The syntax-semantics interface of multi-morpheme motion constructions in Chinese:

An analysis based on hierarchical scalar structure

Abstract
This study analyzes semantic constraints affecting the order of motion morphemes in Mandarin Chinese multi-morpheme motion constructions (MMMCs, e.g. 走-进入房间 ‘walk into the room’ (lit.) ‘walk-enter room’ vs. *进入走 (lit.) ‘enter-walk’). We classify Chinese motion morphemes into four types based on recent study on “scale structure”. Then, we propose an implicational scalar hierarchy formed by the four types of morphemes that can be used to predict the order of motion morphemes in Chinese MMMCs. Our corpus studies demonstrate that the hierarchy can explain the morpheme order of MMMCs for a comprehensive range of existing natural Chinese data. We anticipate that our scalar hierarchy may be extensible to serial-verb motion constructions in other languages as well.
1. Introduction

This paper explains lexical semantic effect that constrains the order of adjacent morphemes in expressions consisting of multiple motion morphemes. For such purpose, we will propose a hierarchy of motion morphemes based on their scale structure, which could be applicable to serial-morpheme (verb) motion constructions in other languages as well.

The term “directed motion event” in this paper refers to an event in which an object moves spontaneously (without an explicit external cause such as pushing or moving) in a certain direction with respect to a reference object and ends up in a new location. The moving object and the reference object are called “figure” and “ground” (Talmy 2000: 25), respectively. Verbs that denote motion are traditionally divided into two types: “manner-of-motion verbs” and “path verbs” (Talmy 2000). A manner-of-motion verb lexicalizes motion and manner, e.g., fly specifies the means of motion, but does not indicate in which direction a figure moves; a path verb lexicalizes motion and path (or direction, path and direction are used interchangeably in this work), e.g., enter specifies motion into an enclosed region, but does not indicate in which manner a figure enters (Talmy 2000).

In Modern Mandarin Chinese (hereafter “Chinese”), a motion event can be expressed in a variety of ways. For instance, both the verbal morphemes expressing manner-of-motion and path can be the only morpheme in a motion expression, as in (1a) and (1b) respectively.

1 a. Xiǎoháì zài jiē-shàng pǎo
   little.child at street-on run
   ‘The kid is running on the street.’

1 b. Xiǎoháì jīn-le fāngjiān
   little.child ascend-ASP second.floor
   ‘The kid went up to the second floor.’

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1 Abbreviations used in this paper: CLF = classifier/measure word; IMP = imperfective; MOD = modifier; NEG = negative marker; PROG = progressive; REL = relative clause marker.
In addition, more than one verbal motion morpheme can occur together to express a motion event. As illustrated in (2), zǒu ‘walk’ specifies manner of motion and jìn ‘enter’ specifies path of motion, and they co-occur in a single motion expression.

(2) Tā zǒu-jìn fángjiān
she walk-enter room
‘She walked into the room.’

Motion constructions consisting of multiple verbal motion morphemes are very common in Chinese. For example, in the first 20 chapters of the novel Tàiyáng Zhào Zài Sānggānhé-shāng (The Sun Shines Over Sanggan River), 146 out of 223 (65.5%) tokens of motion constructions consist of more than one motion morpheme. In this paper, we call such constructions “multi-morpheme motion constructions (MMMCs, hereafter).” In addition, motion morphemes are called “M1”, “M2” and “M3” respectively according to their left to right order in a MMMC for convenience. For example, zǒu ‘walk’ is M1 and jìn ‘enter’ is M2 in (2).

Previous studies have not reached an agreement on the morpho-syntactic statuses of motion morphemes appearing in MMMCs. For example, M2 is sometimes treated as a directional complement to its preceding motion morpheme M1, and thus not as a full verb, as in Liu (1998), Liang (2007), Lamarre (2007, 2008) and Peyraube (2006), among many others. In contrast, Tai (2003) claims that the so-called directional complement M2, instead of M1, actually functions as the main verb in a motion construction. For example, M2 jìn ‘enter’ in a MMMC zǒu-jìn ‘walk-enter’ in (2) can appear as the only verb in the motion expression in (1b). In addition, dào ‘arrive’ appearing in M2 or M3 positions are considered as a co-verb (Li and

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2 A compound, especially a noun compound such as fángjiān ‘room’ (lit.) ‘room room’, is treated as a word unit in this paper. But for motion expressions, a hyphen is used to connect morphemes within a compound and each motion morpheme is glossed, because our analysis was based on the lexical semantic information of each morpheme. To determine if a given combination of motion morphemes is a word unit or not, we tested the combination with the perfective suffix -le. If a combination cannot be separated by -le, it was treated as a compound or a word. For example, zǒu-jìn ‘walk-enter’ in zǒu-jìn fángjiān ‘run-enter room' was treated as a compound because -le cannot be inserted in between zǒu ‘walk’ and jìn ‘enter’; in contrast, in zǒu jìn-lái ‘run enter-come', -le can be inserted in between zǒu ‘walk 'and jìn-lái 'enter-come', so zǒu and jìn-lái were treated as two words.
Thompson 1981), a full verb (i.e. main verb of verbal compound, Tai 2003) or preposition (Lammarre 2007, 2008).

Nonetheless, we would like to ask readers to leave behind any pre-assumption regarding the morpho-syntactic status of motion morphemes that we are discussing here, because we attempt to show how lexical semantic information of each morpheme constrains the distribution of these morphemes.3

Regarding the order of motion morphemes in MMMCs, previous studies (Lu 1977, among others) have claimed that manner-of-motion morphemes must precede path morphemes, so that for example, jìn ‘enter’ may not precede zǒu ‘walk’, cf. (3) and (2).

(3) *Tā  jīn-zǒu  jiàoshì
    she  enter-walk  classroom
    # ‘(intended meaning) She walked into the classroom.’

However, when two path morphemes co-occur, their order does not seem as fixed as the sequences consisting of a manner-of-motion morpheme and a path morpheme. For instance, tuì ‘recede’, huí ‘return’, and dào ‘arrive’ are all path morphemes. When tuì and huí co-occur, huí must follow tuì, as in (4); when huí and dào co-occur, huí must precede dào, as in (5).

(4) a. Dírén  tuì-huí  guānwài  (path-path)
    enemy  recede-return  pass-outside
    ‘The enemy receded back outside the pass.’

b. *Dírén  huí-tuì  guānwài
    enemy  return-recede  pass-outside

3 Because we focus on the lexical semantics of each motion morpheme, the approach adopted in our paper can be applied to full verbs, complements, and even bound motion morphemes (morphemes that are no longer used as full verbs). That is why we use the term “morpheme” to cover all motion morphemes in Chinese. But we will also use the term “verb” when necessary, especially when we refer to previous studies of English motion verbs.
When two path morphemes occur in a motion construction, what determines their relative order? If we rely on the manner-path dichotomy, it is not clear why one order is acceptable (4a, 5a) whereas the other is not (4b, 5b).

In addition, examples are occasionally found in which two path morphemes can appear in either order, such as the huí ‘return’ and fān ‘return’ in (6).

(6) a. Jǐ-ge wénshì jiù huí-fān le
several-CLF scholar then return-return ASP
‘Several scholars then went back.’ (PKU Corpus)

b. Sān diānzhōng qīchénɡ fān-huí xuéxiào
three o’clock set.off return-return school
‘[They] started to go back to school at three o’clock.’ (PKU Corpus)

In this case, both huí-fān ‘return-return’ and fān-huí ‘return-return’ sound natural. It is logical to ask if there is any consistent way to predict grammatical word order in multi-morpheme motion constructions in Chinese.

This study investigates what lexical semantic constraint determines the order of motion morphemes in Chinese MMMCs in light of recent works on scale structure in directed motion verbs (Rappaport Hovav and Levin 2010, among others). We present this as a more refined work based on Talmy’s two-way classification (manner-of-motion verbs and path verbs).

4 PKU Corpus in this paper refers to the corpus of Modern Chinese constructed by the Center for Chinese Linguistics at Beijing University. Currently, the corpus has 307,317,060 characters updated on 7/20/2009. See http://ccl.pku.edu.cn/
The reminder of this paper is organized as follows. Section 2 provides background information regarding MMMCs in Modern Chinese. We also introduce previous approaches explaining morpheme order and provide critiques. In Section 3, we suggest as an alternative concept of scale structure associated with directed motion morphemes by Rappaport Hovav and Levin (2010). A set of independent diagnostics is proposed to test the scale structures of each given morpheme in Chinese. Then we propose an implicational hierarchy that can be used to predict the morpheme order of MMMCs. In Sections 4 and 5, two corpus studies are carried out to verify the hierarchy. In the first study, we examine all existing MMMCs in selected chapters of three Modern Chinese novels in order to investigate whether the morphemes in these constructions are in an order consistent with the hierarchy. In the second study, we investigate whether motion morphemes of the highest frequency and the morphemes they co-occur with in MMMCs are in in the order predicted by the hierarchy. We also discuss the results from the two corpus studies that confirmed our hypothesis that the order of morphemes in motion constructions follows our hierarchy. Section 6 summarizes and concludes our study.

2. Preliminaries

2.1 Basic properties of motion event expressions in Chinese

MMMCs have been treated as a (sub)type of the resultative verbal construction (“RVC”) in previous studies (Li and Thompson 1981, Ross 1990, Shi 2002, Xiao and McEnery 2004, Xu 2006, Hsiao 2009, among many others). However, diverse combinations of M1-M2 as exemplified in (4-6) make us question whether all M1-M2 collocations in motion expressions are necessarily a subtype of RVC. Let us examine in greater detail the differences between the MMMC and the RVC by examining previous studies that classify the MMMC as a subtype of the RVC.

2.2 Semantic differences between RVC and MMMC

Previous studies (Hashimoto 1757, Li and Thompson 1981, Ross 1990, Shi 2002, Xiao and McEnery 2004, among many others, cf. Lu 1977) often treat the MMMC as a (sub)type of the RVC: as pointed out in Li and Thompson (1981: 58), the M2 in an MMMC “signals the direction in which the subject moves as the result of the displacement [M1].” As in (7), the M2 shàng
‘ascend’ specifying the upward direction in which the kid is moving, and it is understood as a result of his action of running.

(7) Xiǎohái pǎo-shàng èrlóu
little.kid run-ascend second.floor
‘The kid ran up to the second floor.’

