Chinese comparatives and their implicational parameters

Jo-wang Lin

Abstract This paper argues that superiority comparatives in Mandarin Chinese are all phrasal comparatives that can be directly interpreted, and makes a new suggestion of taking the *bǐ*-phrase ('compare-phrase') to be an adjunct and one constituent, but with *bǐ*-shells. This syntactic analysis allows one to combine into one phrase various compared constituents that would otherwise not be analyzed as forming a phrase by themselves. Semantically, in extension of work by Heim as well as Bhatt and Takahashi, *bǐ* is taken to compare two sequences of arguments of a gradable predicate along the dimension given by that predicate. It is also suggested that comparatives across languages may be subject to three parameters: (i) argument-dependent comparison vs. non-argument dependent comparison, (ii) phrasal comparison vs. clausal comparison, and (iii) monoadic comparison vs. dyadic comparison.

Keywords Chinese comparatives · Phrasal comparatives · Dyadic comparison

1 Introduction

This paper discusses the syntax and semantics of Chinese comparative constructions, such as those in (1), where the gloss 'COM' is an abbreviation of 'Compare':

(1) a. Yuēhàn   bǐ   mǎlì   gāo 。
         John   COM   Mary   tall
         'John is taller than Mary.'

J.-w. Lin ✉
Department of Foreign Languages and Literatures, National Chiao Tung University,
1001 Ta Hsueh Road, Hsinchu 300, Taiwan, ROC
e-mail: jowang@mail.nctu.edu.tw

b. Tā yīngwén bǐ   wǒ fàwén shuō-de   hǎo 。
    he English COM I   French speak-PART   good
    'He speaks English better than I speak French.'

c. Tā zuótiān   zài xuéxiào bǐ   wǒ jīntiān zài jiālǐ   kāixīn 。
    he yesterday at school   COM I   today   at home happy
    'He was happier at school yesterday than I am at home today.'

It is argued that the above constructions are all phrasal comparatives rather than clausal comparatives and that Chinese is a dyadic argument comparison language. Based on the data from Mandarin Chinese, it will be suggested that the typology of comparative constructions across languages may be subject to the following parameters:

(2) a. Argument comparison language vs. non-argument comparison language
     b. Phrasal comparison language vs. clausal-comparison language
     c. Monoadic comparison language vs. dyadic comparison language

This paper is organized as follows. Section 2 gives an overview of the syntax and semantics of English comparatives. Section 3 briefly introduces the constructions of Chinese comparatives. Section 4 is a review of previous analyses of Chinese *bǐ*-comparatives and their inadequacies. Section 5 proposes an alternative syntactic and semantic analysis of such constructions and the parameters they imply for comparatives across languages. Finally, Section 6 discusses the implications of the Chinese data in a larger context of language variations, such as the one sketched by Beck et al. (2004), Kennedy (2005), and Bhatt and Takahashi (2007).

2 A brief overview of the syntax and semantics of English comparatives

English comparatives are normally divided into clausal and phrasal comparatives, as is illustrated by (3) and (4), respectively.

(3) John is taller than Mary is (tall).   (clausal comparative)

(4) John is taller than Mary.   (phrasal comparative)

The traditional analysis of clausal comparatives is that the *-er* morpheme and *than*-clause are analyzed as forming a degree description (DegP) that is a specifier or modifier of AP (Bresnan 1973; Heim 1985, 2000; von Stechow 2005; among others).[1] However, the *than*-clause is obligatorily extraposed at PF and *-er* is

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[1] An alternative is to analyze the degree expression by way of the Functional AP Hypothesis, according to which an AP is embedded under a functional DegP (Abney 1987; Corver 1994; Kennedy 1999; among others).

morphologically attached to the adjective. The *than*-clause is a wh-construction with a null wh-operator binding a degree gap (Chomsky 1977) and denoting the property of degrees. Moreover, the *-er* morpheme and the *than*-clause, though separate from each other at PF, are moved to a clausal scope at LF, leaving behind a degree variable. Therefore, the main clause is also interpreted as a property of degrees, much like the *than*-clause. The *-er* morpheme requires that the maximal degree associated with the matrix adjective is greater than the maximal degree associated with the (elided) predicate of comparison in the *than*-clause. This analysis of comparatives is known as a degree comparison.

In this analysis, the PF and LF of clausal comparatives are as follows:

(5)   John is taller than Mary is.

(6)   PF: a.   John is tall-er [~~wh₂~~ than Mary is ~~t₂-tall~~]   (clausal comparative)
              b.   John is tall-er [~~wh₂~~ than Mary ~~is~~ ~~t₂-tall~~]   (phrasal comparative)

(7)   LF: [-er [wh$_2$ Mary is t$_2$-tall]]$_1$ John is t$_1$-tall

The LF of (7) is then interpreted as follows. Gradable adjectives are assumed to be relations between individuals and degrees, as in (8a), in which TALL is a measure function of type $<e,d>$, which assigns a unique degree to individuals (Cresswell 1976; Klein 1991; von Stechow 2005).

(8)   a. ||tall|| = λdλx.TALL(x) ≥ d
        b.   TALL = λx.x′s height

The morpheme *-er* takes two $<d,t>$ expressions, *P* and *Q*, as its arguments, and requires that the maximal degree *d* of *P* exceeds the maximal degree *d* of *Q*, as shown in (9). Therefore, the meaning of (5) is equivalent to 'John's maximal height exceeds Mary's maximal height.'

(9) ||**-er**|| = λP$_{<d,t>}$λQ$_{<d,t>}$.the maximal d s.t. Q(d) = 1 > the maximal
        d s.t. P(d) =1.

Regarding phrasal comparatives, one view is that they are derived from clausal counterparts through comparative deletion and ellipsis, as the second possible PF in (6b) shows (e.g. Bresnan 1973), and are thus interpreted in the same way as clausal comparatives. (For more recent literature, see Lechner 2001, 2004; Merchant 2006). The advantage of this analysis is the uniformity it maintains for the meaning of *-er*, i.e., *-er* is always a two-place operator taking two properties of degrees as its argument.

In contrast to the above reduction analysis of phrasal comparatives, some linguists have argued for a direct analysis of phrasal comparatives (Hankamer 1973; Napoli 1983; Kennedy 1999). On this alternative analysis, a phrasal comparative is comprised of *than* followed by a simple DP, rather than a clause. One difficulty

raised by this direct analysis of phrasal comparatives is the lack of a description of the second degree because there is no elided material to form such a description. Hence, a different lexical entry for *-er* is required. One possible such lexical entry was proposed by Heim (1985), who suggested that the direct analysis of phrasal comparatives is not a comparison between two degrees, but rather a comparison between two individuals with respect to a certain dimension. An alternative to Heim's formulation is to treat *-er* as a three-place predicate as in (10), taking two individuals and one predicate of individuals and degrees as its arguments, as suggested by Bhatt and Takahashi (2007).

(10) $\|\text{-}\mathbf{er}\| = \lambda x.\lambda P_{<d,\ <e,t>>}.\lambda y.\exists d[P(y,d) \wedge \neg P(x,d)]$

3 Basic Chinese data

Our discussion begins with a summary of the work of Tsao (1989), who provides a good survey of the basics of Chinese comparatives.[2] His starting point is Li and Thompson's (1981) schema for Chinese comparatives, as given in (11) and illustrated by (12).

(11)   X Comparison word Y (Adverbial) Dimension

(12)   Yuēhàn   bǐ   mǎlì   (gèng) gāo 。
        John   COM   Mary even   tall
        'John is (even) taller than Mary.'

Assuming his own earlier works (Tsao 1982, 1987a, b), Tsao (1989) suggests that a sentence may contain multiple topics, which are further divided into primary and non-primary topics. He then proposes that the compared constituents X and Y, seen in schema (11), must be topics of an equal rank; or more precisely, the compared constituents X and Y must both be primary topics, secondary topics, or tertiary topics, etc.[3] According to Tsao, the examples in (13)–(16) all involve a comparison of secondary topics. Moreover, he shows that double-topic or even triple-topic comparison is also possible, as is shown in (17) and (18).

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[2] In addition to Tsao (1989) and others to be mentioned in the text, there are many descriptive works on Mandarin *bǐ*-constructions published in Mainland China. The reader is referred to Liu (2004) and Xu (2007) for a survey and to the references cited therein.

