Verbs or Nouns? The Headedness and Malleability of Mandarin Disyllabic Compounds

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Table of Contents

Abstract

This thesis explores the noun-verb categories of disyllabic compounds in Mandarin under the theoretical frameworks of Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999) and Exo-skeletal Model (Borer 2005a, 2005b, 2013, 2014). This study focuses on two main research questions. First, are there default categories or specific headedness rules for Mandarin compounds? Second, are there different degrees of malleability among different types of compounds? To investigate these questions, I conducted an experiment with newly-composed Mandarin compounds in NN, NV, VN, and VV patterns. Test 1 was a classifier matching test, where participants were asked to choose either the nominal classifier or the verbal classifier to match the neologism. This corresponds the first research question by examining only the bare forms on these neologisms. Test 2 was an acceptability test, asking participants to rate the degree of acceptability for neologisms under nominal and verbal functional structures, which corresponds to the second research question concerning malleability. Based on the results, which revealed different preferences and probabilities in Test 1, I proposed a language perception model with probabilities. In this model, syntax generates all possible competing structures and probabilities were assigned before they are sent to Logical Form (LF) for further meaning processing. I also propose that probabilities for Mandarin compounds are assigned based on a new Headedness Model with weighted constraints. The head of a compound is determined by probabilistic reasoning under various morphological constraints. The nominal preference of VN compounds with unaccusative monovalent verbs is also explained by the lack of VoiceP. In Test 2, VN compounds demonstrated greater malleability than VV and NN compounds due to their richer potential in syntactic structure generation. The non-preference for NV compounds is attributed to their non-productivity in Mandarin.

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Abbreviations

N	noun
V	verb
CL	classifiers
IPFV	imperfective
MM	modifier marker
NEG	negation
PFV	perfective

Chapter 1 Introduction

1.1 Research Questions on Mandarin Disyllable Categories

In Mandarin Chinese, a language with relatively poor morphological strategies, certain disyllabic words can function either as nouns or as verbs without any morphological differences, such as 跑步 *pǎobù* "run-step" "to run; running" and 调查 *diàochá* "investigate-examine" "to investigate; investigation". Disyllables are typically more flexible in so-called category-shifting than monosyllables, which is analyzed as the syllabic restriction on Mandarin nominalization (Lu 1981, Fu 1994, Deng 2021, Cheng and Cheng 2022, a.o.). For example, it is hard to nominalize monosyllabic verb 跑 *pǎo* "run", but easier to nominalize the disyllabic verb 跑步 *pǎobù* "run-step".

According to the theoretical framework of Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999) and the Exo-skeletal Model (Borer 2005a, 2005b, 2013, 2014), roots are acategorical and featureless. However, much of the discussion on Mandarin disyllables (Lu 1981, Fu 1994) treats them as underlyingly verbs, or at least as items that are first verbalized and then nominalized. For example, 跑步 *pǎobù* "run-step" is initially interpreted as the verb "to run" and then as the noun "running", nominalized from the verb. Given the lack of morphological cues to indicate verbalization or nominalization in Mandarin, the first series of research questions emerges: how do native speakers assign lexical categories to disyllables? Is there a default lexical category, such as verbs over nouns, or category assignment rule, such as the Right-Hand Head Rule (RHHR) in English (Williams 1981), for Mandarin disyllables?

Here I focus specifically on whether different types of compounding can influence native speakers' categorical judgments. For example, the disyllabic compound 跑步 *pǎobù* "to run; running" contains a nominal vocabulary item 步 *bù* "step" and a verbal vocabulary item 跑 *pǎo* "to run"[1]. Aside from the VN compounding like 跑步 *pǎobù* "to run; running", there are also disyllabic compounds formation strategies like NN compounding, NV compounding, and VV compounding in Mandarin. In these four types of compounding, I wonder if the nominal component or the verbal component makes the more decisive influence, or if there is a rule in Mandarin like RHHR in English.

After investigating the default and headedness for disyllabic compounds in Mandarin, our second main research problem concerns the malleability of these disyllables. The malleability stands for the flexibility on lexical category assignment. It seems that there is a type-shifting for words like 跑步 *pǎobù* "to run; running", which can be either used as a noun or a verb. However, under the

[1] "Nominal vocabulary items" and "verbal vocabulary items" refer to those vocabulary items that are most frequently used as nouns or verbs in Mandarin.