However, there are at least two problems with identifying MMMC with RVC. First, as pointed out by Lu (1977), M1 and R in an RVC show a temporal order in that the result is not presupposed to exist before the action denoted in M1 takes place. In contrast, in an MMMC, there is not necessarily such a presupposition regarding M1 and M2 (Lu 1977). We can test the temporal order between M1 and R in an RVC and between M1 and M2 in an MMMC by looking at whether the M1s in these two constructions can take the imperfective marker –zhe. As illustrated in (8a), -zhe is not allowed to modify the M1 dā ‘hit’ in an RVC, whereas the M1 pǎo ‘run’ in a MMMC can be modified by –zhe, as in (8b).

(8) a. * Tā dā-zhe sǐ-le yī-zhī lāoshǔ
    she hit-IMP die-ASP one-CLF rat
    # ‘(intended meaning) She made the rat dead [by] hitting.’

b. Xiǎohái pǎo-zhe shàng-le lóu
    little.kid run-IMP ascend-ASP stairs
    ‘The child went up the stairs [by] running.’

Therefore, while the state denoted by R might always occur later than the action denoted by M1 in an RVC, the motion denoted in M2 does not necessarily occur temporally later than the action denoted in M1 in an MMMC. Instead, the motion in M1 and M2 can occur simultaneously. As illustrated in (8b), running and ascending can happen at the same time especially if the figure was standing at the lower end of the stairs before he started running up them.

Another reason that the MMMC is treated as a subtype of the RVC is that in an MMMC, the M2 signals the direction of motion as a result of action denoted in M1 (Li and Thompson
This observation is correct: the domain of direction and the domain of result can be understood from the shared perspective (also see Xiao and McEnery 2004), and path verbs are identified as a type of result verb by Levin and Rappaport Hovav (1992). Motion verbs and verbs specifying resultant status have in common in that both specify a type of change to a single property. For example, a rat goes through a change from a state of not being dead to the state of being dead as it gets beaten over a period of time. A child’s location goes through a change from downstairs to upstairs as he runs up the stairs.

However, previous studies have not pointed out that in Chinese motion constructions, or directional RVCs, there can be different types of M2 and thus not provided a more fine-grained analysis of these M2s. The following examples demonstrate that the verbal phrase *shàng lóu* ‘ascend stairs’ can be understood telically (9a) or atelically (9b).

(9) a. Xiǎohái zài wǔ fēnzhōng-nèi shàng lóu le  
   little.kid in five minute-inside ascend floor ASP  
   ‘The kid went upstair in five minutes.’

b. Xiǎohái shàng lóu shàng-le wǔ fēnzhōng.  
   little.kid ascend upstair ascend-ASP five minute  
   ‘The kid has been going up to upstair for 5 minutes.’

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5 Although Lu (1977) is among a few studies claiming that the Chinese MMMC is not equivalent to the RVC, Lu’s discussion is not sufficiently accurate, due to lack of understanding that change of direction can be analyzed as a result in the domain of directed motion. For instance, Lu claims that the Chinese MMMC consists of “manner-direction” verb collocations in which M1 must denote the manner of motion and M2 must denote the direction of motion, and the direction cannot be understood as a result.

6 We use the term (a)telicity as a property of phrases, following Krifka (1989) among others. Quantized expressions are telic, and expressions that have cumulative reference are atelic. There is also a standpoint which defines (a)telicity as a property of individual verb, including Garey (1957) who introduced this term, among others.
Shàng lóu ‘ascend stairs’ has a telic reading in (9a) because it can be harmoniously modified by a frame adverbial ‘in five minutes’, but it is atelic in (9b) in that it can be also modified by a durative adverbial ‘for five minutes.’

In contrast, the path morpheme dào ‘arrive’ only behaves telically, as in (10).

(10) a. Xiăohái zài wǔ fēnzhōng-nèi dào-le èrlóu (telic)
    little.kid in five minute-inside arrive-ASP second.floor
    ‘The kid arrived at the second floor in five minutes.’

b. * Xiăohái dào èrlóu dào-le wù fēnzhōng (atelic)
    little.kid arrive second.floor arrive-ASP five minute
    #*(intended meaning) The kid has been arriving at the second floor for five minutes.’

(10a) shows that the phrase dào èrlóu ‘arrive second floor’ denotes a telic event, as it is well-modified by a frame adverbial. However, as in (10b), duration of ‘arriving’ cannot be inferred. It suggests that the event of arriving reaches its inherent endpoint instantaneously.

The differences between shàng ‘ascend’ in (9) and dào ‘arrive’ in (10) with respect to telicity suggest that there must be different types of path morphemes. In addition, the more important point is that besides “manner-direction” (Lu 1977) or “manner/action-result” (Li and Thompson 1981, among others), the semantic relationship between M1 and M2 in a MMMC can be much more diverse. We have already seen from examples (4-6) that not only manner-path relationships, but also path-path relationships, can be expressed by an MMMC. As shown in (11), besides the M1 tuì ‘recede’ that denotes a direction along which the figure moves back, the M2 huì ‘return’ also expresses a backward direction of motion.

7 Frame adverbials (in X time) and durative adverbials (for X time) have been traditionally used to test (a)telicity of VP in English since Vendler (1967). Xiao and McEnery (2006) suggest that the corresponding in-adverbials and for-adverbials in Chinese should be used for (a)telicity test with special carefulness and that some of preverbal or postverbal temporal adverbials in Chinese show different meanings from the temporal frame or duration of events. These exceptions include expressions such as zhè sān tiān ‘these three days’ denoting “range” in the preverbal position and durative adverbials such as sān tiān ‘three days’ used in negated sentences. For further discussion, see Xiao and McEnery (2006).
(11) Dírén  tūi-huí  guānwài  (=4a)

enemy  recede-return  pass.outside

‘The enemy receded back to the outside of the path.’

In what follows, we provide a few tests that distinguish path morphemes from manner-of-motion morphemes for more accurate analysis in this study. According to Rappaport Hovav and Levin (2010) and Rappaport Hovav (2008), a path morpheme differs from a manner-of-motion morpheme in at least two respects of syntax-semantics interface.

First, semantically, the motion lexicalized by path morphemes can be realized via different manners. This allows path morphemes to be modified by phrases expressing various manners. For instance, a figure can return to a place by running or walking:

(12) Dírén  păo/zòu-zhe  huí  guānwài

enemy  run/walk-IMP  return  pass.outside

‘The enemy returned to the outside of the pass by running/walking.’

In contrast, the specific manner of a given motion event cannot be modified again by any other kind of manner of motion. For example, fēi ‘fly’ denotes motion in the manner of flying, and thus cannot be realized by running or walking, as shown in (13)8.

(13) * Tā  păo/zòu-zhe  fēi

he  run/walk-IMP  fly

8 Two manner-of-motion morphemes might co-occur only if the first morpheme loses its literal meaning and functions as a modifier of the second morpheme. As illustrated in (i), the first morpheme fēi ‘fly’ does not literally mean a flying event, but is a modifier of the morpheme păo ‘run’, indicating that the moving objects are running at a very fast speed as if they are flying.

(i) tāmen  zài  chēxiāng  dǐng-shàng  fēi-păo,

they  at  carriage  top-on.top.of  fly-run

yīgègè  dōu  xiàng  yē  hōu zi  shìde
one.CLF.CLF  all  like  wild  monkey  like

‘They are running at a speed of flying on top of the carriage. Each looks like a wild monkey.’

(PKU Corpus)
Second, a manner-of-motion morpheme can take result phrases that denote any state brought about by the morpheme (Rappaport Hovav 2008:22, cf. Filip 2004, Goldberg 1991, Levin and Rappaport Hovav 1995, Simpson 1983, Tenny 1994). As illustrated in (14), diverse result states such as ‘being tired’, ‘losing shoes’, or ‘arrival at school’ can follow the manner-of-motion morpheme pāo ‘run’.

(14) a. Tā pāo-lèi le
he run-tired ASP
‘He was tired as a result of running.’

     b. Tā pāo-diū-le xiézi
        he run-lose-ASP shoe
     ‘He lost his shoes as a result of running.’

     c. Tā pāo-dào-le xuéxiào
        he run-arrive-ASP school
     ‘He ran to the school.’

However, a path morpheme can be followed only by result phrases that are related to the direction of the motion that the morpheme denotes, usually result phrases specifying an endpoint to the path. As illustrated in (15), the path morphemes huí ‘return’ can be modified only by phrases denoting the state of ‘being outside of the pass,’ which is related to the path of the motion events they denote, cf. pāo ‘run’ in (14).

(15) a. *Dírén huí guānwài huí-lèi le
enemy return pass.outside return-tired ASP
# ‘(intended meaning) The enemy was tired as a result of returning outside of the pass.’
b. * Dírén huí guānwài huí-diū-le wǔ qì
Enemy return pass.outside return-lose-ASP weapon
# ‘(intended meaning) The enemy lost his weapon as a result of returning outside of the pass.’

c. Dírén huí-dào-le guānwài
enemy return-arrive-PERF pass.outside
‘The enemy returned outside of the pass.’

In addition to the fact that some previous analyses neglected different types of path morphemes in both manner-path morpheme combinations and in path-path morpheme combinations, some studies (Lu 1977, Ma 2008, among others) have mistakenly treated M1s that are path morphemes as manner-of-motion morphemes. For instance, Lu (1977) classifies the M1 in his MMMC examples such as jiàng xiàlái ‘descend towards speaker’ and shēng shàngqù ‘ascend away from speaker’ as manner-of-motion morphemes. However, jiàng and shēng do not lexicalize any manner information according to Rappaport Hovav and Levin’s (2010) tests of path morphemes above. For instance, jiàng ‘descend’ allows only a resultant complement that further specifies the endpoint of the motion that it lexicalizes:

(16) a. * Fēijī jiàng-huái-le yǐnqìng
plane descend-break-ASP engine
# ‘(intended meaning) The engine of the plane was broken as a result of the plane’s descending.’

b. * Fēijī jiàng-diào-le yī-zhī jīyì
plane descend-lose-ASP one-CLF wing
# ‘(intended meaning) The plane lost one of its wings as a result of its descending.’

c. Fēijī jiàng-dào-le dìmìăn
plane descend-arrive-PERF ground
‘The plane descended to the ground.’
Besides such difference in the lexical semantics of morphemes in two constructions, MMMCs and RVCs are also syntactically different. First, while RVC mainly concerns compounds consisting of two morphemes, MMMCs might have three morphemes M1M2M3, e.g., *huá ‘slide’, *luò ‘fall’, and *dào ‘arrive’ in (17).