[3] Paul (1993) proposed a structural condition on two compared items by suggesting that X, in (11), must c-command or cyclically c-command Y. I agree with Shi's (2001) view that Paul's characterization is problematic.

(13) a. Tā lánqiú bǐ páiqiú dǎ-de hǎo　。 [4]
　　　　　he basketball COM volleyball play-Part good
　　　　　'He plays basketball better than (he does) volleyball.'

      b. Wǒ dàishù bǐ jǐhé xǐhuān　。
　　　　　I algebra COM geometry like
　　　　　'I like algebra more than geometry.'

(14) Tā duì nǐ bǐ duì wǒ hǎo　。
　　　he to you COM to me nice
　　　'He is nicer to you than (he is) to me.'

(15) Tā jīntiān bǐ zuótiān shūfú　。
　　　he today COM yesterday feel-good
　　　'He feels better today than (he did) yesterday.'

(16) Tā bǎ qián bǐ bǎ shēngmìng kàn de zhòng　。
　　　he BA money COM BA life regard DE important
　　　'He regards money as more important than (he does) life.'

(17) *Double-topic comparison*
　　　T<u>ā</u> <u>yīngwén</u> bǐ <u>wǒ</u> <u>fàén</u> shuō-de hǎo　。
　　　he English COM I French speak-PART good
　　　'He speaks English better than I speak French.

(18) *Triple-topic comparison*
　　　T<u>ā</u> <u>zuótiān</u> <u>zài xuéxiào</u> bǐ <u>wǒ</u> <u>jīntiān</u> <u>zài jiālǐ</u> kāixīn　。
　　　he yesterday at school COM I today at home happy
　　　'He was happier at school yesterday than I am at home today.'

In addition, Tsao (1989, pp. 172–179) proposes three deletion principles, as given below, in order to generate more comparative sentences.

(19) *The Primary Principle*

      Any compared topic, primary or non-primary, can be deleted if it is identical to another topic of an equal rank, however, only forward deletion is allowed.

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[4] It has been observed by Hashimoto (1971) that a direct object in its postverbal position cannot be a compared constituent.

(i) *wǒ ài zhēnlǐ bǐ wǒ-de lǎoshī　。
　　I love truth COM my teacher
　　'I love truth more than (I love) my teacher.'

However, Tsao (1989) has argued that if the object is fronted, then it can be compared, subject to some pragmatic and phonological conditions.

(20)   *The Present-Time Deletion Principle*
       A topical constituent referring to the present time can be deleted.

(21)   *The Second Compared Constituent Genitive Deletion Principle*
       When a genitive NP occurs as the second of a pair of compared constituents
       and the possessed NP is identical with that of the first compared constituent,
       then the genitive marker can be optionally deleted after the possessed NP is
       deleted through identical element deletion.

The Primary Principle is used to explain examples such as (22a) or (22b). The
Present-Time Deletion Principle accounts for (23), and the Second Compared
Constituent Genitive Deletion Principle explains (24).

(22)   a.   Tā   yǎnjīng   bǐ   wǒ   ~~yǎnjīng~~   dà   。
            he   eye   COM   I   eye   big
            'His eyes are bigger than mine.'

       b.   Tā   zuótiān   zài   xuéxiào   bǐ   wǒ   ~~zuótiān~~   zài
            he   yesterday at   school   COM   I   yesterday   at
            jiālǐ   kuàilè
            home   happy
            'He was happier at school yesterday than I was at home.'

(23)   Tā   ~~xiànzài~~   bǐ   gāngcái   liǎnsè   hǎo   。
       he   now   COM   a-while-ago   face-color   good
       'He looks much better than (he did) a while ago.'

(24)   Tā-de   tóufǎ   bǐ   wǒ-~~de~~   cháng   。
       he-Gen   hair   COM   I-Gen   long
       'His hair is longer than mine.'

Although I am conservative regarding the notion of multiple topics, Tsao's
description of Chinese comparatives in my view provides a very good base for those
who wish to analyze Chinese comparatives.

4 A review of previous analyses of Chinese *bǐ*-comparatives

4.1 Biclausal analysis

The literature has generated many discussions regarding the syntax of comparatives in
Mandarin Chinese. Some have suggested that *bǐ*-comparatives are transformationally
derived from a biclausal source, similar to what some linguists have proposed
for English phrasal comparatives (e.g. Cheng 1966; Hashimoto 1966, 1971; Fu 1977;
Tsao 1989). However, the biclausal derivation of Chinese *bǐ*-comparatives encounters

some difficulties. As is well known, English comparatives allow constructions, such as (25), where the main clause and the *than*-clause are both full clauses.

(25)   This table is wider than that desk is long.

The Chinese counterpart of (25), in contrast, is ungrammatical.

(26)   *Zhè-zhāng zhuōzi (hěn) kuān bǐ   nà-zhāng zhuōzi (hěn)
        this-Cl   table   very   wide COM   that-Cl   table   very
        cháng ◦ ⁵
        long
        'This desk is wider than that table is long.'

If comparative structures are generated by conjoining two sentences and 'gapping' and comparative deletions do not apply, then there is no reason why (26) should be ungrammatical. The process of gapping in *bǐ*-comparatives is also problematic because gapping in Chinese, as Paul (1999) pointed out, is quite restricted. In particular, gapping in Chinese does not apply to sentences with an overt conjunction marker.

A similar difficulty arises when the *bǐ*-clause is assumed to be an adjunct, and adjoined to VP/AP, as in Liu (1996), who gives (27a) an analysis similar to (27b):

(27)   a. Guōjìng jīntiān bǐ   Huángróng zuótiān   kāixīn   ◦
            Guojing today   COM   Huangrong yesterday happy
            'Guojing is happier today than Huangrong was yesterday.'
        b. Guōjìng jīntiān [$_{PP}$ bǐ [$_{CP}$ Huángróng zuótiān ~~kāixīn~~]] kāixīn

This analysis wrongly predicts that (28) is well formed, unless some ad hoc condition is stipulated.

(28)   *[$_{IP}$ Zhè-zhāng zhuōzi [$_{AP}$[bǐ   nà-zhāng zhuōzi cháng] kuān]]
          This-Cl   table   COM that-Cl   desk   long   wide

Therefore, there seems to be no positive evidence that the constituent following *bǐ* is a full clause. In fact, this is also the conclusion of Xiang (2003, 2005), who rightly points out that it would be a surprising fact if the clausal analysis of Chinese comparatives could only allow an elided CP, but not a full CP, and odd if a marked ellipsis construction would be preferred over an unmarked normal clause. Worse, there is no explanation for this fact: it would be a stipulation.⁶

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⁵ In most contexts, the adverbial *hěn* 'very' is obligatorily present before an adjective, However, (26) is ill formed with or without *hěn*.

⁶ Xiang (2005) has offered other arguments against a clausal analysis of *bǐ*-comparatives, which are not reviewed here. Shi (2001) also argues against deriving *bǐ*-comparatives from a clausal source.

4.2 DegP-shell analysis

In contrast to Liu's (1996) adjunct analysis of *bǐ*-phrases, Xiang (2005) proposes a revised Larsonian (1991) style DegP-shell structure for Chinese comparatives. She posits two degree (Deg) heads in the syntactic structure, one lower than AP and the other above AP. The lower Deg head is a phonologically null degree morpheme, *exceed*, and the higher Deg head is occupied by *bǐ*, as represented in (29).

(29)
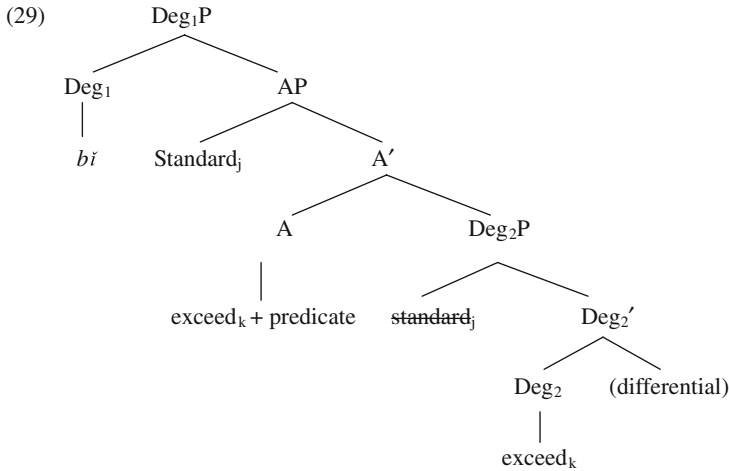
Xiang argues that the above structure has the advantage of generating a transitive comparative such as (30) by head-movement of the $exceed_k$ + predicate to Deg_1 when *bǐ* does not appear.