Exo-skeletal Model, there is indeed no type-shifting, and the category of the compound is defined by different functional structures (Borer 2005a, 2005b, 2013, 2014). In other words, there are no nominal or verbal categories specifically for 跑步 *pǎobù*, just the nominal functional structure assigns the nominal value, and the verbal functional structure assigns the verbal value to 跑步 *pǎobù.* However, there are words that are more flexible in categorical value assignment, such as 跑步 *pǎobù* "to run; running", and some are less flexible, such as 桌椅 *zhuōyǐ* "table and chair", which seems to be restricted to the nominal reading. Thus, the malleability of 跑步 *pǎobù* "to run; running" is better than 桌椅 *zhuōyǐ* "table and chair", with the compatibility with more possible functional structures. Besides the influence of encyclopedic knowledge, I aim to investigate whether compounding structures can systemetically impact the malleability of their products. I therefore examine four types of compounds, namely, NN compounds, NV compounds, VN compounds, and VV compounds.

1.2 Methods

With these theoretical questions in mind and to explore the above-mentioned morphological processes, an experiment was designed to explore the default/headedness and malleability of disyllabic compounds in Mandarin. To better investigate the structure itself, I employ neologisms that do not exist in the language. All the items are newly composed vocabulary items in Mandarin based on monosyllables known to participants, i.e., these disyllables are made for the experiment and are not included in the current Mandarin vocabulary. Focusing on the noun-verb distinction, this study includes four patterns of disyllables: the NN pattern, the NV pattern, the VN pattern and the VV pattern. Each capitalized character stands for a monosyllabic component that is unambiguously used as a noun or a verb in the corpus. This experiment consists of two tests, with Test 1 focusing on bare forms and Test 2 for compounds within functional structures. Test 1 is a classifier matching test, and participants are asked to choose the best match for the neologism from a pair consisting of a nominal and a verbal classifier. Test 2 is a phrasal accepatability test. In this test, participants are informed to assume that these neologisms already appeared in Mandarin, and they are asked to which extent they can accept the nominal or verbal phrase with the neologisms.

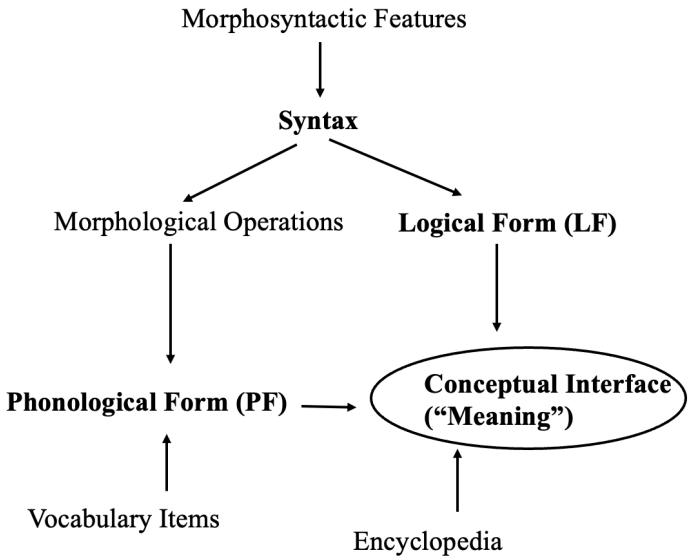
1.3 Theoretical Frameworks

1.3.1 Distributed Morphology

This study is conducted under the framework of Distributed Morphology (DM). The theory derives its term from the proposal that "morphology is distributed among several different components" (Halle and Marantz 1993: 112). DM is characterized by three core features, i.e., *Late Insertion*, *Underspecification* and *Syntactic Hierarchical Structure All the Way Down* (Halle and Marantz 1993, Harley and Noyer 1999). *Late Insertion* pertains to the correlation between *Phonological*

Form (PF) and syntactic operations, indicating that PF is always spelled out after Syntax. In other words, Vocabulary items are inserted post-syntactically. *Underspecification* assumes that PF does not need to specify all morphosyntactic features at Syntax. Moreover, syntactic operations can enter the morphological structure and act directly on morphemes, which is referred to as *Syntactic Hierarchical Structure All the Way Down.* Figure 1 is the Y-model proposed in DM.