(17) Shēngpà tà *huá-luò-dào dī-shàng  
  fear she slide-fall-arrive floor-on
  ‘[The parents] feared that she would slide and fall onto the floor.’] (*Tàiyáng Chūshì)

Furthermore, morphemes in MMMCs can be separated, showing that not all morphemes form compounds (Paul 2008), whereas morphemes in RVC cannot be separated.

(18) a. kàn-jìàn Zhū Dĕ zǒu-le jīn-lái  
  see-see Zhu De walk-ASP enter-come
  ‘[He] saw Zhu De walk in [towards him]’  (*Hong Piàodài)

b. *Zhāngsān kàn-le wán yīběn shū  
  Zhangsan read-ASP complete one.CL book
  ‘Zhangsan finished reading a book.’

In this section, we have shown that neither the previous claim that the MMC is a subtype of the RVC, nor the traditional understanding of the MMC as a “manner-direction” morpheme combination can account for the entire picture of diverse syntax-semantic relationships represented by M1 and M2 in a MMC. Instead, we showed that when M1 and M2 of a MMC represent a manner-path relationship, there can be different types of M2 as the path morpheme. In addition, M1 and M2 of motion expressions may represent a variety of path-path relationships, where neither M1 nor M2 expresses a manner of motion event.

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9 We are grateful for an anonymous reviewer for directing our attention to this syntactic difference. For detailed discussion on formal syntactic analysis on MMMCs and RVCs, which is beyond the scope of this work, see Paul (2008), Sybesma (1999) and Wu (2004).
In the following section, we will present a more comprehensive perspective to the understanding various dynamics of path morphemes in order to examine semantic constraints determining the order of morphemes appearing in the M1 and M2 positions of MMMCs.

3. Classification of motion morphemes in Chinese

Degree achievements are found to have both telic and atelic uses (Dowty 1979, Hay, Kennedy and Levin 1999, among many others). As illustrated in (19), the path verb descend can take both the ‘for 20 minutes’ and the ‘take 20 minutes’ reading of the adverbial in 20 minutes, and thus it cannot be classified simply as an activity verb or as an accomplishment verb, based on the traditional aspectual classification of verbs in Dowty (1979) and Vendler (1967).

(19) The plane descended in/for 20 minutes. (Rappaport Hovav and Levin 2010)

Recent work (Rappaport Hovav and Levin 2010, Rappaport Hovav 2008, Hay, Kennedy, and Levin 1999, among others) has proposed the notion of scalar change as an alternative. In the motion domain, a motion event can be measured through the scale lexicalized by the motion verbs. The scale structure lexicalized by motion verbs plays a key role in determining the verbs’ telicity, which traditional event structure (e.g., Dowty 1979/Vendler 1967 aspectual classification) fails to do.

According to Rappaport Hovav and Levin (2010), motion morphemes can be classified into four types based on three features in terms of scale: the first feature is existence of a scale, i.e. whether the motion takes place along a scale, which classifies motion morphemes into nonscalar change motion morphemes (hereafter “nonscalar change M”, e.g., fly, run, walk) and scalar change motion morphemes (hereafter “scalar change M”, e.g., recede, return, enter); The second feature is boundedness, i.e. whether a scale has an endpoint or not, which further divides scalar change motion morphemes into open scale motion morphemes (hereafter “open scale M”, e.g., recede, ascend) and closed scale motion morpheme (hereafter “closed M”, e.g., return, enter); The third feature is punctuality, i.e. whether motion along a scale is durative (with multiple points) or punctual (with two points, i.e. the starting and ending points), which divides closed scale motion morphemes into multi-point closed scale motion morphemes (hereafter
“multi-pt closed scale M”, e.g., *return, come*) and two-point closed scale motion morphemes (hereafter “two-pt closed scale M”, e.g., *enter, arrive*).

Non-scalar change motion verbs are equivalent to manner-of-motion verbs in Talmy (2000), whereas the other three types are subtypes of Talmy’s path verbs, each with a different scale structure (ibid.). In the remainder of this section, we introduce each type of motion verbs and provide tests to determine in which type each Chinese motion morpheme belongs.

### 3.1 Non-scalar change motion morphemes vs. Scalar change motion morphemes

Both manner-of-motion and path morphemes involve some kind of change (see Dowty 1979, Filip 1993/99, Verkuyl 1989 for a discussion of morphemes that involve and do not involve change). Among the types of change lexicalized in morphemes, the most fundamental distinction is whether or not a morpheme lexically specifies a *scale* of change (McClure 1994, Rappaport Hovav 2008). All manner-of-motion morphemes specify non-scalar changes, and all path morphemes specify scalar changes. A scale of change is composed of a set of points or intervals that measure values on a distinct dimension such as height or temperature (Kennedy 2001, Kennedy and McNally 2005). According to Rappaport Hovav and Levin (2010), in the domain of motion events, a scale is understood on the dimension of distance, that is, the distance of the figure with respect to the ground: being at a position on the path with respect to the ground is understood as having a distinct value on the scale associated with the motion verb, and movement along the path is equivalent to a value change in the scale. For example, the verb *descend* lexically specifies a spatial scale: the measuring points on its scale are ordered along the direction of gravity so the descending event is measurable, e.g., a descending motion of a pencil from a table to a floor is halfway done when the pencil moves halfway on its path (Rappaport Hovav and Levin 2010).

While scalar change Ms lexicalize a directed change in value on a single dimension, non-scalar change Ms cannot be characterized in terms of a single scale of change. Most of the non-scalar changes involve complex changes, i.e. a combination of multiple changes. For example, Rappaport Hovav and Levin (2010) argue that the verb *jog* involves movement of both arms and

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10 Rappaport Hovav and Levin (2010) argue that a single motion verb can be classified only as either a manner verb or a path verb, but cannot have both manner and path meanings at the same time.
legs, but no movement can be understood as “the necessary starting point of motion, that is, one can start jogging by moving one’s left leg first or one’s right leg first” (ibid.: 32).

We suggest two diagnostics to distinguish non-scalar change Ms from scalar change Ms. These tests demonstrate that scalar change Ms lexically specify a scale, whereas non-scalar change Ms do not specify such scale (Rappaport Hovav, 2008). The first diagnostic tests whether a given motion morpheme lexically specifies a direction or not. Since a nonscalar change motion morpheme denote complex change which is not related to any single specific direction, such morpheme can co-occur with modifying phrases that express any direction. For instance, in a running event, a figure can run forward or backward, as in (20).

(20) xiàng qián/hòu pǎo
toward front/back run
‘run forward/backward’

In contrast, a scalar change motion morpheme specifies an inherent direction, so it only allows phrases expressing directions that are compatible with the direction specified in the given motion morpheme. For instance, a figure is assumed to move backward in a receding event, so tuì ‘recede’ does not allow a preposition phrase expressing a forward direction.

(21) a. *xiàng qián tuì
toward front recede
b. xiàng hòu tuì
toward back recede
‘recede backward’

The fact that scalar change Ms lexically specify a scale is demonstrated by our second test as well. Result phrases either denote a scale or introduce a bound that is related to the scale lexically specified by a given morpheme (Goldberg 1991, Levin and Rappaport Hovav 1995, Wechsler 2005, among many others). There is also a generally applied constraint that a predicate cannot contain two phrases that delimit the event (Flip 2004, Goldberg 1991, Levin and
For this reason, nonscalar change Ms that do not have any scale to begin with can appear with various types of result phrases, as in (22), whereas scalar change Ms only allow result phrases that specify or elaborate a bound on a lexically-specified scale (Rappaport Hovav 2008), as in (23).

(22) a.  

\[ \text{Tā zài pǎo} \]

\[ \text{He PROG run} \]

‘He is running.’

b.  

\[ \text{Tā pāo-lèi le} \]

\[ \text{He run-tired ASP} \]

‘He was tired as a result of running.’

c.  

\[ \text{Tā pāo-dīū-le xié} \]

\[ \text{He run-lose-ASP shoes} \]

‘He lost his shoes as a result of running.’

d.  

\[ \text{Tā pāo-dào xuéxiào le} \]

\[ \text{He run-arrive school ASP} \]

‘He ran to the school.’

(23) a.  

\[ \text{Tā shàng shān le} \]

\[ \text{She go-up mountain ASP} \]

‘She went up the mountain.’

b.  

\[ * \text{Tā shàng-lèi le} \]

\[ \text{She go.up-tired ASP} \]

# ‘(intended meaning) She was tired as a result of going up on the mountain.’

c.  

\[ * \text{Tā shàng-dīū-le xié} \]

\[ \text{She go.up-lose-ASP shoes} \]
‘(intended meaning) She lost her shoes as a result of going up on the mountain.’

d. Tā shàng-dào shāng dǐng le
she go.up-arrive summit ASP
‘She went up to the summit of the mountain.’

(22b-d) show that the non-scalar change M pāo ‘run’ can co-occur with various types of result phrases such as ‘tired’, ‘lost shoes’, and ‘arrive at school’. In contrast, as shown in (23), the scalar motion M shāng ‘climb’ only allows result phrases such as ‘arriving at the summit’ (23d) which elaborate on an ending point for the lexically-specified scale.

The primary distinction between non-scalar change Ms and scalar change Ms is whether the morpheme lexicalizes a scale along which a figure moves. Therefore, non-scalar change Ms are equivalent to Talmy’s manner-of-motion morphemes, whereas a scalar change Ms are equivalent to Talmy’s path morphemes. However, Rappaport Hovav and Levin (2010), among others, further divide scalar change Ms (or Talmy’s path morphemes) into three sub-types, which thus allow us to explain the inconsistent behaviors of motion morphemes that cross the traditional two-way classification of motion morphemes. In the following sections, we introduce the three sub-types of scalar change Ms and their diagnostics.

3.2 Open scale motion morphemes vs. closed scale motion morpheme

Scalar change Ms first can be classified into two types based on whether or not the scale lexicalized by a given scalar change M has an endpoint, i.e. whether the scale is bounded or unbounded (cf. Rappaport Hovav and Levin 2010). For example, come and return lexically specify a closed path, whereas descend and rise lexically specify an open path (Rappaport Hovav and Levin 2010).