(30) Tā gāo wǒ sān gōngfēn 。
 he tall I three centimetre
 'He is three centimeters taller than I.'

According to the above analysis, the morpheme *bǐ* and the standard do not form a constituent. This assumption, however, is contradictory to Liu's (1996) coordination test in (31), which shows that *bǐ* and the standard do constitute a prepositional phrase.

(31) Zhāngsān bǐ Lǐsì huòzhě bǐ Wángwǔ gāo 。
 Zhangsan Comp Lisi or Comp Wangwu tall
 'Zhangsan is taller than Lisi or (than) Wangwu.'

Xiang (2005) explains (31) by analyzing it as an instance of ellipsis inside VP-coordination or an Across-The-Board movement.

Although reasonable, Xiang's account of (31) is not an argument against the PP status of a *bǐ*-phrase. It only shows that the ellipsis or rightward movement analysis is compatible with Xiang's proposed structure for *bǐ*-comparatives.

In fact, there are arguments in support of the constituent-hood of *bǐ* + the standard, in support of Liu's adjunct analysis.

The first argument is concerned with examples such as those seen in (32).[7]

(32) a. Tā-de shēngāo bǐ   wǒ   háiyào ǎi '   bǐ   Yáomíng'
          his   height COM   I   even short COM Yaoming
          nà   gèng   shì   tiān chāi dì   yuǎn le
          then even   be   heaven differ ground far Par
          'He is much shorter than I am. If compared with Yaoming, his height is
          even like the distance between the heaven and the ground.'
     b. Zhāngsān jīntiān pǎo dé   hěn bù   lǐxiǎng ' bǐ   wǒ
          Zhangsan today   run DE   very not   ideal   COM   I
          zuótiān ' nà   jiù   chāi de   gèng yuǎn le 。
          yesterday that   then differ DE   more far   Par
          'Zhangsan' did not run very well today. If compared with my running
          yesterday, the difference is even greater.'

Example (32a) clearly shows that *bǐ* + the standard can be used as an independent fragment, hence serves to support the claim that *bǐ* + the standard form a single constituent in syntax. (32b) is even more interesting because it shows that *bǐ* + individual + time also form a constituent.

A second argument is related to the use of the element *dōu* 'all' in Chinese. It is well known to Chinese linguists that *dōu* 'all', analyzed as a generalized distributivity operator by Lin (1998), must be associated with a plural entity, as the contrast between (33a) and (33b) shows:

(33) a. Tāmén dōu   bǐ   wǒ   gāo
          they   all   COM   I   tall
          'They all are taller than I am.'
     b. *Tā   dōu   bǐ   wǒ   gāo 。
          he   all   COM   I   tall

Now consider (34).

(34) Zhāngsān bǐ   Lǐsì huòzhě (bǐ)   Wángwǔ dōu hái   gāo 。
      Zhangsan COM   Lisi or   COM   Wangwu all   still tall
      Lit: 'Zhangsan is taller than both Lisi or Wangwu.'

What is interesting about (34) is the use of *huòzhě* 'or', which in this case is an inclusive interpretation, and therefore is compatible with *dōu* 'all'. However, on Xiang's analysis involving ellipsis inside VP-coordination or rightward Across-The-Board movement, (34) should be ruled out just as (33b) is, because in either analysis *dōu* 'all' would be wrongly associated with a singular individual when the predicate *dōu hái gāo* is reconstructed.

Another potential problem with Xiang's DegP-shell structure is concerned with Tsao's examples of multiple-topic comparison. Such sentences would make both the

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[7] I would like to thank my student Wenjie Peter Wang for providing me with (32a).

DegP-shell structure and AP more complicated than necessary. It is not clear how the three different "dimensions" are moved, and whether some conditions on movement are violated.

As for transitive comparatives, though it is reasonable to link them to the same source structure for *bǐ*-comparatives, this approach has some problems. One problem has to do with the distribution of adverbs like *hái* 'still/more' in (35a). If a transitive comparative is derived by raising the adjective to the position occupied by *bǐ*, it is predicted that (35b) would be a well-formed structure with the adverb *hái* left in situ. However, this prediction is not borne out. The morpheme *hái* must appear before the adjective, as in (35c), casting doubts on a raising analysis of the adjective.

(35) a. Tā   bǐ   wǒ   hái   zhòng   sān   gōngjīn
          he   COM   I   more   heavy   three   kilogram
          'He is three kilograms heavier than I am.'
      b. *Tā   zhòng   wǒ   hái   sān   gōngjīn
          he   heavy   I   more   three   kilogram
      c. Tā   hái   zhòng   wǒ   sān   gōngjīn
          he   more   heavy   I   three   kilogram

On the other hand, the examples in (35) have a very simple explanation if both the *bǐ*-phrase and the adverb *hái* are adjuncts adjoined to AP. Note that, instead of placing *hái* after the *bǐ*-phrase, it is also possible to place the former before the latter. Such freedom of word order is quite normal for adjuncts.
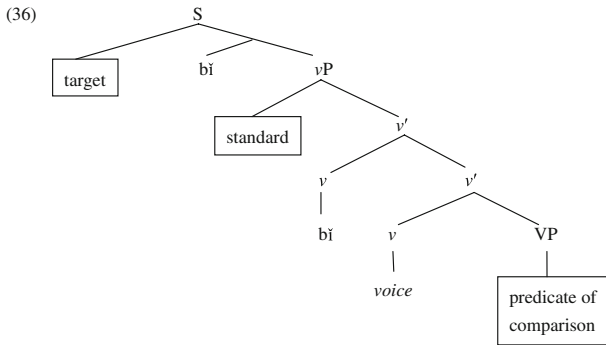
Still another difficulty with Xiang's approach, as pointed out by Erlewine (2007), is that transitive comparatives always require the presence of a differential phrase; however, *bǐ*-comparatives do not have such a requirement. This indicates that the argument structure for adjectives in transitive comparatives might be different from the argument structure for adjectives in *bǐ*-comparatives. Moreover, as noted by Xiang herself, only a limited number of adjectives in Mandarin Chinese have the usage of transitive comparatives.[8] This confirms the necessity to address idiosyncrasy in the lexicon rather than in the syntax.

4.3 Event-based analysis

Most analyses of Chinese *bǐ*-comparatives have focused on syntax rather than semantics. Erlewine's (2007) master's thesis was the first study to discuss the compositional semantics of Chinese *bǐ*-comparatives in detail, and is therefore worthy of review.

His analysis of Chinese comparatives is comprised of two novel ideas. Syntactically, roughly in the same spirit as Xiang's (2005) analysis, he proposes that *bǐ* is a functional head subcategorizing for a voice *v'*, which in turn, subcategorizes for the predicate of comparison, as is shown in (36).The lower *bǐ* in (36) is raised to the position of the higher *bǐ* to obtain the correct surface word order.

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[8] Such adjectives are mostly restricted to monosyllabic ones indicating size, age, or height.

(36)

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                        S
        ┌───────────────┼───────────────┐
    ┌───────┐          bǐ              vP
    │target │                  ┌────────┴────────┐
    └───────┘              ┌────────┐            v′
                           │standard│      ┌──────┴──────┐
                           └────────┘      v             v′
                                           │        ┌─────┴─────┐
                                          bǐ        v          VP
                                                    │           │
                                                  voice   ┌──────────┐
                                                          │predicate of│
                                                          │comparison  │
                                                          └──────────┘
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Semantically, he explores a novel neo-Davidsonian eventuality semantics of comparison, and uses the metavariable ε to represent both events and states (s). Following Kratzer (1996), he assumes that predicates have only internal arguments, and that external arguments are introduced as the Agent or Experiencer of an eventuality via the voice head. A sentence such as *Yuēhàn xǐhuān Tāngmǔ* 'John likes Tom' is thus computed as follows:

(37) a. $[[\text{voice}_{active,\ experience}]] = \lambda x \lambda \varepsilon.\text{Exp}(x, \varepsilon)$

b.

