The Syntax-Semantics of Durative Phrases in Chinese: The Archimedes’ Principle in Linguistics

Wei-wen Roger Liao (Institute of Linguistics, Academia Sinica)
lwwroger@gate.sinica.edu.tw
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1. Introduction
This paper investigates the syntax-LF of durative phrases in Mandarin Chinese.1 I will argue that process-related (P-related) durative phrases can appear in verbal complement positions, and they are best analyzed as numeral-classifier phrases (rather than “floated” adverbs left by verb raising). This syntactic analysis, however, leads to a syntax-semantic mismatch, first noted in Huang (1997), since the numeral classifiers in the nominal domain actually modify the verbal domain, i.e., event modification. I shall review earlier proposals regarding this syntax-semantic mismatch, and argue that the mismatch is only apparent. The mismatch reflects a deeper CP-DP parallelism in syntax (Abney 1987, Grimshaw 2000, Hiraiwa 2005, Larson and Cho 2003, Liao 2011, Megerdoomian 2008, Ogawa 2001, Riemsdijk 1998, Stowell 1981, Vergnaud In press). Such parallelism also governs other related phenomena in natural languages. I therefore propose an “Archimedes’ Principle” in Universal Grammar for the proportional parallelism of the modificational/quantificational scopes between the nominal DP domain and the sentential CP domain.2

The paper is organized as follows. Section 2 gives a brief introduction of the problematic issues regarding durative phrases in Chinese, and argues that a best treatment is to analyze the P-related durative phrases as numeral-classifier phrases. Section 3 discusses the syntax-semantic mismatch brought about by the durative phrase, and reviews earlier proposals regarding this problem. I argue that the numeral-classifier analysis may provide a unified account. Section 4 looks at other syntax-semantic mismatches of similar nature in English, and argues that these intriguing problems may turn out to offer an elegant theory of looking at the CP-DP parallelism in syntax. Section 5 concludes the paper.

2. Durative Phrases in Chinese
In the literature, three types of analyses can be found for the post-verbal durative phrases (Dur.Phrases): complement analysis (Huang 1982, Li 1987), sentential subject analysis (Li 1987, Shi 2006), and floating-adverb analysis (Huang 1997, Lin 2008, 2011, Tang 1994). The first type of analysis assumes that durative phrases are direct complements of main verbs, as in (1):

(1) \([\text{VP} \ V \ [\text{Complement Dur.Phrase}]]\)

The second type of analysis argues that durative phrases are actually syntactic predicates that take sentential subjects, as in (2):

(2) \([\text{IP1} \ [\text{IP2 Sentential Subject}] \ [\text{Predicate Dur.Phrase}]]\)

1 Unless otherwise specified, Chinese in this paper refers to the variety of Mandarin Chinese.
2 The term “Archimedes’ Principle” in linguistics was first coined by Jean-Roger Vergnaud (see Vergnaud In press), in which he tries to capture the structural parallelism between verbal and nominal projections in the underlying syntactic architecture.
The third type of analysis assumes that durative phrases are just like typical adverbs that are originally adjoined to VP (or Aspectual Phrase, AspP), and result in postverbal positions from head movement of V. This is shown in (3):

\[(FP \ V + Asp + Fi) [Asp (Dur.Phrase1) ti [VP (Dur.Phrase2) ti]]\]

In this section, I claim that all of the structures can account for the behaviors of Chinese durative phrases, but different structures actually correspond to three different readings of durative phrases. The different readings have not drawn much attention in most of the earlier studies. I will then focus on a problem imposed by the complement analysis, which leads to a dilemma between syntax and semantics.

2.1. Three Types of Durative Phrases in Chinese

Durative phrases in English are introduced by prepositions in (for telic predicates) and for (for atelic predicates), as in (4). If one takes co-verbs in Chinese as equivalence of prepositions in English (Li and Thompson 1974), durative phrases in Chinese display similar distributions, which are introduced by different co-verbs, sensitive to telicity of the predicates, as shown in (5):

(4) a. John read the book in three hours. [telic]
   b. John read books for three hours. [atelic]

(5) a. Zhangsan zai san ge xiaoshi nei kan-wan na ben shu.
   Zhangsan in three CL hour within read-finish that CL book
   ‘Zhangsan read the book in three hours.’ [telic]
   b. Zhangsan hua san ge xiaoshi du shu.
   Zhangsan spend three CL hour read book
   ‘Zhangsan read books/studied for three hours.’ [atelic]