11 Rappaport Hovav and Levin (2010) first classify scalar change verbs into two types based on whether a given scalar change verb lexicalizes a multi-point scale or two-point scale, i.e. whether the directed motion denoted in the verb is durative or punctual. However, in this paper, we first classify scalar change morphemes into two types based on the feature of boundedness. However, this difference in the order of classification does not affect the result of classification of individual morphemes.
A scalar change $M$ with a bounded scale does not allow the figure to progress beyond the bound, usually the point on a scale where the ground is located. For instance, in *He came to the school at 8am*, the school is the bound of the event of coming. Therefore, the coming event finishes when the figure arrives at the school. Although the figure can move beyond the school, such motion is no longer conceived as part of the coming event. In contrast, an ascending event denoted by ascend does not specify endpoint, so in such an event, a figure can potentially move up forever. In other words, a figure moving on an open scale does not have an endpoint to arrive at. Therefore, by looking at whether a scalar change $M$ allows a figure to move without limitation on a scale, we can distinguish an open scale $M$ from a closed scale $M$.

In Chinese, comparison can be expressed by a *gèng* ‘more’ comparative followed by degree adjectives/adverbs, e.g., *gèng yuǎn* ‘further’ (lit.) ‘more far’, *gèng gāo* ‘higher’ (lit.) ‘more high’. If a scalar change $M$ is compatible with the *gèng* comparative, then the morpheme has an open scale which allows a figure to move further in the scale; otherwise, it has a closed scale. As illustrated in (24), *shēng* ‘ascend’ and *jiàng* ‘descend’ allow the *gèng* comparative.

(24) a. *qìqiú zài 5-fēnzhōng qián jiù xiàng shàng shēng le*
   balloon in 5-minute before then toward up ascend ASP

   *xiànzài yǐnggāi shēng de gèng gāo le*
   now must ascend MOD more high ASP

   ‘The balloon began ascending five minutes ago, now it must have ascended higher.’

b. *fēijī zài 5-fēnzhōng qián jiù xiàng xià jiàng le*
   plane in 5-minute before then toward below descend ASP

   *xiànzài yǐnggāi jiàng de gèng dī le*
   now must descend MOD more low ASP

   ‘The airplane began descending downward five minutes ago, now it must have descended more.’
In contrast, huí ‘return’ and qù ‘go’ in (25) are incompatible with the comparative; once the figure has reached the endpoint, the returning/going event is finished.

(25) a. tā zài 5-fēnzhōng qián jiù huí jiā le
he at 5-minute before then return home ASP

*xiànzài yīnggāi huí de gèng yuǎn le
now must return MOD more far ASP
‘He began returning home five minutes ago, #now he must have returned farther.’ (intended meaning)

b. tā zài 5-fēnzhōng qián jiù qù xuéxiào le
he in 5-minute before then go school ASP

*xiànzài yīnggāi qù de gèng yuǎn le
now must go MOD more far ASP
‘He began going to school five minutes ago, #now he must have gone farther.’

(continued meaning)

Therefore, we can determine that shēng ‘ascend’ and jiàng ‘descend’ are open scale Ms, whereas huí ‘return’ and qù ‘go’ are closed scale Ms.

3.3 Multi-point closed scale motion morpheme vs. two-point closed scale motion morpheme

According to Beavers (2008), “two-point scales only have two values as they are associated with attributes that basically encode having or not having a particular property, and the transition from one value to the other is conceptualized as instantaneous.” For example, an event described in we reached the summit is true only when we have a particular property of ‘being at the summit’ (Rappaport Hovav 2008). Examples of two-pt closed scale Ms in English include arrive, depart, enter and exit.

Unlike two-point closed scales, multi-point closed scales are composed of a minimum and a maximum value as well as many values in between them (Rappaport Hovav and Levin 2010).
The starting point of a motion event is understood to be associated with the minimum value, the endpoint with the maximum value, and the points between the starting and the end point are understood as values that the motion event may have as the figure moves along the scale. Therefore, motion along a multi-point closed scale takes time, and thus such motion is conceived as durative (ibid.). Examples of directed motion verbs describing gradual traversals of a closed path in English include *return*, *come*, and *go* (ibid.).

This property of scale, whether a scale has multi-point or two-point, divides closed scale Ms into two types: multi-pt closed scale Ms and two-pt closed scale Ms. As illustrated in (26), the closed scale Ms *huí* ‘return’ and *qù* ‘go’ allow duration adverbials, which indicates that these verbs have multi-point scales.

(26)  a. Tā huí jiā huí-le 20 fēnzhōng, hái méi dào jiā
    she return home return-ASP 20 minute yet not arrive home
    ‘She has been going back home for 20 minutes but has not arrived at home yet.’

     b. Tā qù xuéxiào qù-le 20 fēnzhōng, hái méi dào jiā
    she go school go-ASP 20 minute yet not arrive home
    ‘She has been on the road going to school for 20 minutes but has not arrived at school yet.’

In contrast, the closed scale Ms *dào* ‘arrive’ and *jìn* ‘enter’ do not allow duration adverbials, which indicates that they have two-point scales, as shown in (27).

(27)  a. *Tā dào xuéxiào dào-le 20 fēnzhōng
    she arrive school arrive-ASP 20 minute
    # ‘She has been arriving at school for 20 minutes.’

     b. * Tā jìn fángjiān jìn-le 20 fēnzhōng

Open scale Ms also describe motion associated with multi points. For example, *we ascended the stairs* is true if the value, i.e. our location along the path associated with the stairs, increases by any value, even by a couple of stairs (Rappaport Hovav 2008). Other examples include *advance, descend, fall, recede, and rise* (Rappaport Hovav and Levin 2010).
she enter room enter-ASP 20 minute
# ‘She has been entering the room for 20 minutes.’

The second test examines whether a given closed scale M allows gradual progress on a lexically-specified path. As illustrated in (28), the closed scale M huí ‘return’ and qù ‘go’ can describe a gradual movement along a path. Therefore these verbs have multi-point scales.

(28) a. Tā huí sùshè huí-le yībàn, xiūxi-le yīhuír, yòu shànglù le
she return dorm return-ASP half rest-ASP a.while again ascend.road ASP
‘She returned halfway to the dorm, rested for a while, and then continued on her way to the dorm.’

b. Tā qù xuéxiào qù-le yībàn, xiūxi-le yīhuír, yòu shànglù le
she go school go-ASP half rest-ASP a.while again ascend.road ASP
‘She went halfway to school, rested for a while, and then continued on her way to school.’

According to Rappaport Hovav (2008), multi-pt closed scale Ms entail some change along the scale, but a single change of a given multi-pt closed scale M is not necessarily the maximal change, even if the morpheme lexicalizes such a maximal change. In contrast, as in (29), the two-pt closed scale Ms dào ‘arrive’ and jìn ‘enter’ cannot appear in such description, reflecting their denotation of instantaneous change due to their lexicalized two-point scales. For two-pt closed scale Ms, the minimal change is also the maximal change (Rappaport Hovav 2008).

(29) a. *Tā dào sùshè dào-le yībàn, xiūxi-le yīhuír, yòu shànglù le
she arrive dorm arrive-ASP half rest-ASP a.while again ascend.road ASP
# ‘(intended meaning) She arrived at the dorm halfway, rested for a while, and then continued her way to the dorm.’
b. *Tā jìn fāngjiān jìn-le yībàn, xiūxi-le yīhuìr, yòu shànglù le
she enter room enter-ASP half rest-ASP a-while again ascend.road ASP
# ‘(intended meaning) She entered the room halfway, rested for a while, and then
continued entering the room.’

The closed scale M lái ‘come’ seems to be on the borderline between multi-pt and two-pt
closed scale Ms because when eleven native speakers were presented with (30), their judgments
of its grammaticality varied: (30) was not accepted by seven speakers, accepted by three
speakers, whereas one speaker could not decide its grammaticality.

(30) ?Tā lái xuéxiào lái-le yībàn, xiūxi-le yīhuìr, yòu shànglù le
she come school come-ASP half rest-ASP a-while again ascend.road ASP
‘She came to school halfway, rested for a while, and then continued on her way on the
road.’

However, a change in the scale of lái ‘come’ does not imply the maximal change, i.e.
arrival at the endpoint of the scale. For instance, (31) is an example from Nakazawa (2006, 2008).
It indicates that a change in the motion denoted by lái ‘come’ does not entail the actual arrival at
the endpoint.

(31) tā bā diǎn lái xuéxiào, dànshì hái méi dào
he eight o’clock come-school but yet NEG arrive
‘He came to school at eight, but he has not arrived.’ (Nakazawa 2006)

Therefore, the scale lexicalized in lái ‘come’ is composed of multiple points, and a coming event
is durative. However, considering lái’s behaviors in (30) and (31), we will classify lái as a multi-
pt closed scale M in our work; meanwhile the reason why lái shows such borderline result in
grammaticality test is left for future exploration.

3.4 Summary of this section
So far, we examined whether a morpheme lexically specifies a scale ([+/- scale]); among scalar change Ms, we asked whether the scale lexicalized by a morpheme is open or closed ([+/- bounded (open/closed scale)]); then among the closed scale Ms, we examined whether a given scale entails two or multiple values [+/-punctual (two-point/multi-point scale)]. The following table summarizes the relevant scalar structures of motion morphemes that we examined.

Table 1 Three features of scales determining four types of motion morphemes

<table>
<thead>
<tr>
<th>Types of motion morphemes</th>
<th>Existence of scale</th>
<th>Boundedness</th>
<th>Punctuality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-scalar change motion morpheme</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(pāo ‘run’)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Open scale motion morphemes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(tuì ‘recede’)</td>
<td>+</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Multi-point closed scale motion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morpheme (huí ‘return’)</td>
<td>+</td>
<td>+</td>
<td>–</td>
</tr>
<tr>
<td>Two-point closed scale motion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morpheme (dào ‘arrive’)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

The three different types of combinations of these features would yield the four categories of motion morphemes: non-scalar change Ms (e.g., zōu ‘walk’, fēi ‘fly’), open scale Ms (e.g., jiàng ‘descend’, shēng ‘ascend’), multi-point closed scale Ms (e.g., huí ‘return’, qù ‘go’), and two-point closed scale Ms (e.g., dào ‘arrive’, jìn ‘enter’).

We propose a hierarchy that is formed by these four types of motion morphemes to predict the order of motion morphemes in MMMCs. The hierarchy is laid out in (32).13

This hierarchy predicts that when two motion morphemes co-occur in a MMMC, the M1 must belong to a type that is left of or equal to a type of the M2 on the hierarchy. For instance, the open scale M `tui` ‘recede’ is located to the left of the multi-pt closed scale M `hui` ‘return’ on the hierarchy in (32), so `tui` can only occur to the left of `hui` (i.e. precede `hui`), as exemplified by `tui-hui Beiing` ‘recede back to Beijing’ and *`hui-tui Beiing`. Similarly, the non-scalar change M `piao` ‘run’ is located to the left side of the two-pt closed scale M `dao` ‘arrive’ on the hierarchy, so `piao` can only precede `dao`, as exemplified by `piao-dao Beiing` ‘run to Beijing’ and *`dao-piao Beiing`.