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                        v′
           λxλs.like(TOM,s) ∧ Exp(x,s)
                ┌───────────┴───────────┐
                v                       VP
                │                 λs.like(TOM,s)
        voice_{active,experience}    ┌──────┴──────┐
                               xihuan        Tangmu
                          λxλs.like(x,s)       TOM
```
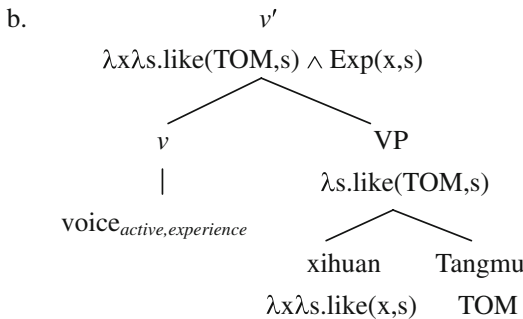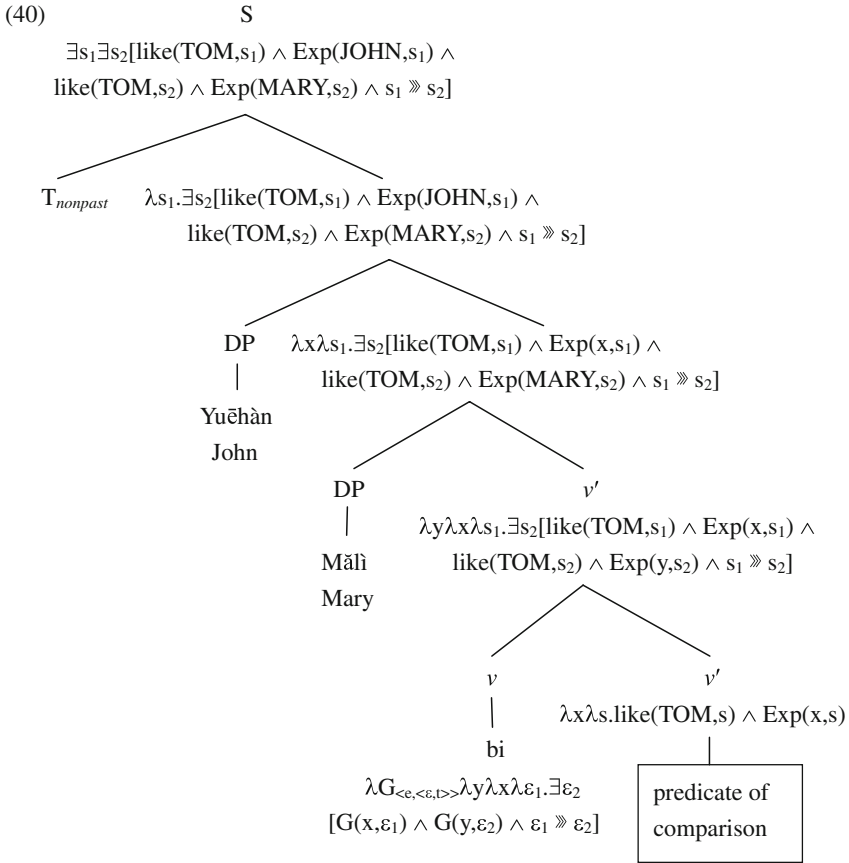
Bǐ, on the other hand, performs three functions:

> It uses two eventuality variables, ε_1 and ε_2, and establishes two external arguments (to be selected) as their external arguments, respectively; it existentially binds the standard's eventuality ε_2; and, finally, it establishes the comparative semantics of ε_1 being greater than ε_2 along a scale established by the predicate. (Erlewine 2007, p. 32)

Notice that Erlewine does not use explicit degree variables. Instead, the comparison proceeds by means of an intensity ordering relation, as defined by '$\gg$', between eventualities. The semantics of *bǐ*, as proposed by Erlewine, is as follows:

(38) $[[bǐ]] = \lambda G_{<e,\ <\varepsilon,t>>}\lambda y \lambda x \lambda \varepsilon_1.\exists \varepsilon_2(G(x,\varepsilon_1) \wedge G(y,\varepsilon_2) \wedge \varepsilon_1 \gg \varepsilon_2)$

On the above assumptions, a comparative sentence, such as (39), obtains its semantic interpretation from the following:

(39) Yuēhàn bǐ   Mǎlì xǐhuān Tāngmǔ
     John   Bi Mary like   Tom
     'John likes Tom more than Mary does.'

(40)   S
        $\exists s_1 \exists s_2[like(TOM,s_1) \wedge Exp(JOHN,s_1) \wedge$
      $like(TOM,s_2) \wedge Exp(MARY,s_2) \wedge s_1 \gg s_2]$

$T_{nonpast}$ $\lambda s_1.\exists s_2[like(TOM,s_1) \wedge Exp(JOHN,s_1) \wedge$
          $like(TOM,s_2) \wedge Exp(MARY,s_2) \wedge s_1 \gg s_2]$

       DP $\lambda x \lambda s_1.\exists s_2[like(TOM,s_1) \wedge Exp(x,s_1) \wedge$
        | $like(TOM,s_2) \wedge Exp(MARY,s_2) \wedge s_1 \gg s_2]$
     Yuēhàn
      John

          DP v'
           | $\lambda y \lambda x \lambda s_1.\exists s_2[like(TOM,s_1) \wedge Exp(x,s_1) \wedge$
         Mǎlì $like(TOM,s_2) \wedge Exp(y,s_2) \wedge s_1 \gg s_2]$
         Mary

              v v'
              | $\lambda x \lambda s.like(TOM,s) \wedge Exp(x,s)$
              bi |
  $\lambda G_{<e,<\varepsilon,t>>}\lambda y \lambda x \lambda \varepsilon_1.\exists \varepsilon_2$ predicate of
  $[G(x,\varepsilon_1) \wedge G(y,\varepsilon_2) \wedge \varepsilon_1 \gg \varepsilon_2]$ comparison

According to Erlewine, the above semantics has some advantages. First, it explains the so-called Internal Argument Prohibition. The object of *xǐhuān* 'like', namely, *TOM*, cannot be a standard of comparison because it has to first combine with the verb *xǐhuān* 'like', making it impossible for the internal argument to be a free variable bound later by an argument of *bǐ* . Another advantage of the eventuality-based semantics of comparison is that the clausal comparative is also analyzed as an instance of individual comparison, rather than degree comparison. Consider the example in (41), adopted from Erlewine (2007).
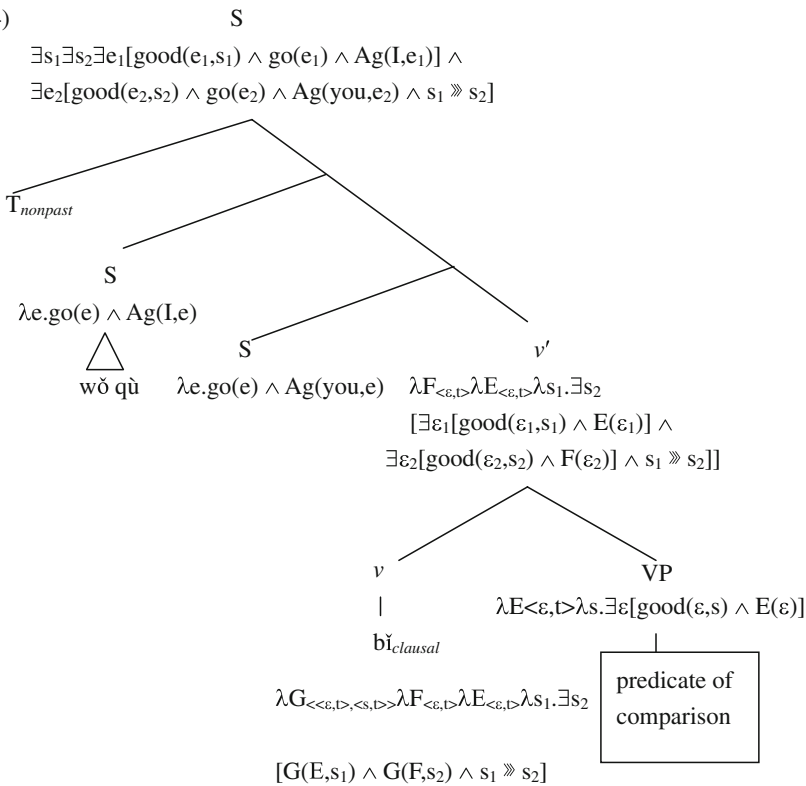
(41) [Wǒ qù] bǐ [nǐ   qù] hǎo
      I   go bi you   go good
     'It would be better if I went than if you went.'

Erlewine has analyzed predicates such as *hǎo* 'good' in (41) as proposition-taking predicates, suggesting that they take a proposition with an unsaturated Davidsonian eventuality argument and return a state description (cf. Kratzer's 2000, 2005 analysis of resultatives and target state passives). In other words, such predicates are of semantic type $<<\varepsilon,t>, <s,t>>$, as in (42) below. In order to compute the semantics of a clausal comparative, Erlewine also introduces another version of *bǐ*, given in (43). The semantics of (41) is thus computed as in (44).

(42) $[[hǎo]] = \lambda E<\varepsilon,t>\lambda s.\exists\varepsilon[good(\varepsilon,s) \wedge E(\varepsilon)]$

(43) $[[bǐ_{clausal}]] = \lambda G_{<\varepsilon,t>,<s,t>>}\lambda F_{<\varepsilon,t>}\lambda E_{<\varepsilon,t>}\lambda s_1.\exists s_2[G(E,s_1) \wedge G(F,s_2) \wedge s_1 \ggg s_2]$

(44)

$$S$$
$$\exists s_1\exists s_2\exists e_1[good(e_1,s_1) \wedge go(e_1) \wedge Ag(I,e_1)] \wedge$$
$$\exists e_2[good(e_2,s_2) \wedge go(e_2) \wedge Ag(you,e_2) \wedge s_1 \gg s_2]$$

$T_{nonpast}$

$$S$$
$$\lambda e.go(e) \wedge Ag(I,e)$$

wǒ qù

$$S$$
$$\lambda e.go(e) \wedge Ag(you,e)$$

$$v'$$
$$\lambda F_{<\varepsilon,t>}\lambda E_{<\varepsilon,t>}\lambda s_1.\exists s_2$$
$$[\exists\varepsilon_1[good(\varepsilon_1,s_1) \wedge E(\varepsilon_1)] \wedge$$
$$\exists\varepsilon_2[good(\varepsilon_2,s_2) \wedge F(\varepsilon_2)] \wedge s_1 \gg s_2]]$$

$$v$$
$$|$$
bǐ_{clausal}

$$\lambda G_{<<\varepsilon,t>,<s,t>>}\lambda F_{<\varepsilon,t>}\lambda E_{<\varepsilon,t>}\lambda s_1.\exists s_2$$

$$[G(E,s_1) \wedge G(F,s_2) \wedge s_1 \gg s_2]$$

$$VP$$
$$\lambda E<\varepsilon,t>\lambda s.\exists\varepsilon[good(\varepsilon,s) \wedge E(\varepsilon)]$$

predicate of
comparison

Erlewine's proposal is very enlightening, but it is not without problems. I begin with his construal of the verbal syntax, in which *bǐ* involves a *v*P-shell structure and forms a constituent with the predicate of comparison rather than with the standard of comparison. As argued above, there is evidence that *bǐ* and the standard form a constituent, but in the structure proposed by Erlewine, they do not.[9]

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[9] Erlewine actually provides five pieces of evidence against *bǐ* and the standard of comparison forming a constituent and functioning as an adjunct. However, his evidence either raises counterarguments or is subject to an alternative explanation, and, hence, is not conclusive. Due to space restriction, those arguments will not be reviewed here.

As for the semantics of *bǐ*-comparatives, Erlewine's analysis of *bǐ* states that only lambda-abstracted variables can be compared items, and only one variable is lambda-abstracted within v' before v' combines with *bǐ*. The consequence of this is that the system will allow comparison across only one dimension. This limitation is a weakness of Erlewine's theory, however. As seen from Tsao's (1989) examples, sometimes the subject and object can be simultaneously compared, as long as the object NP is fronted, as in (13b). The proposed semantics is not able to capture Tsao's cases of double-topic comparison, let alone triple-topic comparison.