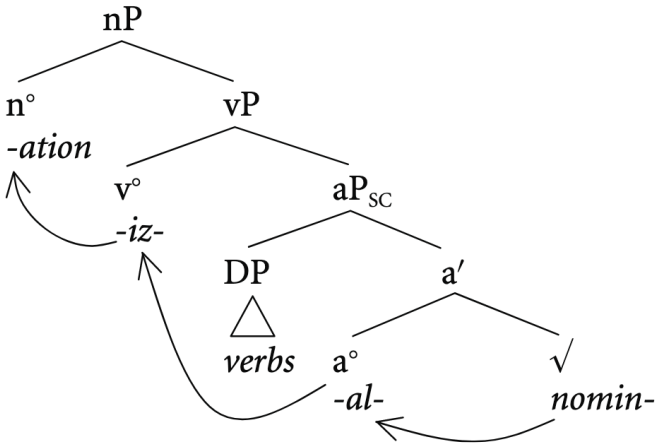
Figure 1. The Y-model (taken from Harley and Noyer 1999, p3)



As for vocabulary items, DM distincts roots (lexical morphemes) and licensers (functional morphemes). Roots are unspecified to categories and realized in different forms according to different licensers. Roots get categories through categorizing heads, such as the nominalizing head n^o and the verbalizing head v^o (Marantz 1997, Embick and Marantz 2008). For example, the root √*destroy* is realized as a verb *destroy* with Tense and Aspect through merging to the verbalizer v^o, and as a noun *destruction* with a determiner through merging to the nominalizer n^o.

It is also possible to include multiple categorizing heads for one vocabulary item, such as the structure for *nominalization* in (1) given by Harley (2009: 336).

(1)



This study explores the compounding structure under Distributed Morphology, and these compounds are composed of roots rather than functional morphemes.

1.3.2 The Exo-skeletal Model

Similar to DM, the Exo-skeletal Model (the XS Model) also claims that lexical vocabulary items do not project any categories on their own (Borer 2005a, 2005b, 2013, 2014), as opposed to the Endo-skeletal Model. It proposes that types just come from the structure. It is the functional structure that assigns the category value to roots. As such, there is no zero-derivation or type-shifting under the framework of the XS Model. This is especially important to Mandarin since there are many plausible zero-derivation patterns in Mandarin. Besides the example of 跑步 *pǎobù* "to run; running" mentioned before, 红 *hóng* can be another classic example, which can mean the noun "the red color", the adjective "red", and the verb "to become red". According to the XS Model, it is not the vocabulary item 红 *hóng* having three lexical entries, but the only vocabulary item getting different categorical interpretations under nominal, adjectival, and verbal functional structures. This can not only reduce the redundancy of indicating categorical information twice, lexically and structurally, but can also make the whole lexicon more economic.

There are direct and indirect strategies for the licensing of functional structures (Borer 2005a). For direct strategies, in which the functional element projects as a head, there are ways of using head features with head movement, such as *-ed* for the past in English, and using f-morphs without head movement, such as *will* for the future in English. There are also two modes for the indirect category range assignment. One is by the specifier-head agreement, such as processors, and the other is by an adverb, such as *mostly* in English.

Instead of testing the flexibility of vocabulary items, this study aims to investigate if functional structures can influence the lexical category of Mandarin compounds.

1.4 Structure

This thesis is organized as follows. Chapter 2 gives the full picture of the experiment conducted in this study, including the details about participants, materials, procedure and results. Sections 3 and 4 explain the phenomena observed in Test 1. Chapter 3 puts forward a fine-grained Headedness Model for Mandarin, in functional structure with a language perception model. Chapter 4 presents an analysis for the puzzle that occurred with unaccusative verbs for VN compounds. Section 5 focuses on Test 2, discussing results under functional structures in aspects of malleability and productivity. Section 6 concludes with limitations for this study and suggestions for possible future research.

Chapter 2 The Experiment on Mandarin Disyllabic Neologisms

2.1 Introduction

In this chapter I present an experiment, which consisted of two tests. Test 1 was a classifier (CL) matching test that is concerned with bare newly-composed disyllables, and Test 2 was an acceptability test of these newly-composed disyllables plus specific functional structure. Test 1 aimed to test an intuitive preference on lexical categories for these bare disyllables. Participants were asked to match them with a nominal classifier or verbal classifier in Mandarin. At this stage, participants were only exposed to these neologisms on their own, and they could only choose based on the structure of the bare compound and the encyclopedic knowledge associated with these neologisms. Through matching them to different classifiers, participants exhibited their preferences for the potential lexical categories of these disyllables.

Test 2 aimed to test the degree of acceptability of these disyllables in nominal and verbal functional structures. Participants were exposed to phrases and they could indicate how acceptable they judged these neologisms to be. In Test 2, participants were informed that the neologisms had already been created. This setup allowed us to examine the malleability of disyllabic items under different functional structures. For instance, if a disyllable is generally accepted within both verbal and nominal structures, it suggests that the disyllable has a relatively high flexibility to function either as a noun or a verb.

This chapter is structured as follows. Section 2 introduces the information about participants. Section 3 presents materials for the experiment. Section 4 explains the procedure of the experiment. Section 5 presents preliminary results. Section 6 concludes. The discussion of the results is in the following chapters 3, 4 and 5.