In other words, we predict that combinations of M1M2 that are \{a, b\}, \{b, b\}, \{b, c\}, \{b, d\} and etc. should be available, but combinations such as \{c, b\} or \{b, a\} should be not available.

In the next section, we will verify this hierarchy of the order of motion morphemes via two corpus studies. In the first study, we examine all MMMCs in selected chapters of three novels, and investigate whether the morphemes in the constructions are consistent with the hierarchy in (32). In the second study, we cross-validate the hierarchy from a different perspective: from each type of motion morpheme, we choose the two most frequently used morphemes and investigate whether these morphemes and their co-occurring motion morphemes follow the order predicted by our hypothesis.
4. Corpus study 1

4.1 Data source

The data used in this study consist of selected chapters of three Modern Chinese novels. Table 2 provides information about these three novels.

Table 2. Data Sources

<table>
<thead>
<tr>
<th>Title</th>
<th>Tàiyáng Chūshì 'The Sun was Born'</th>
<th>Dìqiú de Hóng Piàodài (The Earth's Red flying Ribbon) = Hóng Piàodài</th>
<th>Tàiyáng Zhào Zài Sānggānhé-shàng (The Sun Shines over the Sanggan River) = Sānggānhé</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>Chi Li</td>
<td>Wei Wei</td>
<td>Ding Ling</td>
</tr>
<tr>
<td>Year</td>
<td>1992</td>
<td>1988</td>
<td>1952</td>
</tr>
<tr>
<td>Selection analyzed</td>
<td>entire novel</td>
<td>first 6 chapters</td>
<td>first 12 chapters</td>
</tr>
<tr>
<td>Number of characters</td>
<td>35,433</td>
<td>34,108</td>
<td>28,935</td>
</tr>
</tbody>
</table>

All three novels have great popular appeal in China. Among them, the language of Tàiyáng Chūshì is closer to that of urbanites, whereas the language of Hóng Piàodài and Sānggānhé is accessible to workers and soldiers. The novels are of different length. In order to keep the number of characters relatively balanced among the four novels, only the first six chapters were selected from Hóng Piàodài, and the first twelve chapters were selected from Sānggānhé. Given their differences in content and style, these novels represent a reasonable size and diversity for the purpose of this study.

4.2 Data selection

We compiled data for our analysis by extracting from the chapters listed above all sentences with MMMCs appearing in (1) the M1M2 pattern (-lái/qù ‘come/go’), and (2) the M1M2M3 pattern (in which M3 is not a deictic morpheme, i.e. lái/qù). Then, we excluded:

- Motion expressions in which M2 was a bound morpheme and unproductive in combination with various other morphemes appearing in the position of M1
- Motion expressions with the morphemes guò ‘cross’ and chuān ‘traverse’
- Motion expressions with the morpheme tiào ‘jump’
• Motion expressions with motion morphemes appearing as a single morpheme in the M1 pattern and the M1-lái/qù pattern

The motion expressions we examined include 201 tokens of two-morpheme MMMCs and two tokens of three-morpheme MMMCs combined for a total of 203 tokens (90 unique types in total). In what follows, we explain in detail why we chose to include or exclude the construction types listed above.

4.2.1 The inclusion of M1M2 (M3) MMMCs

The corpus data show that most motion morphemes can occur both in “M1+M2” MMMCs and in “M1+M2+lái/qù” MMMCs, as illustrated by zǒu-jìn ‘walk enter’ in (33).

(33) a. Tāmen zǒu-jìn měnkkōu yī kàn

they walk-enter entrance one see

‘They went into the entrance and took a look.’ (Hóng piàodài)

b. … Jī-ge rén … zǒu-jìn cūn lái

… several-CLF person … walk-enter village come

‘Several people walked into the village.’ (Sānggānhé)

c. kàn-jiàn Zhū Dē zǒu-le jīn-lái

see-see Zhu De walk-ASP enter-come

‘[He] saw Zhu De walk in [towards him].’ (Hóng piàodài)

Therefore, when we examined the relative order of M1 and M2 MMMCs in the corpus, we did not distinguish between “M1+M2” MMMCs and “M1+M2+lái/qù” MMMCs.

In addition, although we were primarily investigating the relative order and semantic relationships between M1 and M2 in MMMCs, we also included three-morpheme MMMCs (which are relatively infrequent) in which M3 was not a deictic morpheme (lái/qù). An example of an included three-morpheme MMMC from the corpus is given in (34).
4.2.3 Exclusion of deictic morphemes lái/qù in M2 or M3 position

We do not treat lái ‘come’ and qù ‘go’ as motion morphemes when they occur in M2 or M3 position, as in (35a-b), and their distribution in the sequences of “M1 + lái/qù” and “M1 + M2 + lái/qù” is not examined by the study; our reasons are given in the remainder of this section.

As previously discussed in sections 3.2-3.3, when lái/qù occurs as the only motion morpheme in a motion construction, it is a multi-pt closed scale M which expresses a bounded motion event. However, when lái and qù occur at the end of motion constructions, they do not express bounded motion events anymore. In other words, their original lexical specification gets lost. We will show this point in the followings.

A multi-pt closed scale M denotes a bounded motion event, a closed scale M such as huí ‘return’ cannot co-occur with PPs denoting unbounded direction such as xiàng xuéxiào ‘toward school’, as in (36a); in contrast, an open scale M or a nonscalar motion M such as zǒu ‘walk’ denotes unbounded motion event, so such a morpheme can co-occur with xiàng xuéxiào ‘toward school’, as in (36b).
b. Xiǎopo  xiàng  xuéxiào- lǐ  zǒu
Xiaopo  toward school-inside  walk

‘Xiaopo walked towards the inside of the school.’ (PKU Corpus)

Because lái/qù is multi-pt closed scale M expressing a bounded motion event when it is used as the main motion morpheme in a motion expression, we can anticipate that lái/qù does not co-occur with xiàng xuéxiào ‘toward school’, as illustrated in (37).

(37) a. *Tā  xiàng  xuéxiào  lái/qù  le
     he  toward school  come/go  ASP
     #He came/went toward the school.

However, when lái/qù follows another motion morpheme and occurs in M2 or M3 position, it no longer specifies information about boundedness: when lái/qù follows a motion morpheme denoting an unbounded event, e.g., zǒu ‘walk’, the combination zǒu-lái/qù ‘walk-come/go’ can co-occur with xiàng xuéxiào ‘toward school’ as in (38a). In contrast, when lái/qù follows a motion morpheme denoting a bounded motion event, e.g., huí ‘return’, the combination huí-lái ‘return come’ cannot be modified by xiàng xuéxiào ‘toward school’ as in (38b).

(38) a. Women  měitiān  qīngchén  xiàng  xuéxiào  zǒu-qù  shí
     we  everyday  morning  toward school  walk-go  when
     ‘when we walk toward school every morning’ (PKU Corpus)

b. *xiàng  xuéxiào  huí-lái
     toward school  return-come

The examples in (38) illustrate that when lái/qù occurs after another motion morpheme in M2 or M3 positions, it is no longer a closed scale motion morpheme. Instead, the boundedness of a motion construction consisting with a sequence of “M1(M2) + lái/qù” is determined by the boundedness of the M1(M2) preceding lái/qù: the sequence denotes a bounded event if the
preceding morpheme expresses a bounded path, and an unbounded event if the preceding morpheme specifies an unbounded path.

Therefore, we do not treat lái/qù in M2 or M3 position as a typical motion morpheme, and our hierarchy is not used to predict the distribution of such lái/qù. Accordingly, we treat motion constructions such as (35a) as one-morpheme MMMCs, and (35b) as two-morpheme MMMCs, and only examine the order of M1 and M2 in motion expressions with a “M1 + M2 + lái/qù” sequence, i.e. zōu ‘walk’ and chū ‘exit’.

4.2.4 Inclusion of productive bound morphemes in M2

We included MMMCs in which M2 is a productive bound morpheme, specifically rù ‘enter’, qǐ ‘rise’, kāi ‘apart’ (lit.) ‘open’, zōu ‘away’. Among these bound morphemes qǐ ‘rise’ and kāi ‘apart’ (lit.) ‘open’ are treated as directional complements by Chao (1968:458) and Li & Thompson (1981: 59). In contrast, rù ‘enter’ was excluded by Chao (1968) for being less active than jìn ‘enter’ in Mandarin, and zōu ‘away’ was not discussed. In our corpus studies, we will include bound morphemes in M2 position if they are relatively productive in combining with a variety of motion morphemes. As illustrated in (39), rù ‘enter’ can follow diverse M1s.

14 We included MMMCs where lái and qù occur as M1.

(i) Jīntiān tā lái-dào xuéxiào le
   Taoday she come-arrive school ASP
   ‘Today, she came to school.’

15 Among these verbs, kāi (lit.) ‘drive’ and zōu (lit.) ‘walk’ need special attention. They denote manner of motion when appearing as free morphemes in M1 position.

(i) a. Yuānchū kāi-lái yǐliàng qichè
    far.place drive-come one.CLF car
    ‘A car drives in this direction from a distant location.’

    b. Tā mìtiān zài gōngyuán zǒu yìquán
       she everyday at park walk one.CLF
       ‘She walks one lap in the park everyday.’

However, when kāi and zōu appear in M2 position as bound morphemes, they denote directed motion.
There are two major reasons to include these productive bound morphemes. First, these morphemes were independent morphemes denoting directed motions in the history of Chinese. Second, they still lexically specify directions in modern Chinese. As illustrated in (40), all the M1s, fēi ‘fly’, piāo ‘float’, and pǎo ‘run’, are non-scalar change Ms that do not specify direction of motion, so it is the bound morphemes that denote the direction of motion.

(40) a. Fēijī fēi-rù yúncéng-zhōng

plane fly-enter cloud-inside

‘The plane flew into the cloud.’

b. kuài tiān-hēi de shǐhòu, hěmiàn-shàng piāo-qǐ yānwù

soon sky-black REL time river.face-on float-rise smoke

‘When the sky was about to become dark, smoke floated and rose from the surface of the river.’ (http://bbs.uuu9.com/archiver/?tid-5056562.html)

c. Xiǎomāo pǎo-kāi le

little.cat run-open ASP

‘The kitten ran away.’

d. Xiǎoniǎo fēi-zōu le

little.bird fly-walk ASP

‘The little bird flew away.’
4.2.5 Exclusion of unproductive bound morphemes in M2

In contrast to productive bound morphemes in M2 position specifically rü ‘enter’, qǐ ‘rise’, kāi ‘apart’ (lit.) ‘open’, zōu ‘away’ (lit.) ‘walk’, motion expressions with a non-productive bound morpheme were excluded. For instance, in (41), chū-fā ‘depart’ (lit.) ‘exit set out’ includes the bound morpheme fā (‘set out’ in classical Chinese).