Another problem with Erlewine's semantics of Chinese comparatives is the need it gives rise to for different lexical entries for normal individual comparison and proposition comparison. A better alternative is to unify the apparently different cases under the same meaning of *bǐ*. Such a proposal will be made later.

5 An alternative analysis

5.1 Argument-dependent comparison

As was noted earlier, some examples, such as (26) and (28), reproduced below, are ungrammatical, suggesting that proposition comparison in Chinese is not allowed.

(26)   *Zhè-zhāng zhuōzi (hěn) kuān bǐ   nà-zhāng zhuōzi (hěn) cháng   。
        this-Cl   table   very wide COM that-Cl   table   very   long
        'This desk is wider than that table is long.'

(28)   *[IP Zhè-zhāng zhuōzi [AP[bǐ   nà-zhāng   zhuōzi cháng]   kuān]]
            this-Cl   table   COM that-Cl   desk   long   wide
        'This desk is wider than that table is long'.

However, it is not true that clausal propositions cannot be compared. The following examples clearly show that proposition comparison is possible in Chinese:

(45)   [CP Nǐ   qù]   bǐ   [CP wǒ   qù]   hǎo
            you   go   COM   I   go   good
        'It's better for you to go than for me to go.'

(46)   [CP Tā zài   túshūguǎn niàn   shū] bǐ   [CP tā   zài   jiālǐ
            he at   library   read   book COM   he   at   home
        niàn   shū]   rènzhēn
        read   book   serious
        'He studies more seriously in the library than he does at home.'

The contrast between (26) and (28), on the one hand, and (45) and (46), on the other hand, must be accounted for by any adequate syntactic analysis of Chinese comparatives.

A crucial distinction between (26), (28) and (45), (46) is that the two compared clauses linked by *bǐ* in the former are independent clauses that are not arguments of any predicate, whereas the two compared clauses in the latter can be regarded as the external arguments of the predicate of comparison. This observation is obvious for (45) because *nǐ qù* 'you go' and *wǒ qù* 'I go' are normally analyzed as the sentential subject, hence an argument, of the adjective *hǎo* 'good'. (46) is a bit more complicated, because it does not seem intuitive to say that the proposition *tā zài jiālǐ niàn shū* 'he studies at home' is the sentential subject of the predicate (*hen*) *rènzhēn* '(very) serious'. Its argument-hood, however, can be ensured once it is assumed that verbs have an event argument, as Davidson (1967) proposed, and that (manner) predicates, such as (*hen*) *rènzhēn* '(very) serious', are predicated of properties of events, i.e., type $<<\varepsilon,t>, <\varepsilon,t>>$ expression as in Parsons (1990). Under the above assumptions, the meaning of a sentence such as (47) is something like (48).

(47) Tā   niàn   shū   hěn   rènzhēn
      he   study   book   very   serious
      'He studies seriously.'

(48) a. ‖tā niàn shū ‖ = $\lambda\varepsilon\exists x.[study'(x)(\varepsilon)(he') \& books'(x)]$
      b. ‖hěn rènzhēn ‖ (‖Tā niàn shū‖) = $\lambda\varepsilon\exists x[study'(x)(\varepsilon)(he') \& books'(x) \& serious'(\varepsilon)]$

From the above analysis, the proposition *tā zài jiālǐ niàn shū* 'he studies at home' in (46) is an argument of the predicate *hěn rènzhēn* 'serious', and, therefore, can be analyzed as a sentential subject as well. It can be safely concluded, then, that what distinguishes (26) and (28), on the one hand, and (45) and (46), on the other, is whether the compared items function as arguments of a gradable predicate.

Based on the above proposition comparison, the examples discussed by Tsao (1989) are reanalyzed below. Recall that his generalization with respect to Chinese *bǐ*-comparatives is that the morpheme *bǐ* must be flanked by constituents of equal rank, and that these compared constituents can be individuals, times, or locations. From his examples, it is not difficult to conclude that both external and internal arguments of a predicate can be compared, as long as they occur before the predicate. Some examples are reproduced below.

(49) *Comparison of external argument*

      Yuēhàn   bǐ   mǎlì   (gèng)   gāo   。
      John   COM   Mary   even   tall
      'John is (even) taller than Mary.'

(50) *Comparison of various internal arguments*

      a. Wǒ   dàishù   bǐ   jǐhé   xǐhuān   。
          I   algebra   COM   geometry like
          'I like algebra more than geometry.'

   b.   Tā   duì   nǐ   bǐ   duì   wǒ hǎo   。

       he   to   you   COM   to   me nice

       'He is nicer to you than (he is) to me.'

   c.   Tā   bǎ   qián   bǐ   bǎ   shēngmìng kàn

       he   BA   money COM BA   life   regard

       de   zhòng   。

       PART important

       'He regards money as more important than (he does) life.'

In addition to external and internal arguments, we have found, from Tsao's examples, that times and location can be compared, as in (51) and (52).

(51)   *Comparison of time*

      Tā jīntiān bǐ   zuótiān   shūfú   。

      he today   COM yesterday feel-good

      'He feels better today than he did yesterday.'

(52)   *Comparison of location*

      Tā zài xuéxiào bǐ   zài jiālǐ   kuàilè 。

      he at   school COM at   home   happy

      'He is happier at school than at home.'

Moreover, the different kinds of compared constituents can all appear simultaneously, giving rise to what Tsao called multiple-topic comparison, as in (53).

(53)   *Triple-topic comparison*

      Tā zuótiān   zài xuéxiào bǐ   wǒ jīntiān zài jiālǐ   kāixīn 。

      he yesterday   at   school   COM I   today   at   home happy

      'He was happier at school yesterday than I am at home today.'

There is no doubt that external and internal arguments are true arguments, but what about times and locations? Traditionally, times and locations are treated as adjuncts. However, there are reasons to believe that times and locations are more like arguments than adjuncts with respect to wh-extraction (see Tsai 1994 for Chinese wh-extraction). Semantically, it is often assumed, especially in works studying tense and aspect, that time is an argument of a predicate (e.g. Lin 2003, 2006 for Chinese). Linguists occasionally lump time and location together as one single argument. For example, Kratzer (1988), when discussing the distinction between stage-level and individual-level predicates, suggests that stage-level predicates have a spatial-temporal argument in their argument structure, though this argument only optionally appears in overt syntax. If it is true that times and locations are part of the (perhaps optional) argument structure of a predicate, a clear generalization about Chinese comparatives is (54).