On the other hand, Chinese durative phrases do not always need a preposition. For atelic hua-durative phrases, as the one in (5b), they may also occur postverbally (Huang 1982, Li 1987, Liao 2004, Lin 2008, 2011, Shi 2006, Tang 1994, among many others), as in (6):

(6) a. Zhangsan du-le san ge xiaoshi (de) shu.
   Zhangsan read three CL hour DE book
   (i) ‘Zhangsan read books/studied for three hours.’
   (ii) ‘Zhangsan read the book in three hours.’
   b. Zhangsan nian-le wu nian gaozhong, hai-mei biye.
   Zhangsan study-Asp five year high.school yet-not graduate
   ‘Zhangsan attended high school for five years, and has not graduated yet.’

In addition to telicity, durative phrases are also subject to other restrictions. First, with respect to different types of temporal durations being measured by durative phrases, we can further identify three types of durative phrases in Chinese (see Liao 2004 for discussion). The first type of durative phrase measures the temporal duration of result directly caused by the event, which is called “Result-related” durative phrase, as in (7a), where the time being measured is the result (the time of “being in the water”). The second type of durative phrase measures the process of event itself, called “Process-related” durative phrases, as in (7b), where the time being measured is the process/action (the time of “attending high school”), or the Viewpoint Time (Smith 1991). The third type of durative phrase, called “Result Time-related” durative
phrases, measures the salient part of the event to the Reference Time (Klein 1994), as in (7c), where the time being measured is the time from graduation to the Reference Time, which is by default the Speech Time “now”:

(7) a. **Result-related (R-related):** measure the result directly caused by the event
   
   Zhangsan tiao dao-shui-li wu fenzhong
   
   ‘Zhangsan jumped into the water (and stayed in the water) for five minutes.’

b. **Process-related (P-related):** measure the event (Situation Time) itself
   
   Zhangsan nian-le wu nian gaozhong
   
   ‘Zhangsan attended high school for five years.’

c. **Resultant Time-related (RT-related):** measure Situation Time to Reference Time.
   
   Zhangsan nian-wan gaozhong wu-nian le
   
   ‘It has been five years since Zhangsan graduated from high school (until now).’

I argue that P-related durative phrases appear in post-verbal complement positions, RT-related durative phrases are predicates taking sentential subjects, and R-related durative phrases are floated adverbs left by head raising. Let us begin with the R-related durative phrases. Adopting Ramchand (2008), it is proposed in Lin (2008) that the R-related durative phrase actually modifies a syntactic Result Phrase (RP), which is a complement phrase of the main predicate. According to the analysis, (7a) has the underlying structure in (8), and the durative phrase is a modifier of RP:

(8) Zhangsan tiao [RP wu fenzhong [R dao-shui-li]]

The surface word order is derived after the complex head of the RP [dao-shui-li] raises to the main verb tiao, hence stranding the durative phrase. Independent evidence that this type of durative phrase is a modifier of independent complement phrase comes from the fact that the R-related durative phrase is not admissible to the verb-copying construction (Huang 1984, Li 1990), which suggests that the R-related durative phrase is not a direct complement. See (9):

(9) *Zhangsan tiao jin-shui-li tiao wu fenzhong

The ungrammaticality is in sharp contrast to the P-related durative phrase, which can enter verb-copying constructions, as in (10):

(10) a. Lisi nian gaozhong nian wu nian.

   ‘Lisi attended high school for five year.’

b. Lisi chi hanbao chi-le shi fenzhong

   ‘Lisi ate a hamburger(s) for ten minutes.’

These examples also show that the P-related durative phrase should be treated as a direct complement of verb (Li 1987, 1990). Shifting our attention to the RT-related durative phrase,
I slightly modify Li’s analysis, and propose that the RT-related durative phrase modifies a (silent) predicate *you ‘have’, and it takes the preceding clause as a sentential subject, as shown in (11) (see also Li 1987, Liao 2004, Shi 2006):

(11) [[IP Lisi nian-wan gaozhong] [PredP yijing (you) wu nian le]].
    Lisi study-finish high.school already have five year Perfect
    ‘It has been five years since Lisi graduated from high school.’