(41) Cǐ-cì zì Gānshēng Xīngguó chū-fā
this-time from Gan.Province Xingguo depart

‘This time, (they) departed from Xingguò in Gan Province.’ (Hóng Piàodài)

Although fā can co-occur with very limited set of morphemes to denote a directed motion in Chinese such as chū-fā (lit.) ‘exit set out’ and jǐn-fā (lit.) ‘enter set out’, it is not productive in compounding such as *fēi-fā (lit.) ‘fly set off’, *tuì-fā (lit.) ‘recede set out’, compared with other relatively more productive bound motion morphemes, e.g., -rù ‘enter’, as in jǐn-rù ‘enter enter’, fēi-rù ‘fly enter’, tuì-rù ‘recede enter’.

4.2.6 Exclusion of guò ‘cross’ and chūan ‘traverse’

According to Rappaport Hovav and Levin (2010), English cross and traverse are not typical scalar change Ms because although these morphemes are associated with paths, the points on the path are not ordered in a lexically specified direction. For instance, in John crossed that street, cross does not specify which side of the street John started crossing from. The Chinese motion morphemes guò ‘cross’ and chūan ‘traverse’ are similar to English morphemes of crossing in this way. For instance, in (42), the starting direction is not identifiable from the meaning of guò.

(42) Tā guò-le mǎlù
He cross-ASP street

‘He crossed the street.’

For current analysis, we did not include guò and chūan, but further exploration on classification of these motion morphemes will be useful in the future.
4.3 Analysis

In order to code the motion morphemes in the data, we tested each morpheme in terms of four types of motion morphemes, based on the set of diagnostics that we introduced in Section 3. Here we give additional examples showing how we tested the scalar structure of productive bound morphemes and of some motion morphemes that resulted in different scalar classifications from those associated with the equivalent English verbs.

4.3.1 Testing the scale structures of productive bound morphemes

The scales associated with bound motion morphemes can also be identified via the tests introduced in Section 3. Because bound motion morphemes cannot occur as the only morphemes in a motion construction, we chose a non-scalar change M as M1 (e.g., pǎo ‘run’, fēi ‘fly’) so that the M1 did not interfere with the interpretation of scalar structures of M2. For instance, by testing whether the combinations of M1M2 are compatible with the comparative adverb gèng, we found that that qǐ ‘up’ (lit.) ‘rise’, kāi ‘away’ (lit.) ‘open’, and zǒu ‘away’ (lit.) ‘walk’ lexicalize open scales, whereas rù (lit.) ‘enter’ is associated with a closed scale, as in (43):

(43) a. Qīngnián zhēnggè rén fēi-qǐ de gèng gāo, yòu hěn kuài luò-xià
   young.man whole person fly-rise MOD more high again very fast fall-descend
   ‘The whole body of the young man flew up higher, and then fell down very quickly.’
   (http://tieba.baidu.com/f?kz=254566429)

   b. Wǒ xiǎngyào yí-ge rén zǒu-kāi de gèng yuǎn yìxiē
   I want one-CLF person walk-away MOD more far some
   ‘I wanted to walk away further.’ (http://www.topit.me/user/topic/12490)

   c. Duìfāng bǐ zìjǐ táo-zǒu de gèng yuǎn
   the.opposite.party than self escape-away MOD more far
   ‘The opposite party escaped away further than us.’
   (http://www.qdwenxue.com/BookReader/1019535,24614485.aspx)
d. *Wōmen zōu-rù fāngjiān zōu-rù de gēng yuǎn

we walk-enter room run-enter MOD more far

#‘We walked into the room farther.’

Then, we need to test whether rù (lit.) ‘enter’ is a multi-pt or two-pt closed scale M. As illustrated in (44a), zōu-rù ‘walk enter’ does not allow gradual progress in its motion, cf. (44b) where the multi-pt closed scale M huí ‘return’ does; therefore, rù (lit.) ‘enter’ specifies a two-pt closed scale.

(44) a. *Tā zōu-rù fāngjiān zōu-rù-le yībàn, xiūxi-le yīhuìr,
she walk-enter room walk-enter-ASP half rest-ASP a.while

yòu shànglù le
again ascend.road ASP

#‘She walked into the room halfway, rested for a while, and then continued on her way to the room.’

b. Tā huí sùshè huí-le yībàn, xiūxi-le yīhuìr, yòu shànglù le = (28)
she return dorm return-ASP half rest-ASP a.while again ascend.road ASP

‘She returned halfway to the dorm, rested for a while, and then continued on her way to the dorm.’

Therefore, with the diagnostics proposed in Section 3, all bound motion morphemes found in the data can be tested in minimal pairs.

4.3.2 Táo ‘escape’ – Non-scalar change motion morpheme

According to Levin (1993), escape is a verb of directed motion in English. As illustrated in (45), escape only takes result phrases that further elaborate a bound of the lexically specified scale.

(45) a. *He escaped his shoes lost.

b. *He escaped tired.
c. He escaped to Shànghài.

However, the morpheme táo ‘escape’ in Chinese seems to indicate manner of motion. As shown in (46), táo ‘escape’ can be modified by a variety of result phrases.

(46) a. …xiǎoqīr,…, jīng táo-diā-le yī.zhī pò bùxié

Little.beggar…unexpectedly escape-lose-ASP one.CLF worn cloth.shoe

‘The little beggar unexpectedly lost one of his worn cloth shoes when he escaped.’


b. dàdǎn xiǎożéi táo-lèi-le, jīng zài cǎocōng -li shuǐzháo le

bold little.thief escape-tired-PERF unexpectedly at brushwood-in sleep ASP

‘The bold little thief fell asleep in the brushwood after he became tired in escaping.’


c. tóngnián 2 yuè dǐ , Wáng. Hǎi bīn děngrén táo-dào Shànghài

same.year 2 month end Wang.Haibin et.al. escape-arrive Shanghai

‘In the same year, Wang Haibin and others escaped to Shanghai at the end of February.’

(PKU Corpus)

The contrast between (45) and (46) shows that the Chinese morpheme táo ‘escape’ is a non-scalar change M.

4.4 Coding

Each M1 and M2 in the data was coded for three scalar features, [+/- scale], [+/- bounded], and [+/- punctual]. The hierarchy in (32), rephrased here in (47), can be reformed into three sub-hypotheses, as in (48).

(47)

<table>
<thead>
<tr>
<th>Nonscalar change M (a):</th>
<th>Open scale M (b):</th>
<th>Multi-point closed scale M (c):</th>
<th>Two-point closed scale M (d):</th>
</tr>
</thead>
<tbody>
<tr>
<td>pǎo ‘run’</td>
<td>tuǐ ‘recede’</td>
<td>huǐ ‘return’</td>
<td>dào ‘arrive’</td>
</tr>
</tbody>
</table>
(48) In an MMMC,

a. If M2 is [-scale], M1 can only be [-scale]; if M2 is [+scale], M1 can be [+scale] or [-scale];

b. If M2 is [-bounded], then M1 must be [-bounded]; if M2 is [+bounded], then M1 can be [+bounded] or [-bounded];

c. If M2 is [-punctual], M1 must be [-punctual]; if M2 is [+punctual], M1 can be [+punctual] or [-punctual];

In terms of scalar feature, we can imagine the following four combinations for M1 and M2: [-scale, -scale], [-scale, +scale], [+scale, -scale], and [+scale, +scale]. However, if the scalar hierarchy is correct, then the combination [+scale, -scale] would not appear in natural Chinese data. Similarly, the combinations [+bounded, -bounded] or [+punctual, -punctual] are predicted not to occur in Chinese.

4.4 Results

We tested our data against hypothesis (48) and analyzed whether those combinations of scalar features of M1M2 excluded by the hypothesis existed in the data. Existence of such combinations would challenge our hypothesis.

Table 3 shows the frequency counts of all four combinations of scalar features of M1M2 analyzed in the data. The shaded combinations are the ones that were not predicted by our hypothesis.

<table>
<thead>
<tr>
<th>Table 3 M1M2 combinations in selected chapters of three novels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existence of Scale</strong></td>
</tr>
<tr>
<td>[M1, M2]</td>
</tr>
<tr>
<td>[-scale, -scale]: 0</td>
</tr>
<tr>
<td>[-scale, +scale]: 139</td>
</tr>
<tr>
<td>[+scale, -scale]: 0</td>
</tr>
<tr>
<td>[+scale, +scale]: 62</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
As shown in Table 3, among the 201 instances of “M1M2” MMMCs, there are no instances of scalar-feature combinations that were unexpected by the hypothesis.

In addition, as shown in Table 3, certain combinations are shown with higher frequencies than the others with respect to each scalar feature. For instance, in terms of scale, [-scale, +scale] is the most frequent combination, whereas we found no instances of a [-scale, -scale] combination. This result indicates that M2 tends to be a scalar change M in MMMCs. In the corpus data we observed that scalar change Ms such as ouch ‘exit’, jin ‘enter’, shang ‘ascend’, xia ‘descend’, and dao ‘arrive’ are the most frequently used M2s. Scalar change Ms such as hu ‘return’, jin ‘enter’, and sheng ‘ascend’ also occurred in M1 position, but M1 is filled more frequently by non-scalar change Ms such as zou ‘walk’, pao ‘run’, and chuang ‘rush’.

In terms of boundedness, we found that the majority of M2s (82.1%, 165 out of 201 instances) lexicalized bounded scales, but the majority of M1s (83.1%, 167 out of 201 instances) lexicalized unbounded scales. In terms of punctuality, the majority of M1s (94%, 189 out of 201 tokens) are non-punctual (i.e. durative) morphemes, which include both non-scalar change morphemes (e.g., zou ‘walk’, pao ‘run’) and multi-point scalar change morphemes (e.g., hu ‘return’, sheng ‘ascend’). In contrast, the majority of M2s (72.1%, 145 out of 201 tokens) denoted punctual motion.