(54) *Argument requirement of Chinese comparatives*

In Mandarin Chinese, compared constituents must be arguments of a gradable predicate of comparison.

The above generalization predicts that true adjuncts like manner expressions are not comparable constituents. This prediction is borne out, and thus, sentences like (55) are not acceptable.

(55) a. *Wǒ-de   shēngrì   huì   mànmàndi   bǐ   kuàikuàdì   dào   。
           my   birthday will   slowly   COM   quickly   arrive
           'My birthday will come more slowly than quickly.'
      b. *Tā   miǎnqiǎngdi   bǐ   xīn-gān-qíng-yuàn-di   dāyìng   zuò
           he   reluctantly   COM   willingly   promise   do
           nà-jiàn shì   。
           that-Cl thing
           'He promised to do it more reluctantly than willingly.'

This is in contrast with English, which allows manner adverbs to function as compared constituents. The following three examples are all real life sentences, as found on the internet.[10]

(56) a. Although there may be a $ 100 million picture out there, I think that its day will come **more slowly than quickly**, so that the market will be allowed a chance to grow more **slowly than swiftly**.
      b. In this sense, cultural organizations – for the most part public or at least dependent on public funding – take part, **more reluctantly than willingly**, in this process of...
      c. He sighs, but **more happily than sadly**.

Manner adjuncts, more often than not, are analyzed as functions, which take VPs as their arguments. In this sense, manner adjuncts are predicates rather than arguments. The generalization in (54) thus excludes them from comparable constituents.

In fact, the same generalization also excludes normal predicates from being comparable. Therefore, examples such as (57) are ruled out.

(57) *Zhāngsān (hěn)   yònggōng   bǐ   (hěn)   cōngmíng   。
       Zhangsan very   diligent   COM   very   clever
       'Zhangsan is more diligent than clever.'

---

[10] An anonymous reviewer remarks that the examples in (56) need to be understood as 'rather than', thus casting doubt on the distinction between English and Chinese. However, it is not clear that the remark is correct. The examples in (56) can be easily paraphrased as degree expressions. For example, the sentence *Its day will come more slowly than quickly* is equivalent to 'The degree to which its day will come slowly exceeds the degree to which its day will come quickly'. Such paraphrases are standard paraphrases of comparative constructions. Another objection to the reviewer's suggestion is that the expression 'rather than' implies a total negation, but examples such as (56a) and (56b) do not seem to have such an implication.

Predicates are not arguments. Therefore, they are not comparable. However, the English counterpart of (57), as indicated in the translation, is grammatical, showing that predicates in English are, after all, comparable.

   Likewise, it is predicted by (54) that reason clauses are not comparable in Chinese, and this prediction is borne out, as evidenced by (58).

(58)   *Māma   yīnwèi   Xiǎomíng   shuōhuǎng   bǐ   yīnwèi   tā
       mother   because   Xiaoming   say-lie   COM   because   he
       tōu   qián   gēng   shēngqì   。
       steal   money   more   angry
       'Mother was angry more because Xiaoming told a lie than because he
         stole money.'

Again, this is in contrast to English comparatives, which allow reason clauses to be compared items. Below are two examples from the internet.

(59)   a.   However, this westward movement took place **more because the
             English were searching for better land than because the
             population was increasing**.
       b.   ... for doubtless many persons have suffered **more because
             someone else has said "don't" to them than because they
             themselves gave up and said "die."**

   The above contrasts between English and Chinese point to the following parameter of comparative constructions across languages.

(60)   *Argument dependence parameters of comparatives*

       Comparatives in a given language may be argument-dependent or
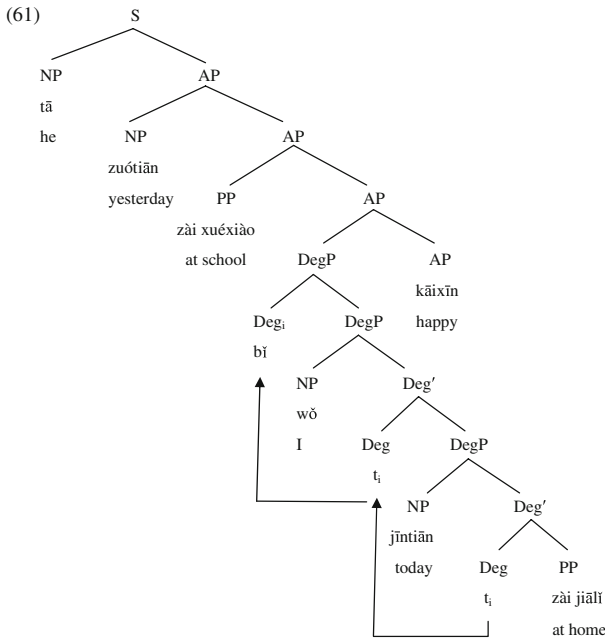   non-argument-dependent.

In argument-dependent languages, such as Mandarin Chinese, only arguments of gradable predicates can serve as compared constituents, while in non-argument-dependent languages, compared constituents are not restricted to arguments. Later, it will be shown that the restriction to argument comparisons in Chinese can be derived from a proper semantics of the morpheme *bǐ*.

5.2 The syntax of Chinese *bǐ*-comparatives

As noted earlier, there seems to be no positive evidence for the existence of clausal comparatives in Mandarin Chinese, in that the morpheme *bǐ* may not be followed by a full clause. Therefore, *bǐ*-comparatives in Mandarin Chinese are truly phrasal underlyingly, rather than reduced constructions derived from clausal comparatives. There are also indications that *bǐ* and subsequent constituents form a syntactic unit. This assumption has no problem when *bǐ* is followed by a single phrase, no matter whether that phrase denotes an individual, time, or location. However, when *bǐ* is followed by two or more phrases, it becomes more challenging to maintain the assumption. The most challenging cases are sentences like (53) where a time and a

location phrase are compared in addition to the external argument. It is usually assumed that the subject of a sentence does not form a constituent with a temporal and/or location modifier. Perhaps for this reason, sentences such as (53) are sometimes analyzed as cases of reduced comparatives where *bǐ* is followed by a full clause with an empty predicate elided. In what follows, however, a proposal will be made that allows the subject and a temporal and/or location modifier to form a constituent.