Evidence for such an analysis comes from the scope test. Suppose the RT-related durative phrase in (11) were a direct complement of the matrix verb *nian ‘study’, we predict that it should fall under the scope of negation. However, as seen in (12a), the scope of negation cannot reach the RT-related durative phrase. Again, this is in sharp contrast to the P-related durative phrase in (12b):

(12) a. Lisi mei-you nian gaozhong yijing wu nian le [RT-related]
    Lisi not study high.school already five year Perfect
    ‘It has been five years since Lisi did not attend high school.’  (five years > not)

b. Lisi mei-you nian wu nian gaozhong. [P-related]
    Lisi not study five year high.school
    ‘Lisi did not attend high schools for five years.’  (not > five years)

Given these facts, I therefore argue that the durative phrase is a direct complement if and only if it has a process-related reading.

2.2. A Dilemma of P-related Durative Phrases
We see that the sentential subject analysis can account for the syntax of RT-related durative phrase, and the floating adverbial analysis describes the syntax of R-related durative phrase. These analyses also offer systematic and transparent syntax-semantic mappings. The RT-related interpretation hinges upon the Perfect sentence final particle *le (which introduces a Reference Time that gives rise to the temporal measurement), and the result-related interpretation comes from a syntactic result phrase that provides a measurable result phase. This, however, leaves us a dilemma of P-related durative phrases. On the one hand, from the perspective of syntax-semantic mapping, it is very tempting to assume that the P-realted durative phrase adjoins to VP or AspP, and it is able to directly measure the temporal duration provided by the Viewpoint aspects in Chinese (Smith 1991, Tenny 2000). This type of analysis, argued in Liao (2004) for Chinese (and independently in Demirdache and Uribe-Etxebarria (2004) for English), has an advantage in constructing a straightforward syntax-semantic mapping theory. However, as we have seen in the earlier section, syntactic evidence from the scope test and verb copying constructions points out that the P-related durative phrase is best analyzed as a direct complement of verb.

One might wonder whether the P-related durative phrase can also be analyzed as floated adverb, on a par with the R-related durative phrase. Unfortunately, the unification is not empirically supported. First, consider other VP-level adverbs, such as manner adverbs (Ernst 2002, Jackendoff 1990). These VP-level adverbs are strictly local to verbs (inside VP) since they are able to incorporate into verbs (Rivero 1992), as in (13), while other higher-level adverbs (such as vP-level agent-oriented adverbs or TP-level temporal adverbs) are not, as shown in (14) and (15). Incorporation therefore serves as a good indication that manner adverbs and verbs are in strict local relations (i.e. manner adverbs are in VP):
(13) VP-level manner adverb
   a. \([\text{VP} [\text{VP/V'} \text{man-man de}] \text{pao}]\)
      \(\text{slow-slow DE run}\)
      \('\text{to run slowly}'\)
   b. \([\text{V} \text{man-pao}]\)
      \(\text{slow run}\)
      \('\text{to jug}'\)

(14) vP-level agent-oriented adverb
   a. \([\text{vP} [\text{gu-yi de}] [\text{VP pao}]\]
      \(\text{intentional DE run}\)
      \('\text{to run intentionally}'\)
   b. *\text{gu-pao}, *\text{yi-pao}

(15) TP-level temporal adverb
   a. \([\text{TP} [\text{ming-tian}] \ldots [\text{VP pao}]\]
      \(\text{tomorrow-day run}\)
      \('\text{to run tomorrow}'\)
   b. *\text{ming-pao}

Consider next the analysis that treats the P-related durative phrase as floated adverb. An immediate question that arises is why the manner adverb is not stranded on a par with the P-related durative phrase. Observe the examples in (16):

(16) a. Zhangsan manman-de chi-le shi fenzhong hanbao.
    \(\text{Zhangsan slow-ly eat-Asp ten minute hamburger}\)
    \('\text{Zhangsan consumed the hamburger slowly for ten minutes.'}\)
   b. *Zhangsan chi-le manman-de shi fenzhong hanbao.
    \(\text{Zhangsan eat-Asp slow-ly ten minute hamburger}\)

One might even argue that manner adverbs are structurally higher than the final landing site of verb raising, but this is not empirically attested, either. English allows the right-adjoined adverbs to stack in the same direction (Jackendoff 1990), and the fact from English suggests that manner adverbs are structurally lower than the durative phrases, as shown in (17):

(17) John \([\text{TP[AspP[VP drove slowly] for ten hours (*slowly)]] in the storm (*slowly)]\).

The manner adverb \textit{slowly} always appears adjacent to V. This fact again challenges the floating-adverb analysis. If the P-related durative phrase is stranded in the post-verbal position by verb-raising, then why are other structurally lower adverbs not stranded in a similar fashion?