Figures 1-3 demonstrate the frequencies of M1 and M2 in Chinese MMMCs in terms of each feature of scale: M1 tends to be [-scale], [+duration], and [-bounded], whereas M2 tends to be [+scale], [-duration], and [+bounded]. This result confirms our predictions from the scalar (semantic) hierarchy in (52-53).

**Figure 1.** The frequencies of M1 and M2 in Chinese MMMCs in terms of [+/scale]
5. Corpus study 2

We conducted a second corpus study to cross-validate our hypothesis from a different perspective. We focused on the highest frequency motion morphemes and examined all possible relative morpheme orderings of these morphemes with respect to other co-occurring morphemes in MMMCs.

5.1 Data source and selection

As discussed in Section 3, Chinese motion morphemes can be classified into four types of scalar structures: non-scalar change Ms, open scale Ms, multi-pt closed scale Ms, and two-pt closed scale Ms. For this study, we chose the two morphemes of each type that occurred with the highest frequency in the first corpus study. We then searched for these morphemes in the PKU Corpus. Within the PKU Corpus, we narrowed down the genre to the novel category for two
reasons: first, novels reflect spoken language more directly than other types of written documents such as news report or academic writings; second, using the same type of data, i.e. novels, in Corpus Study 2 will enable us to cross-validate the result of Corpus Study 1 in a more consistent way. Table 4 shows the most frequently occurring morphemes of each scalar type in the first corpus study.

Table 4 Most frequently occurring motion morphemes of each scalar type

<table>
<thead>
<tr>
<th>Morpheme type</th>
<th>non-scalar change Ms</th>
<th>open scale Ms</th>
<th>multi-pt closed scale Ms</th>
<th>two-pt closed scale Ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphemes selected</td>
<td>pǎo ‘run’</td>
<td>shàng ‘ascend’</td>
<td>huí ‘return’</td>
<td>dào ‘arrive’</td>
</tr>
<tr>
<td></td>
<td>zǒu ‘walk’</td>
<td>xià ‘descend’</td>
<td>lái ‘come’</td>
<td>chū ‘exit’</td>
</tr>
</tbody>
</table>

In order to make manual counting feasible, we only took the first 500 instances of MMMCs that were returned from the search of each morpheme. Among those 500 instances, we then selected MMMCs that fit the “M1M2” and “M1M2- lái/qù” patterns. Besides these two patterns, we also included a few MMMCs in the form of “M1M2M3”, where M3 is not a deictic morpheme (lái /qù). This selection resulted in 569 tokens of two-morpheme MMMCs and 4 tokens of three-morpheme MMMCs, which form the data for our second corpus analysis. Among total 573 tokens of MMMCs, there were 129 types of MMMCs in total.

5.2 Coding

We coded each morpheme in the data for its scalar features following the same coding principles we introduced in the first corpus study. We then looked at the distribution of morphemes in M1M2 (M3) and examined whether the relative ordering of the searched-for morphemes and the other co-occurring motion morpheme(s) violated the scalar hierarchy in (32).

For instance, with the multi-pt closed scale M huí ‘return’, we postulated according to the scalar hierarchy that two-pt closed scale Ms would not precede the multi-pt closed scale M huí. In contrast, it should only be preceded by non-scalar change Ms or open scale Ms. If we found

16 In the category of non-scalar change Ms in Table 4, zǒu only refers to the free morpheme verb denoting ‘walk’, but not the bound morpheme denoting ‘away’.
any unexpected ordering of the morpheme huí with respect to other motion morphemes, then the scalar hierarchy would be challenged.

5.3 Results

Figures 4-7 display the distribution of each key morpheme and the motion morphemes preceding and following the key morphemes. Take Figure 4 for example. Figure 4 demonstrates the distribution of the two most frequent non-scalar change Ms pǎo ‘run’ and zǒu ‘walk’ in Figure 4a and Figure 4b, respectively. In Figure 4a, the middle column represents the frequency of the key morpheme pǎo ‘run’. In total, there are 201 instances of pǎo ‘run’ found in MMMCs. The column on its left represents the different types of motion morphemes that occur after pǎo: 58 instances of non-scalar change Ms. The column on the left of pǎo represents the types of motion morphemes that precede pǎo: 14 instances of open scale, 18 instances of multi-pt closed, and 111 instances of two-pt closed scale motion morphemes.

For instance, as illustrated in (49a), the non-scalar change M bēn ‘rush’ precedes pǎo, and thus bēn was counted as one instance of a non-scalar change M preceding pǎo, whereas the two-pt closed scale M dào ‘arrive’ follows pǎo in (49b), so its frequency was counted as one instance of a “two-scale” morpheme.

(49) a. Nà-ge nǚ tónɡxué zài cāochǎnɡ -shànɡ … bēn-pǎo
that.CLF female student at play.ground-on …. rush-run
‘That girl student was rushing on the playground.’

[(ben: left, pǎo: middle column, PKU Corpus)]

b. Pǎo-dào Qiān fó sì hòu -biān
run-arrive thousand.Buddha temple behind-side
‘[They] ran to the rear of the Thousand Buddha Temple.’

[pǎo: middle, dào: right column, PKU Corpus]

Similarly, Figure 4b shows the frequency of the non-scalar change M zǒu ‘walk’ and the frequencies of motion verbs appearing to the left or right to zǒu in the data MVMCs. The height of each column in the chart indicates the total number of instances preceding or following the
key morpheme, and numeric numbers to the right of each bar indicate the number of frequencies of each type of motion morphemes.

The non-scalar change Ms pǎo and zǒu show similar distributions in terms of the types of motion morphemes that can co-occur to their left and right sides. Critically, we found that morphemes preceding pǎo and zǒu are all non-scalar change Ms. In addition, all types of scalar change Ms can follow pǎo and zǒu: two-pt closed scale Ms, as dào ‘arrive’ in pǎo-dào ‘run-arrive’, multi-pt closed scale Ms, as huí ‘return’ in pǎo-huí ‘run-return’, or open scale Ms, as shàng ‘ascend’ in pǎo-shàng ‘run-ascend’; in contrast, non-scalar change Ms cannot follow pǎo/zǒu, e.g., *pǎo-táo ‘run escape’. The relative ordering of pǎo/zǒu with respect to their co-occurring motion morphemes in MMMCs is consistent with the scalar hierarchy.

The most frequent open scale Ms, shàng ‘ascend’ and xià ‘descend’ also have similar distribution in terms of order in MMMCs. See Figure 5.
As shown in the figure, *shàng* and *xià* tend to occur in M2 position. We found only one token of a morpheme following *shàng* or *xià* to the right, shown in (50).

(50) Yī-xià yī-xià shàng-zhǎng zhídào yì chuī lái yǐyàng

One-time one-time ascend-rise until overflow exit come alike

‘It rose up again and again until it was as if it was going to flow out.’

In this sentence, the morpheme following *shàng* is *zhǎng* ‘rise’, which is an open scale M just like *shàng*. The scalar hierarchy also postulates that morphemes of the same scale may co-occur in MMMCs. Therefore, the relative ordering of *shàng* and *zhǎng* does not violate the hierarchy.

In addition, only two types of morphemes occurred to the left of *shàng/xià*: non-scalar change Ms (e.g., pá ‘climb’ in pá-shàng ‘climb ascend’, chōng ‘rush’ in chōng-xià ‘rush descend’) and open scale Ms (e.g., luò ‘fall’ in luò-xià ‘fall descend’). We found no two-pt or multi-pt closed scale Ms preceding the open scale Ms *shàng/xià*, confirming the scalar hierarchy in (32).

Next we present the distribution of multi-pt closed scale Ms *huí* ‘return’ and *lái* ‘come’ in MMMCs. As illustrated in Figure 6, there were no two-pt closed sacle Ms occurring to the left of *huí/lái*, e.g., *jìn-huí* ‘enter-return’, and there were no non-scalar change Ms or open scale Ms...
occurring to the right of *huí/lái*, eg., *huí-shàng* ‘return-ascend’. These results also confirmed the scalar hierarchy.

Finally, the distributions of the two-pt closed scale Ms *dào* ‘arrive’ and *chū* ‘exit’ supported the hierarchy as well, as in Figure 7.

The two-pt closed scale Ms *dào* and *chū* tend to be M2 in MMMCs. We did not find any non-scalar change Ms or multi-pt closed scale Ms occurring to the right of *dào* or *chū*, eg., *dào-pǎo* ‘arrive-run’, *dào-huí* ‘arrive-return’. In Figure 7a, the two instances of morphemes appearing to
the right of dào ‘arrive’ included dá ‘reach’, a bound morpheme lexicalizing the same scalar features as dào ‘arrive’, i.e. a closed two-point scale, as illustrated in (51-52).

\[(51) \quad Tā \; dào-dá \; hòu, \; jiù \; suǒqū \; jù běn \; lái \; kàn\]

She arrive-reach after, then ask play PURPOSE read

‘She asked for a play to read after she arrived.’

\[(52) \quad Jùzǔ \; yǐ \; dào-dá, \; bìng \; yǐ \; kāi \; pāi\]

Film.crew already arrive-reach and already start film

‘The film crew had already arrived, and they had started filming.’

In addition, all types of scalar change Ms except two-pt closed scale Ms can precede the two-pt closed scale Ms dào/chū as shown in Figure 7: non-scalar change Ms, open scale Ms and multi-pt closed scale Ms were found to the left of two-pt closed scale Ms.

In summary, Figures 4-7 suggest that morphemes with the same features of scale usually behave similarly. For instance, as shown in Figure 4, the non-scalar Ms tend to occur in M1 position and may be followed by three other types of scalar change Ms, and as shown in Figure 7, the two-pt closed scale Ms usually occur in M2 position, and are unlikely to be followed by the three other types of motion morphemes. We did not find any MMMCs that served as counterexamples to our hypothesis. The results cross-validate the scalar hierarchy hypothesis and also the results of the first corpus study.

### 6 Discussion

The results from the two corpus studies presented in Sections 4 and 5 indicate that the constituent order of morphemes in MMMCs follows the scalar hierarchy in (32). That is, a scalar change M may not precede a non-scalar change M; a morpheme denoting instantaneous motion may not precede a morpheme denoting durative motion, and a morpheme lexically specifying a bounded scale may not precede a morpheme specifying an unbounded scale.

Additionally, we made a number of observations based on analysis of the results. First, two morphemes with the same scalar features may co-occur in a motion expression. For instance,
as illustrated in (32), \textit{luò} ‘fall’ is an open scale M like \textit{xià} ‘descend.’ Both of them specify motion in the direction of gravity and they do not lexically specify an endpoint for the motion.