The idea pursued here is a variant of Xiang's (2005) DegP-shell, or Erlewine's (2007) vP-shell structure, in the sense that *bǐ* is a functional head that can move. However, unlike Xiang and Erlewine, we propose that DegP-shell is an adjunct adjoined to the predicate of comparison in the spirit of Liu (1996), rather than a functional projection in which the predicate of comparison is embedded. Moreover, *bǐ* is analyzed as a dyadic degree operator, which is like an adverb of quantification in being able to quantify over more than one indefinite (Lewis 1975; Heim 1982). The structure, as proposed for the triple comparison in (53), is (61):

(61)
```
              S
         ┌────┴────┐
        NP         AP
        tā    ┌────┴─────┐
        he   NP          AP
          zuótiān   ┌─────┴─────┐
         yesterday PP          AP
              zài xuéxiào ┌──────┴──────┐
               at school DegP          AP
                     ┌────┴────┐      kāixīn
                   Degᵢ      DegP     happy
                   bǐ      ┌───┴────┐
                          NP      Deg′
                          wǒ   ┌───┴────┐
                          I   Deg      DegP
                             tᵢ    ┌────┴────┐
                                  NP        Deg′
                                jīntiān  ┌───┴───┐
                                 today  Deg     PP
                                        tᵢ    zài jiālǐ
                                             at home
```

According to the above analysis, the innermost argument of *bǐ* is the location phrase, which appears in the complement position of the lowest Deg head. Both time and individual arguments are the specifiers of recursive DegPs. The degree head *bǐ* is raised from the lowest Deg position to the highest Deg position. Under this analysis, the string *wǒ jīntiān zài xué xiào* 'I today at school' forms a constituent to the exclusion of the main predicate AP and the whole recursive DegP, including *bǐ* is a constituent. This analysis of *bǐ*-comparatives will be referred to as the dyadic DegP-shell analysis, which belongs to the family of direct phrasal comparatives. As shown later, the dyadic DegP-shell analysis may interpret the *bǐ*-phrase directly once a proper semantics is assigned to *bǐ*.

Assuming the above analysis of *bǐ*-comparatives to be correct, this points to another possible parameter of comparatives across languages, namely:

(62)   *Adicity of comparative degree heads*

          A comparative degree head in a language may be dyadic or monoadic.
The Chinese *bǐ* is an instance of dyadic comparison, whereas the English *-er* is an instance of monoadic comparison.

An anonymous reviewer of this paper questions this conclusion, noting that Chineses does seem to allow comparisons parallel to the English examples below.

(63)   a.   He is taller than I thought.
         b.   I have written more papers than he has read.
         c.   I own more books than he does CDs.

If constructions parallel to those in (63) exist in Chinese, then that challenges the claim of argument-dependent comparisons in Chinese.

In my estimation the Chinese constructions that are closest to the English sentences in (63) are as follows:

(64)   a.   tā   (shēngāo)   bǐ   wǒ   yuánlái   xiǎng de   hái   gāo   ∘
              He   height   COM   I   originally think DE   more   tall
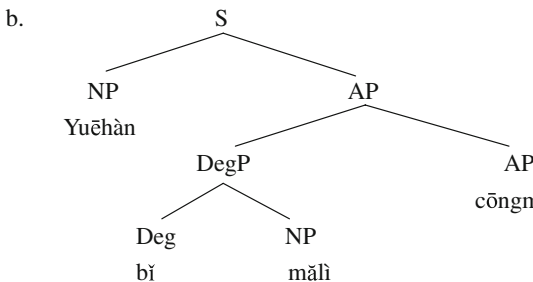   'He is taller than what I thought (originally).'
         b.   wǒ   xiě   de   wénzhāng bǐ   tā   dú   de
              I   write   Rel   article   COM   he   read   Rel
              (wénzhāng)   hái   gèng   duō   ∘
              article   more   even   many
              'The articles that I have written are more than the articles that he
              has read.'
         c.   wǒ   yǒngyǒu   de   shū   bǐ   tā   yǒngyǒu   de   CD   hái
              I   own   Rel   book   COM   he   own   Rel   CD   more
              gèng   duō   ∘
              even   many
              'The books that I own are more than the CDs that he owns.'

However, none of the above sentences involves a clausal comparison. In (64b) and (64c), the two items being compared are two noun phrases with a relative clause. Therefore, they are examples of individual (noun phase) comparisons.

(64a) may look more like a clausal comparison, but the nominalization marker *de* in this example, which is homophonous to the relative clause marker *de* as in (64b) and (64c), immediately rules out this possibility. The function of the nominalization marker *de* turns a clause into something very close to a free relative in English. Therefore, the meaning of (65a) can be paraphrased as (65b).

(65)   a.   wǒ   bù   xǐhuān   tā   mǎi   de   ∘
              I   not   like   he   buy   DE
         b.   I   don't like   what he   bought.

It is sometimes assumed that a nominal constituent, which is phonologically empty and whose content can be reconstructed from the context, actually follows the nominalization marker. Therefore, the phrase *wǒ yuánlái xiǎng de* 'what I originally thought' is actually a noun phrase or a nominal constituent denoting the wrongly assumed height, rather than a clausal constituent denoting a property of degrees. Under this analysis, it is easy to treat (64a) as a case of argument comparison, because the subject NP and the nominalized constituent can both be regarded as an argument of the predicate *gāo* 'tall', as one can say either *tā hěn gāo* 'He is tall' or *tā de shēn gāo hěn gāo* 'His height is tall'. Similar remarks apply to (64b) and (64c).

It is also worth noting that if the nominalization marker *de* in (64a) is deleted, the sentence becomes grammatically incorrect, as shown in (66), further supporting the view that (64a) does not involve a clausal comparison.

(66) *tā   (shēngāo)   bǐ   wǒ   yuánlái   xiǎng   hái   gāo   。
       He   height   COM   I   originally think   more   tall
      'He is taller than what I thought (originally).'

5.3 Semantics of *bǐ*

Recall that Heim (1985) and Bhatt and Takahashi (2007) provided methods to directly interpret phrasal comparatives. The lexical entry of *-er*, as suggested by Bhatt and Takahashi, is recast as follows:

(67) $\|\text{-er}\| = \lambda x.\lambda P_{<d,\ <e,t>>}.\lambda y.\exists d[P(y,d) \wedge \neg P(x,d)]$

According to (67), *-er* is a three-place operator, which takes two individuals, one predicate of individuals and degrees as its arguments. Interestingly, the argument structure of *-er*, as in (67), corresponds exactly to the syntactic structure given in (68b), which is proposed in this study for Chinese comparatives such as (68a).

(68) a. Yuēhàn   bǐ   mǎlì   cōngmíng   。
          John   COM   Mary   clever
         'John is cleverer than Mary.'

b.