Another piece of evidence from the Taiwanese (Southern Min) variety of Chinese further suggests that the post-verbal durative phrase actually takes its following NP as complement, and therefore, it cannot be a modifier. In Taiwanese, a phonological tone sandhi rule applies to head-complement structures, but not to modifiers, which form separate phrasal constituents (adjuncts of XP) (Chen 2000, Lin 1994). The contrasts are illustrated in (18) (# stands for a tone sandhi boundary, while = stands for a tone sandhi application):
(18) a. Ong-e wu neng ki(MSandhi) = bak-kiaN.
   ‘Ong-e has two pairs of glasses.’
   b. Ong-e bak-kiaN wu neng ki(HCitation) #
   ‘Ong-e has two pairs of glasses.’

(19) Ong-e dak-kang(HCitation) # [vp khui chhia].
   ‘Ong-e drives two cars every day.’

(20) Ong-e beh o-sik(LCitation) # [dp hit ki bak-kiaN]
   ‘Ong-e bought a pair of black glasses.’

(18a) and (18b) illustrate that the classifier (an extended projection of noun) undergoes tone sandhi (from its citation tone R to the sandhi tone H) when it takes a syntactic complement. If the complement NP is fronted, as in (18b), tone sandhi will not apply to the classifier because it now occurs in the rightmost edge position (and the classifier remains its citation tone R). In (19) and (20), however, although the adverb dak-kang ‘every day’ and the adjective o-sik ‘black’ do not occur in the rightmost edge positions, they do not undergo tone sandhi, showing that modifiers create tone sandhi boundaries that separate them apart from their following elements. Bear such contrasts in mind. When we look at durative phrases, tone sandhi patterns suggest that durative phrases take the following NPs as complements, and should not be treated as modifiers of the following VP or NP.3

(21) kangCL ‘day’: HCitation → MSandhi
   Gua thiaN-kong Ong-e sia saN kang(MSandhi) = tua-li tioh sen a.
   ‘I heard that Ong-e got tired after practicing calligraphy for three days.’

(22) niNCL ‘year’: RCitation → HSandhi
   Tan-e kong Ong-e thak lak niN(HSandhi) = tai-hak a,
   ‘Tan-e said that Ong-e had attended college for six years, and had not graduated yet.’

Any theories that treat the P-related durative phrase as stranded adverb (or adjectives of its following NP) would wrongly predict that tone sandhi cannot apply between the durative phrase and its following NP. Alternatively, facts from tone sandhi suggest that not only the P-related durative phrase is the complement of verb, but it also takes the following noun as a complement, on the same par with the numeral-classifier phrase (see also footnote 4). That is to say, the post-verbal P-related durative phrase has an underlying structure in (23), comparable to a typical numeral-classifier construction in (24):

3 Many speakers of Taiwanese do not like sentences with durative phrases followed by object NPs, and object preposing is preferred in these cases (e.g. Ong-e tai-hak tak lak niN a ‘Ong-e college study six-year SPF’). I thank Audrey Li (p.c.) for pointing out to me that the sentences can be much better improved in embedded contexts, as in (21) and (22). I also owe to Rui-wen Wu, Yu-yun Wang, and Henry Chang for judgments on the Taiwanese data.
3. A Syntax-semantic Mismatch
Having identified that the post-verbal P-related durative phrase is actually a numeral-classifier, the remaining question is how to account for the syntax-semantic mismatch. That is, how can a numeral-classifier phrase quantify into the verbal-aspectual event? In what follows, two earlier analyses proposed in Huang (1997) and Huang, Li and Li (2009) are reviewed. While both analyses are able to account for the surface mismatch, I argue that the numeral-classifier analysis may provide a unification for the two competing analyses.

3.1. Two Previous Accounts
Huang (1997) and Huang, Li and Li (2009: 97) argue that the surface syntax-semantic mismatch is a surface illusion resulting from a nominalized IP and light verb syntax. The derivation is illustrated as follows:

(25) a. Lisi mai-le yi-nian (de) yu.
Lisi sell-Asp one-year DE fish
‘Lisi sold fish for a year.’