2.2 Participants

In this experiment, 77 Mandarin speakers participated, and 74 of them had acquired Mandarin before 6 years old. I excluded the data of 3 participants who had not acquired Mandarin or who had not been fluent in Mandarin before 6 years old. Among 74 participants whose data were effective, 37 were male participants, 35 were female participants, and 2 participants did not specify their biological gender. The participants' ages ranged from 21 to 58, with a mean age of 27 (SD = 6.39).

Aside from Mandarin, most participants (70, 94.6%) can speak at least one more language or dialect. These languages include English (51, 68.9%), French (4, 5.4%), Japanese (3, 4.1%) and

German (2, 2.7%). The dialects spoken were Wu (24, 32.4%), Zhongyuan Mandarin (4, 5.4%), Min (3, 4.1%), and Hakka (2, 2.8%), among others.

2.3 Materials

2.3.1 Test 1: A Classifier Matching Test

Test items consist of 40 stimuli of newly composed Mandarin disyllables. Every disyllable is composed of two monosyllables. Based on the most frequent and dominant categories of these monosyllables in a corpus (see below), the stimuli include 10 NN disyllables, 10 NV disyllables, 10 VN disyllables and 10 VV disyllables. For example, 云 *yún* "cloud" and 石 *shí* "stone" are two monosyllables commonly used as nouns in Mandarin. The functional structure of 云 *yún* "cloud" and 石 *shí* "stone" creates the new NN pattern disyllable 云石 *yún-shí* "cloud-stone" which is a neologism. As such, 笔裂 *bǐ-liè* "pen-crack", 走沙 *zǒu-shā* "walk-sand", 吃抖 *chī-dǒu* "eat-tremble" are examples for a newly-composed NV disyllable, VN disyllable and VV disyllable, respectively.

To minimize the potential influence of syllable combinations, such as the order of presentation for monosyllabic nouns and verbs, I assigned labels and numbers to each monosyllable and created four distinct lists for this test. As demonstrated in Table 1, the NV combination in List 1 (N3-V1) corresponds to the VN combination of List 2 (V3-N1). Thus, each NV disyllable has a counterpart in the VN disyllables across different lists.

Table 1: Four lists of stimuli for Mandarin disyllables in Test 1

List	**NN**	**NV**	**VN**	**VV**
List 1	N1-N2	N3-V1	V2-N4	V3-V4
List 2	N2-N3	N4-V2	V3-N1	V4-V1
List 3	N3-N4	N1-V3	V4-N2	V1-V2
List 4	N4-N1	N2-V4	V1-N3	V2-V3

To make one list of 40 disyllables, 40 monosyllabic nouns and 40 monosyllabic verbs are selected. All these monosyllabic nouns and verbs are predominantly used as nouns and verbs in Mandarin, as verified by the BCC corpus (Xun et al., 2016). According to the number of tokens in the corpus, the frequency of these monosyllables is outlined as follows: Firstly, all the monosyllables are common syllables, ranked within the most frequent 3200 syllables in a comprehensive list of 5708 syllables that appear more than 5 times in the corpus. Secondly, the chosen monosyllables are also not clustered in the same frequency interval and are distributed across different frequency intervals to ensure diversity. As nouns are generally more frequent than verbs, the selection of nouns and verbs is based on two different criteria. For nouns, half of them are in the interval of the most frequent 1000 frequent syllables, and the remainder is ranked between 1000 and 3000. For verbs,

approximately one-third of them (15) fall within the most frequent 1000 frequent syllables, 16 are in the interval from 1000 to 2000, and 9 range from 2000 to 3200.