(53) \textit{yèzi yǐ jīng fēnfēn luò-xià} (PKU Corpus)

leaf already one.after.another fall-descend

‘The leaves have fallen down one after another.’

The co-occurrence of two morphemes with the same scalar features is consistent with our prediction. As shown in (54, repeated from 32), the order of M1 and M2 should reflect their left-to-right order on the scalar hierarchy. This prediction also included the repetition of the same type of morphemes such as \{b, b\} or \{c, c\}.

Second, we observed from the data in the two corpus studies that MMMCs consisting of “path + path” are not rare in Chinese. In the data for the first corpus study, 74 out of 203 MMMCs (36.5\%) consisted of two scalar change Ms denoting direction. In the data for the second corpus study alone, 29 (35.7\%) of 81 instances of MMMCs that involve the scalar change M \textit{dào} ‘arrive’ consisted of a scalar change M denoting direction and the two-pt closed scale M \textit{dào}, and 10 (26.3\%) of the 38 instances of MMMCs that involve \textit{xià} ‘descend’ consisted of \textit{xià} and other scalar change M denoting direction. If we relied on the traditional understanding that manner morphemes must precede path morphemes in an MMMC, then all these instances would have had to be considered as exceptions to the rule.

Third, we observed that the hierarchy can be applied to the relative ordering of three morphemes appearing in MMMCs in which M3 is not a deictic morpheme \textit{lái/qù}. We found six tokens of three-morpheme MMMCs in the two corpus studies, e.g., (55).
M1 duó is a non-scalar change M, M2 huí is a multi-pt closed scale M, and M3 dào is a two-pt closed scale M, which is thus consistent with the hierarchy. Besides this example, we also found five more tokens of three-morpheme MMMCs when we searched for MMMCs using huí ‘return’ in the second corpus study. All these examples also confirmed our scalar hierarchy.\(^\text{17}\)

In the traditional treatment of MMMCs as a subtype of RVCs, huí ‘return’ and dào ‘arrive’ in (55) are understood as a bi-syllabic result complement. The scalar theory, however, enables us to analyze this example as having three motion morphemes that confirm the scalar hierarchy, because the combination of the three motion morphemes in (55) shows the features [non-scalar change, open scale, two-point closed scale].

Fourth, the scalar hierarchy can be also used to explain the constituent ordering of morphemes in a RVC. Three RVC examples are given in (56):

\[\begin{align*}
86 &\quad Gōngrén \quad bǎ \quad lùmiàn \quad pū-kuān-le \quad săn \quad mí \\
\quad &\text{worker} \quad BA \quad \text{road.surface} \quad \text{pave-wide-ASP} \quad \text{three meter} \\
\quad &\text{‘The worker paved the road three meters wider.’} \\
\quad &\text{[pū ‘pave’: non-scalar change, kuān ‘wide’: open scale]} \\
87 &\quad \text{Dàfēng} \quad chuī-gān-le \quad yīfū \\
\quad &\text{big.wind} \quad \text{blow-dry-ASP} \quad \text{clothes} \\
\quad &\text{‘The strong wind blew the clothes dry.’} \\
\quad &\text{[chuī ‘blow’: non-scalar change, gān ‘dry’: multi-point closed scale]} \\
88 &\quad Zhè-ge \quad xiǎo hái \quad dā-sī-le \quad yī-zhī \quad wénzì
\end{align*}\]

\(^{17}\) The six MMMCs with three non-deictic motion verbs are: huá-luò-dào di-shàng ‘slide onto the floor’, pēn-shè chuī-lái ‘spurt out’, zuò-huí-dào shāfū-shàng ‘sit back onto the sofa’, duó-huí-dào bàngōngtái-páng ‘stroll back to the office desk’, luò-huí-dào gāobèiyī-lǐ ‘fall back into the high-back chair’, huá-luò-dào shuǐnǐ-dì-shàng ‘slide onto the concrete floor’.
This-CLF little.child hit-die-PERF one-CLF mosquito

‘The child hit a mosquito to death.’

[dǎ ‘hit’: non-scalar change, sǐ ‘die’: two-point closed scale]

In terms of scalar structure, pū ‘pave’, chuī ‘blow’, and dǎ ‘hit’ in (56) are non-scalar change morphemes in the domain of change of state, like zǒu ‘walk’ and pǎo ‘run’ in the domain of directed motion. In contrast, kuān ‘wide’, gān ‘dry’, and sǐ ‘dead’ are scalar change morphemes in that the degree of the result expressed by them can be measured in terms of scales: in the multi-pt open scale of width (kuān), in the multi-pt closed scale of dryness (gān), and in the two-pt scale of alive and dead (sǐ) (cf. Kennedy and McNally 2005, Kennedy and Levin 2008, Rappaport Hovav 2008, among many others). Width is an open scale because an entity can potentially be infinitely widened; dryness is a closed scale because an entity cannot be drier if there is no humidity left; death is a two-pt scale because an entity can only be either alive or dead. In this sense, in terms of boundeness, kuān is unbounded, similar to the motion morpheme shàng ‘ascend’, dry is bounded, similar to the motion morpheme huí ‘return’, and sǐ ‘dead’ is bounded, similar to the motion morpheme jìn ‘enter’. Compared to the traditional two-dimensional approach that assumes only a “manner (cause)-result” relationship, the scalar theory interprets the constituent order of a wider range of data.

Finally, we observed that the morpheme dào ‘arrive’ seems idiosyncratic compared with other two-pt closed scale Ms. Hypothetically, based on the scalar hierarchy, two-pt closed scale Ms such as jìn ‘enter’, chū ‘exit’, and dào ‘arrive’ are expected to follow other open scale Ms, e.g., shàng ‘ascend’ or multi-pt closed scale Ms, e.g., huí ‘return’. However, only dào ‘arrive’ is found to do so, cf. (57a) and (57b-c).

(57)  a. Shàng/huí-dào èrlóu de fángjiān
    ascend/return-arrive second.floor MOD room
    ‘go up/return to the room on the second floor’

    b. *Shàng/huí-jìn èrlóu de fángjiān
    ascend/return-enter second.floor MOD room
    # ‘(intended meaning) go up/come/return and enter the room on the second floor’
c. *Shàng/huí-chū èrlóu de fángjiān

ascend/return-exit second.floor MOD room

#‘(intended meaning) go up/come/return and exit the room on the second floor’

In addition, neither jìn ‘enter’ nor chū ‘exit’ can follow dào ‘arrive’ (58a), although dào can follow jìn (58b).

(58) a. *Dào-jìn/chū fángjiān-lǐ

arrive-enter/exit room-inside

b. Jìn-dào fángjiān-lǐ

enter-arrive room-inside

‘enter into the room’

It is logical to ask why dào behaves differently than other two-pt closed scale Ms. We suggest that among two-pt closed scale Ms, dào’s morphological status is different from that of jìn/chū. Compare (59) and (60).

(59) a. Xiǎotōu pǎo-dào ménkǒu

little.thief run-arrive entrance

‘The thief ran to the entrance.’

=/> b. * Xiǎotōu pǎo dào-lái le

Little.thief run arrive-come ASP

# ‘(intended meaning) the thief ran in [towards the speaker who was inside the entrance].’

Dào in M2 position should be always followed by a ground NP (an object of dào), but jìn/chū in M2 position can be either followed by a ground NP or by a deictic morpheme lái/qù.
(60) a. Xiăotōu păo-jīn mĕnkōu
   little.thief run-enter entrance
   ‘The thief ran into the entrance.’

   ➔ b. Xiăotōu păo jīn-lăi le
   little.thief run enter-come PERF
   ‘The thief ran in [towards the speaker who is inside the entrance].’

In this sense, dăo is similar to a preposition, which should be followed by an object denoting a location. At the same time, dăo is different from a pure preposition in that it shows closer constituency with M1 in MMMCs, than with the location object. See (61).

(61) a. Xiăotōu păo-le dăo mĕnkōu.
    Thief run-ASP arrive entrance

   b. Xiăotōu păo-dăo-le mĕnkōu.
    Thief run-arrive-ASP entrance
    ‘The thief ran to the entrance.’

The perfective aspect marker le is a verbal suffix in Chinese. As in (61b), le should immediately follow dăo rather than păo. It shows that dăo is a part of a verbal construction.

In conclusion, dăo’s morphological status seems to be different from other two-pt closed scale Ms. We will not analyze the morphological status of dăo further here. However, further study is necessary to explore the relationship between, dăo’s morphological status and its high productivity in combining with morphemes of various scale structures.

7. Conclusion
In this study, we have shown that the traditional two-way classification of motion morphemes into manner-of-motion morphemes and path morphemes, and simply treating MMC as a
(sub)type of RVCs cannot cover the entire range of existing natural data of MMMCs in Modern Chinese.

As an alternative, we have proposed a four-way classification of Chinese motion morphemes based on the scale structure that the morphemes specify. Specifically, based on the three scalar features, i.e. existence of a scale, boundedness, and punctuality, Chinese motion morphemes can be classified into non-scalar change motion morphemes, open scale motion morphemes, multi-point closed scale motion morphemes, and two-point closed scale motion morphemes. In addition, we have introduced a set of independent diagnostics to test the features of the scales lexicalized in each morpheme, and thus determine which category the morpheme falls into.

We also have proposed a hierarchy of motion morphemes based on their scale structure to predict morphemes’ relative orderings in MMMCs. According to this hierarchy, the left-to-right word order of the morphemes in an MMC must follow the left-to-right order in the hierarchy, which thus shows why certain orders of motion morphemes are not allowed in Chinese MMMCs, whereas others are acceptable.

Two corpus studies were carried out to verify the predictability of the scalar hierarchy. The results of the corpus studies suggested that the scalar hierarchy of motion morphemes can be applied to a comprehensive range of existing motion expressions in natural Modern Chinese data, and not only to MMMCs consisting of two motion morphemes but also to MMMCs with three morphemes. More significantly, as shown in Section 6, the semantic relationships between the elements in a Chinese RVC can be analyzed from the perspective of scale structure as well, which indicates that we can yield more consistent results by examining the scale structure of morphemes.

We anticipate that our scalar hierarchy of motion morphemes could be applicable to serial-verb motion constructions in other languages as well. Therefore, this paper calls for related studies in other serial-verb languages, including Thai (cf. Thepkanjana 1986, Muansuwan 2001, Zlatev and Yangklang 2004, among others), Ewe and Akan (cf. Ameka and Essegbey 2001, among others).
References
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