One might speculate that the marker *de in (25) suggests that the durative phrase might be an adjective phrase modifying its following NP, as adjectives in Chinese generally requires *de. It is noticed, however, that the same marker *de is also used in classifier/measurement constructions. One way to distinguish the two types of *de’s is through NP-fronting, as suggested in a recent paper by Audrey Li (2013). Adjectival *de is obligatory after NP-fronting, while the post-classifier *de cannot appear at all after NP-fronting. The contrast becomes clear in light of the following examples:

(i) Gaozhong, Lisi du-le san nian (*de) e i.
   high-school Lisi study-Asp three year DE
   ‘As for high school, Lisi attended it for three years.’
(ii) Gaozhong, Lisi du-le san nian *(de) e i.
    high-school Lisi study-Asp three year DE
    ‘As for high school, Lisi attended the one with three-year curriculum.’
In (i), the P-related durative phrase behaves on a par with classifiers, and *de cannot appear after NP-fronting, while in (ii), the “fake” durative phrase, which is an adjective modifying NP (i.e., a three-year high school) requires the presence of *de even when the NP is fronted. The *de marker in (25) also belongs to the former category, as evidenced in (iii):

(iii) Yu, Lisi mai-le yi nian (*de)
    fish Lisi sell-Asp one year DE
    ‘As for selling fish, Lisi
Huang’s (1997) original proposal successfully “analyzes away” the surface syntax-semantic mismatch. The durative phrase still modifies the verbal domain in the underlying structure, and it surfaces as a NP modifier due to nominalization of the verbal domain. The verb raises to the light verb DO, and thus yields the surface syntax-semantic mismatch.

An alternative approach to the mismatch problem, also suggested in Huang, Li, and Li (2009: 98), is to treat the object NP as an “eventive” argument that bears a special theta role, such as “Incremental Theme” (Dowty 1991), rather than as an typical “entity” argument, such as “Theme” or “Patient.” In this sense, the durative phrase has the semantic function of defining the object NP as an eventive argument that is measured by the durative phrase. In terms of (25), this means that the object ‘fish’ is not an entity of selling, but is simply an eventive role participating in the ‘selling’ event, much like fish-selling in English (Lisi did one year of fish-selling).

### 3.2. A First Step toward an Unified Treatment

I argue that the two analyses are not incompatible with each other. In fact, taking the (P-related) durative phrase as numeral-classifier phrase may unify the two competing analyses. Here, I adopt Larson’s (2003) line of inquiry, which attempts to unify the measurement of time/event and that of object. That is, the expressions in (26a, b) are equivalent, and two hours of sleep in (26b) is analogous to the object-measurement constructions in (27):

\[
\begin{align*}
(26) & \quad \text{a. sleep for two hours} & \quad \text{b. get two hours of sleep} \\
(27) & \quad \text{a. two feet of rope} & \quad \text{b. two spoonfuls of sugar}
\end{align*}
\]

Combining the event semantics in Davidson (1967) and the semantics of measurement in Cartwright (1975), Larson treats “measurement (M)” as a function that scopes over the whole proposition, and therefore, just like the object measurement in (28), one can directly measure events by durative phrases, as in (29) (Larson 2003: 251-252):

\[
\begin{align*}
(28) & \quad \text{a. Mary bought two spoonfuls of sugar.} \\
& \quad \text{b. } M_{\text{spoonfuls}}[\text{the } x: \text{sugar}(x) \& \text{buy}(\text{Mary}, x)] = 2 \\
& \quad \text{‘Measured in spoonfuls, the amount of sugar bought by Mary is 2.’}
\end{align*}
\]
(29)  a. Mary observed two hours of walking.
    b. $M_{\text{hours}}[\text{the e: walking(e) & observe(Mary, e)}]=2$
    ‘Measured in hours, the amount of walking observed by Mary is 2.’

Since measurement is often achieved through overt classifiers in Chinese, Larson’s analysis therefore provides a way of covering the two competing analyses under the same roof. The equivalence between (26a) and (26b) corresponds to Huang’s analysis of nominalization. The nominalization of the VP represents a reanalysis of the durative phrase as numeral-classifier. On the other side, the incremental theme analysis is also related to this proposal. It is argued in Liao and Wang (2011) that classifiers define the “roles of counting” in classifier constructions. Individual classifiers provides a criterion for counting individual/atomic objects, and kind classifiers defines the counting level as “natural kinds” of “artificial types.” It is natural to think that durative phrases, as “eventive” classifiers, are also able to define the counting roles as “time/event.” Therefore, the complement NP simply represents an “event participant” at that time/event. The semantic form is illustrated in (30), adopting Larson’s formulation:

(30)  a. Lisi mai-le yi-nian (de) yu.
    Lisi sell-Asp one-year DE fish
    ‘Lisi sold fish for a year.’
    b. $M_{\text{year}}[\text{the e: selling(e) & Agent (Lisi, e) & Participant (fish, e)}]=1$