Table 2: Frequency of monosyllabic nouns and verbs

Categories	**<1000**	**1000-2000**	**>2000**
nouns	(20) 云 *yún* “cloud” 石 *shí* “stone” 笔 *bǐ* “pen” 沙 *shā* “sand” 纸 *zhǐ* “paper” 书 *shū* “book” 球 *qiú* “ball” 钟 *zhōng* “clock” 眼 *yǎn* “eye” 台 *tái* “platform” 星 *xīng* “star” 门 *mén* “door” 山 *shān* “mountain” 板 *bǎn* “board” 河 *hé* “river” 船 *chuán* “boat” 月 *yuè* “moon” 脚 *jiǎo* “foot” 脸 *liǎn* “face” 灯 *dēng* “lamp”	(17) 帽 *mào* “hat” 桌 *zhuō* “table” 箱 *xiāng* “box” 鼻 *bí* “nose” 袋 *dài* “bag” 芽 *yá* “bud” 裤 *kù* “trousers” 桥 *qiáo* “bridge” 椅 *yǐ* “chair” 盒 *hé* “box” 帽 *mào* “hat” 肚 *dù* “belly” 窗 *chuāng* “window” 杯 *bēi* “cup” 店 *diàn* “shop” 壳 *ké* “shell” 瓶 *píng* “bottle”	(3) 毯 *tǎn* “blanket” 帘 *lián* “curtain” 霜 *shuāng* “frost”
verbs	(15) 走 *zǒu* “walk” 吃 *chī* “eat” 落 *luò* “fall” 接 *jiē* “connect” 抓 *zhuā* “grab” 立 *lì* “stand” 转 *zhuǎn* “rotate” 跑 *pǎo* “run” 摇 *yáo* “shake” 飞 *fēi* “fly” 播 *bō* “sow” 推 *tuī* “push” 游 *yóu* “swim” 跳 *tiào* “jump”	(16) 裂 *liè* “split” 抖 *dǒu* “shake” 溜 *liū* “slide” 躺 *tǎng* “lie down” 撞 *zhuàng* “collide” 吞 *tūn* “swallow” 飘 *piāo* “flutter” 漂 *piāo* “drift” 滚 *gǔn* “roll” 喝 *hē* “drink” 浮 *fú* “float” 爬 *pá* “crawl” 碰 *pèng* “bump” 捉 *zhuō* “catch”	(9) 塌 *tā* “collapse” 啃 *kěn* “gnaw” 咳 *ké* “cough” 趴 *pā* “lie prone” 捏 *niē* “pinch” 蹲 *dūn* “squat” 蹦 *bèng* “jump” 摔 *shuāi* “fall” 踢 *tī* “kick”

	切 *qiē* “cut”	逃 *táo* “escape” 涨 *zhǎng* “rise”	

Semantically, the nouns refer to inanimate objects, deliberately excluding nouns referring to humans or animals like 虎 *hǔ* “tiger”. This exclusion is motivated by the fact that animate objects often lend themselves to agentive interpretations, and disyllabic patterns like NV can be more readily understood as an agent plus a verb. The verbs are balanced in 4 types, defined by their syntactic and semantic properties. 40 verbal monosyllables consist of 10 unaccusative monovalent verbs, 10 unergative monovalent verbs, 10 unaccusative divalent verbs, and 10 unergative divalent verbs. This classification of verbs is adopted from Huang (2007).

In the analysis of Mandarin verbal structures, Huang (2007) adopts the division of unaccusative and unergative verbs proposed by Perlmutter (1978) and further differentiates them based on the valency of these verbs. According to Huang (2007), both unaccusative and unergative verbs can be either monovalent or divalent, with either one or two arguments, respectively. Monovalent unaccusative verbs possess only one internal argument, while monovalent unergative verbs exclusively have one external argument. Both unergative divalent verbs and unaccusative divalent verbs can have one internal and one external argument; however, only the internal argument of unaccusative divalent verbs can become the subject when there is no external argument. Semantically, compared to unergative divalent verbs, unaccusative divalent verbs carry a stronger causative implication (Li 1985). For example, in the following examples with the unaccusative divalent verb 转 *zhuǎn* “rotate”, (1a) has the causative implicature that I made the fan rotate, while (3b) only indicates that the fan rotated. In (3b), the fan can either rotated on its own or with the help of others. This phenomenon also exists in English, as demonstrated by the sentences *They sank the boat yesterday* and *The boat sank yesterday.*

(3a) 我 转了 电风扇。
wǒ *zhuǎn-le* *diànfēngshàn*
I rotate-PFV fan
“I rotated the fan.” (I made the fan rotate.)

(3b) 电风扇 转了
diànfēngshàn *zhuǎn-le*
fan rotate-PFV
“The fan rotated.” (The fan rotated on its own.)

These 4 types of verbs are distributed equally over the list. In other words, every set of 4 monosyllabic verbs contains one unaccusative monovalent verb, one unergative monovalent verb, one unaccusative divalent verb, and one unergative divalent verb. To be specific, among the first 4 verbs 裂 *liè* “crack”, 走 *zǒu* “walk”, 吃 *chī* “eat” and 抖 *dǒu* “tremble”, 裂 *liè* “crack” is an unaccusative monovalent verb, 走 *zǒu* “walk” is an unergative monovalent verb, 抖 *dǒu* “tremble” is an unaccusative divalent verb, and 吃 *chī* “eat” is an unergative divalent verb.