```
                        S
              ┌─────────┴─────────┐
             NP                   AP
           Yuēhàn         ┌───────┴───────┐
                        DegP              AP
                     ┌───┴───┐          cōngn
                    Deg     NP
                    bǐ      mǎlì
```

However, the semantics of *-er*, as stated in (67), is a monoadic *-er*, which is not able to cover examples of multiple comparison involving individuals, times, or locations. In order to capture dyadic comparison, a more general semantics for *bǐ* is required.

The following proposes a generalized version of -er, which may directly interpret phrasal comparatives.

To begin with, let us assume that gradable stage-level predicates, as opposed to individual-level predicates, allow (optional) time and location arguments, in addition to individual ones. Thus, in addition to individuals of type e, and degrees of type d, we have semantic type i for time, and l for location, in our system. Under these assumptions, adjectives such as *cōngmíng* 'clever' and *kāixīn* 'happy' may have the following denotations, respectively:

(69)   a. $\|c\bar{o}ngm\acute{i}ng\| = \lambda d\lambda x.\text{CLEVER}(x) \geq d$
       b. $\text{CLEVER} = \lambda x.x's$ intelligence

(70)   a. $\|k\bar{a}ix\bar{i}n\| = \lambda d\lambda l\lambda i\lambda x.\text{HAPPY}(l)(i)(x) \geq d$
       b. $\text{HAPPY} = \lambda l\lambda i\lambda x.x's$ happiness at location l at time i

In order to explain examples such as (68a), the semantics of *bǐ* can be defined as in (71).

(71)   *Semantics of* bǐ *– preliminary version I:*

       $\|b\check{i}\| = \lambda x.\lambda P_{<d,<e,t>>}.\lambda y[\iota_{max}\, d[P(d)(y)] > \iota_{max}\, d\, [P(d)(x)]]$

However, the semantics of *bǐ* as given in (71) is not able to cover comparison of times, locations, or those across different domains, such as exemplified in (72).

(72)   a.   Tā   zuótiān   bǐ   jīntiān   kāixīn   。
             he   yesterday COM   today   happy
             'He was happier yesterday than today.'
       b.   Tā   zài   jiālǐ   bǐ   zài   xuéxiào   kāixīn   。
             he   at   home   COM   at   school   happy
             'He is happier at home than at school.'
       c.   Tā   jīntiān bǐ   wǒ   zuótiān   kāixīn   。
             he   today   COM   I   yesterday   happy
             'He is happier today than I was yesterday.'
       d.   Tā   zài   xuéxiào   bǐ   wǒ   zài   jiālǐ   kāixīn   。
             he   at   school   COM   I   at   home   happy
             'He is happier at school than I am at home.'
       e.   Tā jīntiān zài xuéxiào bǐ   wǒ zuótiān   zài jiālǐ   kāixīn   。
             he today at   school   COM   I yesterday   at home   happy
             'He is happier at school today than I was at home yesterday.'

In order to explain all of the above examples, a generalized meaning of *bǐ*, such as (73), is required.

(73)   *Semantics of* bǐ *– preliminary version II:*
       $\|b\check{i}\| = (\lambda l)^i(\lambda i)^j\lambda x\lambda_{\wp_{<d,\,<(l),\,<(i),\,<e,t>>>>}}(\lambda l')^i(\lambda i')^j\lambda y[\iota_{max}\, d[\wp\,(d)(l')(i')$
       $(y)] > \iota_{max}\, d\, [\wp\,(d)\,(l)(i)(x)]]$

In (73), parentheses are used to indicate that the element within the parentheses is optional. Symbols with the same superscript index must match in their presence or absence. Therefore, when the left 'λl' appears, the right 'λl′' must appear with it, and similarly for 'λi' and 'λi′'. This analysis covers all examples in (72), with (71) as a special instance of (73). In particular, it guarantees that the comparative degree morpheme *bǐ* is always flanked by constituents of the same type, thus capturing Tsao's (1989) generalization that compared items must be "topics of an equal rank". We thus directly account for the semantics of *bǐ*-constituents, without resorting to any reduction analysis.

Two points are worth mentioning, however. One feature of (73) is the requirement that the external argument, i.e., the variables x and y, is always a compared item. At first glance, this prediction seems to be wrong because of examples, such as (74a), where the external argument is not being compared.

(74) a. Zhāngsān   zài   xuéxiào   bǐ   zài   jiālǐ   kāixīn   。
          Zhangsan   at   school   COM at   home   happy
          'Zhangsan is happier at school than at home.'
      b. Zhāngsān   zài   xuéxiào   bǐ   tā   zài   jiālǐ   kāixīn   。
          Zhangsan   at   school   COM he   at   home   happy
          'Zhangsan is happier at school than at home.'

This apparently wrong prediction is not serious. As proposed by Tsao (1989) and discussed earlier, Chinese comparatives are subject to a forward deletion principle, which deletes the second compared item. Therefore, the structure of (74a) does contain an empty individual argument after *bǐ*, which is equivalent to the pronoun in (74b). This empty argument will fill the value of the variable x, which is co-referential with the value of the variable y.

A real inadequacy of (73) is that it only allows one individual argument of a predicate to be compared. However, Chinese *bǐ*-comparatives may compare external and internal arguments at the same time when the internal argument is fronted, as (75) shows.

(75) Tā   lánqiú   bǐ   wǒ   páiqiú   dǎ-de   hǎo   。
      he   basketball   COM   I   volleyball play-Part   good
      'He plays basketball better than I play volleyball.'

In order to cover examples such as (75), one more individual variable must be added to (73), and thus, (73) is revised to (76a).

(76)   *Semantics of* bǐ – *final version:*

   a. $\|b\check{\imath}\| = (\lambda l)^i (\lambda i)^j (\lambda w)^k \lambda x \lambda \wp_{<d,\ <(l),\ <(i),\ <(e),\ <e,t>>>>>} (\lambda l')^i (\lambda i')^j (\lambda z)^k \lambda y$
       $[\iota_{\max} d\ [\wp(d)(l')(i')(z)(y)] > \iota_{\max} d\ [\wp\ (d)\ (l)(i)(w)(x)]]$

   b. $\|b\check{\imath}\| = \lambda \overrightarrow{a_i}\ \lambda \wp_{<d,<\overrightarrow{a},t>>} \lambda \overrightarrow{a_{i'}} [\iota_{\max} d\ [\wp(d)(\overrightarrow{a_{i'}})] > \iota_{\max} d\ [\wp\ (d)\ (\overrightarrow{a_{i'}})]],$
       where $|\overrightarrow{a}| \geq 1$.

However, (76a) is complicated and would be more desirable if simplified, as in (76b), where the symbol '$\overrightarrow{a}$' indicates a sequence of arguments of a gradable predicate, $\langle\overrightarrow{a}\rangle$ is the corresponding semantic type, and $|\overrightarrow{a}|$ is the number of arguments in the sequence. Moreover, the matching subscript index i in (76b) replaces the matching indices in (76a); and it is required that the sequence of arguments must contain at least one element. This reformulation maintains the essence of (76a) and appears simpler and more elegant.

6 Concluding remarks: implicational parameters of comparatives

Recently, several linguists have begun to pay attention to crosslinguistic variations in the expression of comparison (Beck et al. 2004; Kennedy 2005; Bhatt and Takahashi 2007). Kennedy (2005) has addressed this issue in detail by suggesting that languages may differ with respect to two potential parameters in expressing comparison. One is explicit versus. implicit comparison; and the other, individual verses. degree comparison.

- *Explicit versus implicit comparison:* Does the comparison involve specialized morphology that expresses arbitrary ordering relations (explicit comparison), or does the comparison involve taking advantage of the inherent context sensitivity of the positive (unmarked) form (implicit comparison).
- *Individual versus degree comparison:* Do the comparatives express orderings between arbitrary individuals (individual comparison), or do they (also) express orderings between individuals and arbitrary (linguistically explicit) degrees? (Kennedy 2005:1)

For the individual/degree comparison distinction, the following two parameters are suggested by Kennedy:

- *The Degree Abstraction Parameter*: A language {does, does not} have binding of degree variables in the syntax.
- *The Standard Type Parameter*: Languages may differ in whether the comparative morphology selects a standard of type d (degree comparison) or of type e (individual comparison)

Bhatt and Takahashi (2007), on the other hand, suggest that universal grammar may allow a language to interpret phrasal comparatives either by ''reduction analysis'' or ''direct analysis''.

This concluding section aims to link our discussion to the picture of comparatives across languages, as sketched by these authors. To begin, recall that Chinese does not have clausal comparatives, and all comparatives can be analyzed as (multiple)-phrasal comparatives using ''direct analysis'' to interpret them. From here, a clear implicational universal is:

- If a language does not have clausal comparatives, it does not have degree comparison, i.e., it does not have the binding of degree variables in the syntax.

Therefore, even if ''reduction analysis'' is sometimes available for phrasal comparatives in some languages (Bhatt and Takahashi 2007), this strategy is not available for Chinese. Thus, Chinese, as Kennedy (2005) has suggested, is a language of individual comparison.

However, also according to Kennedy (2005), when a language is an individual comparison language, the standard type of parameter is of type e. This is problematic. As discussed earlier, in addition to normal individuals, times, locations, and even propositions can be a standard of comparison in Mandarin Chinese, as long as they are arguments of the predicate of comparison. In view of this, an independent parameter of comparison, such as the following, might still be needed:

- Comparatives in a language can be argument-dependent or non-argument-dependent.

Individual comparison of type e is a special case of argument-dependent comparison. Perhaps argument-dependent languages may allow different types of arguments to serve as standards of comparison. This parameter needs further investigation in the future for languages other than Mandarin Chinese.

Another parameter discussed in this article is dyadic comparison vs. monoadic comparison. This parameter can be stated as follows:

- If a language has phrasal comparatives, the construction may allow comparison of one phrase (monoadic comparison) or more than one phrase (dyadic comparison).

Undoubtedly, this parameter is a lexical matter. For some languages, the comparative morpheme may allow only one standard, but for some languages, it may allow more than one. Since the author does not know enough languages to confirm more cases of dyadic comparison, this parameter must await further confirmation in the future.

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