A possible syntactic mechanism that relates the numeral-classifier NPs and the verbal aspectual projection can be found in Borer (2005), who proposes an Aspectual Quantity Phrase (AspQP) in charge of telicity of predicate (Krifka 1988, Verkuyl 1993). The AspQP is an extended projection that licenses/checks a quantity phrase in its specifier position:

(31)

Suppose that in Chinese the object DP also raises to Spec, AspQP at LF in order to check the telicity feature, this analysis then provides a mechanism that relates the nominal numeral-classifier to the verbal aspectual property.\(^5\) The raising analysis, however, leaves several problems unsolved. Specifically, since the P-related durative phrases measure atelic predicates, rather than telic ones, it is not clear if the (LF) telicity raising is necessary at all in these cases. Even if we allow such an operation, it is not entirely clear why only P-related, but not R-related or RT-related durative phrases can occur as numeral-classifiers. Especially, it is generally assumed that the resultative phrase may also provide a telic point for the

\(^5\) Lin (2011) makes a similar proposal regarding the telic “in-duratives”, but not the atelic “for-durative phrases” in Chinese:

(i)  Zhangsan [AspQP san tian [VP xie-wan yi ben shu]]
    Zhangsan three day write-finish one CL book
    ‘Zhangsan wrote a book in/*for three days.’
predicate (e.g. *John pushed the cart [to the hilltop]*)], and they also raise to the Spec, AspQP in Borer (2005). The upshot is that additional ad hoc stipulations are still required.

In the next section, I further examine the relation between nominal and verbal projections. I argue that the correspondence may take us far beyond the issue of telicity and durative phrases, but to other syntax-semantic mismatches of similar nature.

4. Beyond Syntax-Semantic Mismatches

Let us dwell upon the cross-domain nominal-verbal correspondence. The general questions I am to investigate are why there is such a correspondence, and how elements in the nominal and verbal domains correspond to each other. These questions call for a new interpretation of Huang’s nominalization analysis and Borer’s raising analysis. I argue in this section that the nominal-verbal correspondence reflects a CP-DP parallelism, and I support this analysis by examining the cross-linguistic syntax-semantic mismatches. My conclusion is that a proportional principle can be found in UG, much like a linguistic version of the Archimedes’ Principle, as in (32):

\[(32) \text{The “Archimedes’ Principle” in UG} \]

The scope of a nominal element can be translated in proportion to the quantificational force on its corresponding verbal element.

In other words, the height of a nominal element directly entails the height of its potential “verbal scope.” The CP-DP correspondence has long been observed in generative grammar (Abney 1987, Grimshaw 2000, Hiraiwa 2005, Larson and Cho 2003, Liao 2011, Megerdianian 2008, Ogawa 2001, Riemsdijk 1998, Stowell 1981, Vergnaud In press, among many others). The general idea is that extended projections in a nominal tree and those in a verbal tree should mirror each other, as shown in (33) (modifying Vergnaud *In press*), where \[F\#\] represents the functional value of a given category (Grimshaw 2000):

\[(33) \text{Parallel Verbal-Nominal Projections} \]

<table>
<thead>
<tr>
<th>Verbal domain</th>
<th>Nominal Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>[C_{[F3]}]</td>
<td>[Q_{[F3]}]</td>
</tr>
<tr>
<td>[T_{[F2]}]</td>
<td>[D_{[F2]}]</td>
</tr>
<tr>
<td>[Asp_{[F1]}]</td>
<td>[CL_{[F1]}]</td>
</tr>
<tr>
<td>[V_{[F0]}]</td>
<td>[N_{[F0]}]</td>
</tr>
</tbody>
</table>

The Archimedes’ Principle predicts that a nominal modifier or head is able to scope over a verbal element that carries the same functional value. That is to say, modifiers of N, CL, D, Q (or the heads per se) are able to modify V, Asp, T, and C, respectively.

\[\text{I categorize both C-T and Q-D in (33) to the sentence-level. This is because in most cases discussed here (in English and Chinese), Quantifier and Determiner can form morphologically indistinctive units. For example, the quantifier every has a definite meaning. Likewise, C and T often shows collective behaviors, for instance, in Case-assigning properties (Chomsky 2001). I leave it open whether there are finer distinctions in C-T and Q-D in other languages.}\]
I believe that the proposal captures the basic spirit of Huang’s nominalization analysis. Given Grimshaw’s theory, it is natural to think that the durative phrase, which is related to the Aspectual phrase, can be reanalyzed as the corresponding element in the nominal domain with the same functional value, namely, as (numeral-)classifier. The analysis proposed here also accounts for the Spec-Head checking relation in Borer’s raising analysis, and instead of syntactic raising, it is proposed that the “checking relation” is a more primitive type of structural correspondence, which arises from the CP-DP parallelism, where aspectual phrase and classifier phrase share the same functional value, as shown in (34):

(34) The Parallel Event/Object-Level

Verbal domain Nominal Domain
Asp_{[F1]} CL_{[F1]}
durative phrase

The scope of the “durative classifier phrase” in Chinese can therefore be accounted for as a result of the Archimedes’ Principle, and only P-related reading can be obtained for this type of durative phrase because the “verbal scope” of a classifier phrase cannot be further extended to any higher/lower functional categories.

