion of the “saying” event. In Chinese, dui has the function label DIRECTION provided that dui highlights the orientation of the message uttered by the speaker as in (7). Even though they express the same scene role in the parallel corpus, their lexical semantics still requires them to have different functions.

(6) You would have to say to:RECIPIENT~GOAL them: “I saw a house that costs $20,000.” (en. lpp. 1943.172).

(7) (nǐ) bǐxū [duì:RECIPIENT~DIRECTION 2SG must P:to tāmen] shuō: “wǒ kàn jiàn le yī dòng 3PL say 1SG see one CL shìwàn fāngzí.”
10,000 franc DE house ‘You must tell them: “I see a house that costs 10,000 francs.” ’ (zh. lpp. 1943.172).

3.3 Unproductivity of Function
Throughout the annotated data, Chinese adpositions have relatively limited functions compared to English. For example, in English, the functions of in include LOCUS, TIME, MANNER, as well as TOPIc as in (8) and (9). In Chinese, however, LOCUS is the only function label for the paralleled localizer shàng, and the scene role is expressed through the construal TOPIC~LOCUs as in (10).

(8) In:TOPic certain more important details I shall make mistakes. (en. lpp. 1943.201)

(9) I should have liked to begin this story in:MANNER the fashion of the fairy-tales. (en. lpp. 1943.183)

(10) wǒ hên kěněng [zài:LOCUS [mǒuxiě 1SG very probably P:at some zhòngyào de xǐjìé] important DE detail shàng:TOPIc~LOCUs] huà cuò draw be-mistaken le. ASP ‘I probably made mistakes on some important details.’ (zh. lpp. 1943.201)

4 Corpus Annotation and Evaluation
20 chapters of The Little Prince have been pre-processed by Stanford Word Segmenter (Chang et al., 2008) using ‘ptb’-mode with subsequent manual corrections following the Penn Chinese Treebank guidelines (Xia, 2000).

Corpus annotation. With our Chinese-specific guidelines, we annotated 20 chapters of The Little Prince in Chinese consisting of 13,000+ tokens. 14 chapters were annotated jointly by three native Chinese speakers, all of whom had received advanced training in theoretical and computational linguistics. Among the 602 adpositions we annotated, 40 types of construals were identified, with 24 of the 50 supersenses appearing as scene roles and 23 as functions.

Inter-annotator agreement. As a preliminary evaluation of the reliability of the adapted scheme

https://nlp.stanford.edu/software/segmenter.html
for Chinese, we conducted an agreement study on six chapters (Ch. 15–20), including 111 adpositions. Raw agreement was .92 on scenes, .95 on functions, and .90 on role+function combinations. Average pairwise Cohen’s kappa was .90 on scene roles, .93 on functions and .88 on role+function combinations, indicating strong agreement.

5 Cross-lingual Correspondence
We compared chapters 1, 4, and 5 of The Little Prince that are annotated both in English and Chinese, and found that the inventory of supersenses captures the cross-linguistic similarities of adpositional semantics between the two languages.

5.1 Alignment
Among the 256 English and 141 Chinese adpositions in the three chapters of The Little Prince, 71 are manually aligned based on two criteria: (i) the matching mentions in English and Chinese both appear as NP constituents; and (ii) both NP constituents are governed by adpositions. For instance, the coverb and the localizer together in (11) match the adposition in (12) because the constituents governed by the adpositions in both English and Chinese are semantically equivalent to each other.

(11) ... zài:LOCUS→LOCUS yì běn miáoxì ... P:at one CL describe yúánhí sēnlín de míngjiào “zhēnhí de primeval forest DE call true DE gūshí” de shù zhǒng:LOCUS→LOCUS... story DE book LC:in ‘In a book about primeval forest called True Stories.’ (zh._tp. 1943.2)

(12) ... in:LOCUS→LOCUS a book , called True Stories from Nature , about the primeval forest. (en._tp. 1943.2)

73% of the aligned adpositions share the same scene role and 51% share the same function. This result matches the principles of the construal analysis in which scene roles capture the contextual usage (Hwang et al., 2017) and thus are more frequently matched in a bilingual parallel corpus.

5.2 Applicability of Contrual Analysis in Chinese
We compared scene role and function annotations in three chapters in English and Chinese and found that most adpositions have identical scene and function. As shown in Table 1, for 70% of annotated English tokens, both scene role and function receive the same supersense, and the same holds for 86% of Chinese tokens.

| Role vs. Function | Same | Total |
|-------------------|------|-------|
| English           | 178  (70%) | 256   |
| Chinese           | 121  (86%) | 141   |

Table 1: Comparing the scene role and function annotations for adpositions in Ch. 1, 4, and 5.

Though in both languages the lexical semantics of adpositions (i.e., function supersense) and their contextual usage (i.e., scene role supersense) usually have the same type, 14% and 30% of adposition tokens have different usages in context in Chinese and English respectively. In the three chapters of the Chinese translation, 10 distinct adpositions are represented in the 14% of tokens whose scene role does not agree with the function, versus 34 distinct adpositions in the remaining tokens (86%). Though scene matches function in many Chinese adpositions, some particular adpositions (e.g. zhōng) vary their lexical semantics to different usages (e.g. CIRCUMSTANCE and MANNER). A non-construal analysis would not capture the richness of contextual usage in some Chinese adpositions. These observations indicate that the construal analysis should be applied not only in English but also in Chinese.

5.3 Analysis by Subhierarchy
As in Figure 1, all 50 supersenses in SNACS are categorized into three non-overlapping subhierarchies: Circumstance (CIRC), Participant (PART), and Configuration (CONF) (Schneider et al., 2018b). Circumstance usually provides non-core information of an event, Participant involves arguments of an event, and Configuration builds up relations between two entities. The data between English and Chinese reveals the similarities that the scene role is more likely to fall into Participant if it does not match the function in the same subhierarchy.

We turn now to tokens where the scene role and function diverge significantly, i.e., are categorized in different subhierarchies. There are 38 such “cross-hierarchy” tokens in English and 14 in Chinese—the breakdown by subhierarchy appears in Table 2. Of these, overwhelmingly the scene...
role comes from the PART subhierarchy, such as TOPIC in (10). The distribution reveals the tendency that if adpositions are used across subhierarchies, the context favors them to be the arguments of an event in both languages. This observation represents similarities between the two languages at the subhierarchy level and seemingly restricts scenes to agree with functions within the subhierarchy. This commonality between English and Chinese demonstrates the practicality of extending SNACS to Chinese.

Furthermore, adpositions with CONF supersense are more frequent in English than in Chinese. On the diagonal of Table 2, only 7% (10 out of 140) of adpositions in Chinese involve the CONF subhierarchy as both role and function, versus 28% (71 out of 247) in English, indicating that relationships between entities are not usually expressed by adpositions in Chinese. Though the lexical semantics of Chinese adpositions has lower tendency to fall into Configuration, this subhierarchy is still needed to describe some of the Chinese adpositions.

6 Conclusion
We have adapted SNACS to Mandarin Chinese, having developed new guidelines for phenomena not present in English and annotated 20 chapters of The Little Prince, with high interannotator agreement. The parallel corpus substantiates the applicability of construal analysis in Chinese and gives insight into the differences in construals between adpositions in two languages. The corpus can further support automatic disambiguation of adpositions in Chinese, and the common inventory of supersenses between the two languages can potentially serve cross-linguistic tasks such as machine translation.

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