Table 3: Four types of verbs

Unaccusative Monovalent verbs	**Unergative Monovalent Verbs**	**Unaccusative Divalent Verbs**	**Unergative Divalent Verbs**
裂 *liè* "split"	走 *zǒu* "walk"	接 *jiē* "connect"	吃 *chī* "eat"
落 *luò* "fall"	跑 *pǎo* "run"	播 *bō* "sow"	抓 *zhuā* "grab"
立 *lì* "stand"	飞 *fēi* "fly"	抖 *dǒu* "shake"	啃 *kěn* "gnaw"
浮 *fú* "float"	游 *yóu* "swim"	摔 *shuāi* "fall"	吞 *tūn* "swallow"
飘 *piāo* "flutter"	跳 *tiào* "jump"	碰 *pèng* "bump"	捏 *niē* "pinch"
漂 *piāo* "drift"	蹦 *bèng* "jump"	涨 *zhǎng* "rise"	推 *tuī* "push"
躺 *tǎng* "lie down"	爬 *pá* "crawl"	撞 *zhuàng* "collide"	喝 *hē* "drink"
逃 *táo* "escape"	咳 *ké* "cough"	滚 *gǔn* "roll"	踢 *tī* "kick"
趴 *pā* "lie prone"	溜 *liū* "slide"	转 *zhuǎn* "rotate"	切 *qiē* "cut"
蹲 *dūn* "squat"	塌 *tā* "collapse"	摇 *yáo* "shake"	捉 *zhuō* "catch"

See Appendix 1 for the detailed lists.

2.3.2 Test 2: A Phrasal Acceptability Test

Test 2 builds upon the disyllables crafted for Test 1. While these disyllables are in their bare forms in Test 1, Test 2 combines them with different functional structures and uses them in phrases. Corresponding to the 4 different lists from Test 1, there are four analogous lists in Test 2.

Every list in Test 2 contains 32 phrases. 4 types of nominal functional structures and 4 types of verbal functional structures are each combined with 4 patterns of disyllables, i.e., NN, NV, VN, and VV. Nominal functional structures contain situations when the disyllable is combined with the existential quantifier 一些 *yīxiē* "some", the universal quantifier 所有 *suǒyǒu* "all", the nominal classifier 三种 *suǒzhǒng* "three kinds" and functions as the internal argument with the verb 喜欢 *xǐhuān* "like", as illustrated in Table 4 for NN disyllables. Verbal functional structures contain situations when the disyllable is combined with the verbal classifier 一下 *yīxià* "a bit", the perfective aspect marker 了 le, the negative imperative 请不要 *qǐng bùyào* "please don't", and with the manner adverbial 慢慢地 *mànmàn-de* "slowly", as shown in Table 5 with examples of NN disyllables.

Table 4: Nominal Functional structures

Nominal Functional structures	**NN**
1. with the existential quantifier: some (一些) *yīxiē*__ some__	一些云石 *yīxiē yún-shí* some cloud-stone
2. with the universal quantifier: all (所有的)	所有的帽月

suǒyǒu de__ all the__	*suǒyǒu de mào-yuè* all the hat-moon
3. with the nominal classifier: kind（种） *sān zhǒng __* three kinds of __	三种书鼻 *sān zhǒng shū-bí* three kinds of book-nose
4. as an internal argument: like __ (喜欢) *XiǎoLǐ hěn xǐhuān __* Xiaoli really likes __	小李很喜欢袋芽 *XiǎoLǐ hěn xǐhuān dài-yá* Xiaoli really likes bag-bud

Table 5: Verbal Functional structures

Verbal Functional structures	**NN**
1. with the verbal classifier: a bit(一下) ____*yīxià* ____a bit	桥眼一下 *qiáo-yǎn yīxià* bridge-eye a bit
2. with the aspect marker: *le* (了) 昨天___了 *zuótiān___ le* yesterday ____.	昨天椅门了 *yǐ-shū le* yesterday chair-book
3. with the negative imperative: please don't (请不要) *qǐng bùyào __* please don't __	请不要肚帘 *qǐng bùyào dù-lián* please don't belly-curtain
4. with the manner adverbial: slowly (慢慢地) *mànmàn de __* slowly __	慢慢地河窗 *mànmàn de hé-chuāng* slowly river-window

See Appendix 2 for the detailed lists.

Judgements were collected on a 7-degree Likert scale. The options on the scale for Test 2 are completely unacceptable, largely unacceptable, somewhat unacceptable, neutral, somewhat acceptable, largely acceptable, and completely acceptable.