A related syntax-semantic mismatch in the event-level modification can also be found in Krifka (1990), who points out an intriguing ambiguity in English:

(35) a. Four thousand ships passed through the lock last year.
     b. The library lent out 23,000 books in 1987.

The sentences have two readings. One reading (object-related reading) involves direct counting of the number of objects (there are distinct 4000 ships and 23,000 books), and the other reading (event-related reading) involves counting the total events (there might only be 100 ships, but these ships passed through the lock for four thousand times, and there might be 1000 books in the library, but these books are lent out for 23,000 times). Although Krifka (1990) analyzes the different readings as involving different determiners, I suggest that they actually involve different classifiers because in classifier-languages like Chinese, these different readings can be brought about by different classifiers. To wit, observe the contrasts between individual classifiers and event classifiers in the following pair:

(36) a. Zuotian you san liang huoche jingguo-le Taibei.
     yesterday have three CL_{individual} train pass-Asp Taipei
     ‘Three (distinctive) trains passed through Taipei yesterday.’
     (object-related reading)

Another way of expressing the event-oriented reading is through compounds formed by “eventive” noun roots, as in (i), which has an event-oriented reading equivalent to (ii). I leave open here whether the two sentences have any derivational relations:

(i) Meitian you shi ge chuan-ban cong Jiulong dao Xianggang.
    Every.day have ten CL boat-schedule from Kowloon to Hong.Kong
(ii) Meitian you shi ban chuan cong Jiulong dao Xianggang
    Every.day have ten CL_{event} boat from Kowloon to Hong.Kong
    ‘(i)=(ii) There are ten schedules of boats from Kowloon to Hong Kong every day.’
b. Zuotian you san ban huoche jingguo-le Taibei.
yesterday have three CL event train pass Taipei
‘Three schedules of trains were through Taipei yesterday.’
(event-oriented reading)

While (36b) is possible in a scenario that the same train passed Taipei for three times, the salient reading for (36a) is that there were three distinctive trains. If I am on the right track, then the distinction between object-oriented and event-oriented readings observed in Krifka (1990) might be related to the distinction between “individual” classifiers and durative “eventive” classifiers in Chinese. That is, in event-related readings, event modification is made possible through numeral-classifier phrases, given the parallelism between CL and Asp in (34).

As expected, the CP-DP parallelism and the Archimedes’ Principle are not limited to durative phrases and event/object-level modifications alone, and we should predict that other “bracketing paradoxes” and syntax-LF mismatches can be accounted for under the same principle. I think this expectation is borne out. Let us turn to the predicate-level correspondence in (33). It has been noted that in English, one can modify VP through NP adjectives, as shown in (37) (Alexiadou and Schäfer 2010, Larson 1998, among others):8

(37) a. John took [NP good [NP care of his patients]].
   = ‘John took care of his patient well.’
   b. John sipped a [NP quick [NP cup of tea]].
   = ‘John quickly sipped a cup of tea.’

Under the Archimedes’ Principle, we predict that the N-level modifiers can have a “verbal scope” over V (in addition to their inherent nominal scopes, if any). This then explains why NP-level adjectives can have the VP-level manner-adverbial readings in (37a) and (37b). The parallel scopes can be illustrated as follows:

(38) The Parallel Predicate-Level

<table>
<thead>
<tr>
<th>Verbal domain</th>
<th>Nominal Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{[F0]}$</td>
<td>$N_{[F0]}$</td>
</tr>
<tr>
<td>Modifier phrase</td>
<td></td>
</tr>
</tbody>
</table>

At the same time, the Archimedes’ Principle correctly rules out impossible cases, in which the NP-level adjectives modify the sentence-level verbal domains, as in (39).9

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8 Skeptical readers might wonder why these examples are not possible in Chinese (and are very restricted in other languages as well). At this point, I can only conjecture that the distinction between languages that allow and disallow these types of expressions might be due to some constraint(s) among languages (see Williams 2003 for the restrictive nature of “bracketing paradox”), and I have little to contribute in this paper. However, one might notice that the Archimedes’ Principle does not force the nominal adjective to take a verbal scope; rather, it simply provides a way of predicting the position of verbal scope, if a language allows for the cross-domain modification.