2.3.3 Groups

Since each participant was required to perform both Test 1 and Test 2 consecutively, I aimed to minimize any potential learning effects by using different lists of stimuli for each test, as detailed in Table 6. For instance, participants in Stimuli Group 1 completed Test 1 with disyllables from List 1 and Test 2 with disyllables from List 2. As there are no overlapping disyllables between the two lists, the likelihood of participants being influenced in Test 2 by the disyllables from Test 1 is reduced. With Test 1 comprising 40 stimuli and Test 2 containing 32, each participant was exposed to a total of 72 targeted items.

Table 6: Stimuli groups for the experiment

Stimuli Group	**Test 1**	**Test 2**
Group 1 (72)	List 1 (40)	List 2 (32)
Group 2 (72)	List 2 (40)	List 3 (32)
Group 3 (72)	List 3 (40)	List 4 (32)
Group 4 (72)	List 4 (40)	List 1 (32)

In this experiment, 16 participants took the stimuli from Group 1, 20 from Group 2, 18 from Group 3, and 18 from Group 4.

2.4 Procedure

All participants conducted the experiment online using their personal computers in private settings, with each session lasting approximately 6 to 10 minutes. Participants first checked the informed consent form for the experiment, and after giving their consent, they were subsequently asked to complete a basic personal information questionnaire that included year of birth, biological sex (with options male, female, unspecified or prefer not to say), whether they had acquired and were fluent in Mandarin Chinese before the age of six (yes or no), and any other languages they spoke fluently. Following the survey, they proceeded to Test 1 and then Test 2.

In Test 1, on each page, participants were presented with one newly-composed disyllable and two options. The new disyllable was from a specific list, e.g., list 1, and two options were presented in Test 1. One is the nominal classifier, 一种 *yīzhǒng* "a kind", and the other is the verbal classifier 一次 *yīcì* "once". To match these classifiers with disyllables, I set blankets alongside these classifiers, as in (4) and (5)[2].

(4) 一种____
*yīzhǒng*____
"a kind____"

(5) ____一次
____*yīcì*
"____once"

Participants were instructed to intuitively select the better option for the neologism from the two options. The test began with three practice disyllables to help participants familiarize themselves with the pattern of matching classifiers in this part.

Test 2 is a phrasal acceptability test. Participants in this test were presented with a phrase containing the neologism on every page and asked to what extent they could imagine this phrase being used by native speakers, assuming the new disyllable already exists. The response scale

[2] Here the word order is different, with the classifier preceding the disyllable and the verbal classifier following the disyllable. However, these are the unmarked way of using nominal and verbal classifiers. By default, the nominal classifier precedes the noun, and the verbal classifier follows the verb (see the discussion on Mandarin classifiers in Chao 1968, Fang 1993, Zhang 2017, a.o.).

ranged from **completely unacceptable**, **largely unacceptable**, **somewhat unacceptable**, **neutral**, **somewhat acceptable**, **largely acceptable**, to **completely acceptable**. Participants were asked to select one to represent their acceptance level. Like Test 1, this test also began with three practice phrases to help participants get familiarized with the test format before it started officially.

2.5 Results and Analyses

In this study, statistical analyses including binomial tests, t-tests, and chi-square tests were conducted using the R software environment (R Core Team, 2015) within RStudio (RStudio Team, 2019) to evaluate the data obtained from Test 1 and Test 2.

2.5.1 Test 1: general results

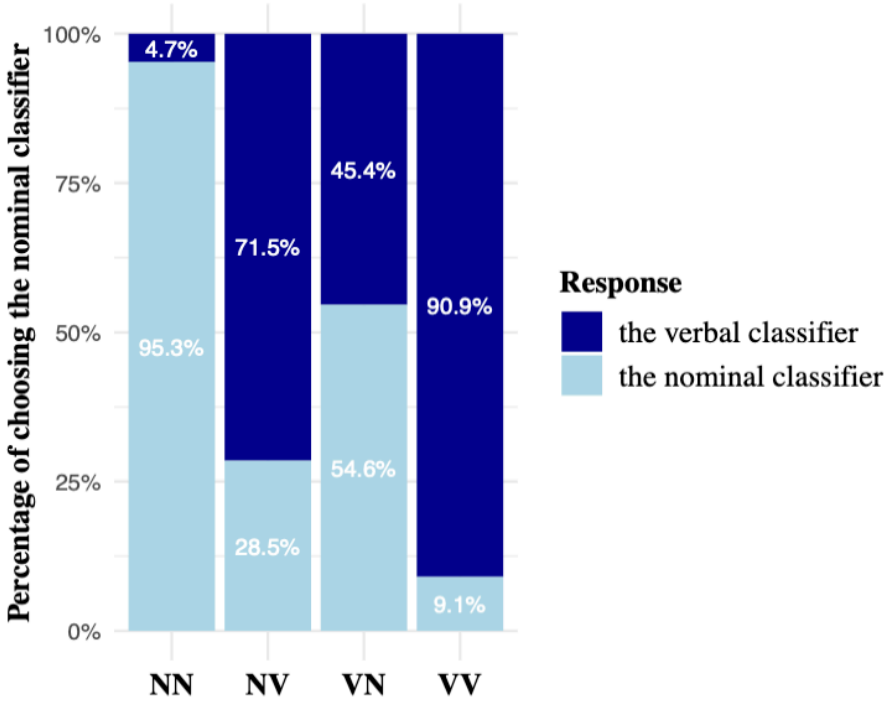
In Test 1, matching the disyllable with the nominal classifier 一种 *yīzhǒng* "a kind" represents the nominal perception of this newly-composed disyllable. Similarly, choosing the verbal classifier 一次 *yīcì* "once" stands for the verbal recognition of the disyllable.