9 The sentence in (39b) may be admissible for nominal scope readings (where the adjectives simply modify NPs). Therefore, (39b) can mean (somewhat marginally) ‘John sipped something that was probably a cup of tea.’ Likely, in occasional-constructions below, the adjectives may obtain nominal scope readings (or internal readings in Larson 1998). Bearing little significance to the main points here, I will ignore the (internal) nominal scope readings in the following.
Let us further examine some nominal adjectives that are able to take sentence-level “verbal scopes.” An immediate type of example that comes to mind is the occasional-constructions (OC) (Bolinger 1967, Larson 1998, Stump 1981, Zimmermann 2003), where the adjective occasional is able to obtain an “OC-reading” that quantifies over the whole sentence, like its adverbial counterpart, occasionally, as shown in (40):

(40)  a. The/An occasional sailor strolled by.  
     = ‘Occasionally, a sailor strolled by.’
   b. Sally heard the/a sporadic shot.  
     = ‘Sporadically, Sally heard a shot.’

At first blush, it appears that the adjectives occasional and sporadic are NP-level modifiers, and hence, they seem to pose a threat to the Archimedes’ Principle since they are able to take scope over entire sentences (other than the corresponding VP). However, Larson (1998) and Zimmermann (2003) convincingly argue that this type of adjective actually forms a constituent with determiner under the OC-reading, as in (41a), and they are not NP-modifiers in (41b):

(41)  a. [DP/QP [D/Q The/an occasional] sailor] strolled by.
   b. *[DP/QP The/an [NP occasional sailor]] strolled by.

Three pieces of evidence for the complex-determiner analysis are provided in Stump (1981), Larson (1998), and Zimmermann (2003). First, the occasional-adjective can only appear with the definite article the or indefinite article a, but not other quantifiers or determiners, as in (42), showing that there is a strong selection between the occasional-adjective and D:

(42)  a. [Two occasional sailors] strolled by.  
     ≠ Occasionally, two sailors strolled by.
   b. [Every occasional sailor] strolled by.  
     ≠ Occasionally, every sailor strolled by.

Second, under the OC-reading, the occasional-adjective must be adjacent to the determiner, and cannot be interfered by another adjective, as in (43):

(43)  The/a well-dressed occasional sailor strolled by.  
     ≠ Occasionally, a well-dressed sailor strolled by.

Third, the occasional-adjective cannot be coordinated with another adjective, as in (44):

(44)  [The/an occasional and well-dressed sailor] strolled by.  
     ≠ Occasionally, a well-dressed sailor strolled by.

The Archimedes’ Principle again correctly predicts that the occasional-type of adjective, which is able to take a sentence-level verbal scope, should be a modifier of higher functional category (D or Q) in the nominal domain. Still another sentence-level cross-domain mismatch can be found in quantifiers. In the widely accepted semantic theory of Generalized Quantifier,
it is assumed that quantifiers scope over the entire sentences/propositions (Barwise and Cooper 1981, Keenan 2002, just to name a few). Again, this naturally falls under the Archimedes’ Principle. The sentence-level CP-DP parallelism is shown in (45):

(45) The Parallel Sentence-Level

Verbal domain

Nominal Domain

T/C_{F2/3} D/Q_{F2/3}

Modifier phrase

5. Conclusion
I have argued that the three readings of durative phrases in Chinese correspond to three distinctive syntactic structures. Especially, I argue that syntactically, P-related durative phrases should be analyzed as numeral-classifiers. While the syntactic structures of R-related and RT-related durative phrases can be directly mapped to their LF interpretations, the P-related durative phrase seems to elicit a syntax-semantic mismatch. That is, it is a nominal numeral-classifier, but at the same time, it is able to modify the verbal aspectual phrase at LF. I argue that this syntax-semantic mismatch comes from an underlying CP-DP parallelism, subject to the Archimedes’ Principle in UG, which suggests that the hierarchy of a nominal element directly entails the height of its potential verbal scope in the verbal domain. I have provided empirical evidence for the claim by examining other syntax-semantic mismatches in English. The result suggests that despite surface discrepancies, syntax-semantic mismatches are indeed systematically governed by principles of UG.

References


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