The null hypothesis (H0) posits that the possibility of selecting the nominal classifier 一种 *yīzhǒng* "a kind" for each pattern of disyllables is approximately 50%, implying that participants do not have preconceived notions about the categories of these disyllables as they are newly-composed. This is also the protolinguistics view of compounds (Jackendoff 2002, 2009, Progovac 2006, 2009), in which sense compounds are fossils or traces of an evolutional stage, and these compounds are thus barely syntactic.

In contrast, the alternative hypothesis (H1) postulates that the frequency of choosing the nominal classifier for each disyllable pattern differs significantly from this expected distribution, indicating that participants possess an intuitive bias towards the possible lexical categories of these disyllabic neologisms. This would indicate they subconsciously follow a structural rule such as the Right-Hand Head Rule (RHHR) in English (Williams 1981).

The following figure presents the results, i.e. the proportions of the nominal classifier and the verbal classifier choices for the four patterns of disyllables (NN, NV, VN and VV) from the collected data.

Figure 2: Distribution of responses for the nominal and verbal classifiers



Upon analyzing the data using binomial distribution tests in R, the results revealed significant deviations from the null hypothesis for all four patterns: NN, NV, VN, and VV. For the NN pattern, the probability of selecting the nominal classifier was notably high at 95.3%, with a 95% confidence interval ranging from 93.5% to 96.7% (P<0.001*[3]). For the NV pattern, the probability was 28.5%, with a confidence interval of 25.3% to 31.9% and a p-value less than 0.001*. The VN pattern exhibited a probability of 54.6%, with a confidence interval of 50.9% to 58.2% and a p-value of 0.014 *. Lastly, the VV pattern displayed a probability of 9.05% of choosing the nominal classifier, with a confidence interval of 7.09% to 11.4% and a p-value less than 0.001*.

A Chi-square test was conducted for the relationship between the four compounding patterns, NN, NV, VN and VV compounds, and the experimental results in Test 1 ($\chi^2(3) = 1238.99$, $p < 0.001$). Given that $\chi^2(3)$ is very high and the p-value is smaller than the commonly accepted significance level of 0.05, this result strongly indicates that different patterns of compounds have a significant impact on the experimental results.

Given the significance of these results, it is evident that the null hypothesis (H0) cannot be upheld. Specifically, there exists a strong preference for selecting the nominal classifier in the NN and VN patterns, while the NV and VV patterns demonstrate a pronounced inclination towards choosing the verbal classifier. Moreover, the order of nominal inclination for these patterns is NN > VN > NV > VV.

[3] The asterisk (*) denotes that the results are statistically significant.

3.5.2 Test 1: Verb type-specific results

In addition to the general results on the NV, VN, VV, and NN patterns, I also analyzed the impact of different types of verbs on the outcomes for the VN and NV patterns. As mentioned in Section 3.3.1, these types include unaccusative monovalent verbs, unergative monovalent verbs, unaccusative divalent verbs, and unergative divalent verbs. The null hypothesis (H0) posited that the type of verbs does not overall affect the judgment of the VN and NV patterns, meaning that participants' overall assessments of the VN and NV patterns would be consistent. The alternative hypothesis (H1) suggested that the outcomes for the VN and NV might be influenced by specific types of verbs, indicating distinctive characteristics within the VN and NV patterns under different verb types.

For the NV pattern, as shown in Table 7, all four verb types significantly demonstrated a preference for using verbal classifiers ($P < 0.001$), suggesting that participants predominantly interpreted these disyllables as verbs. The chi-square test was conducted to assess the impact of verb type on the distribution of verbal and nominal classifiers. The results of this test showed no significant association between verb types and classifier distribution, with a chi-square value of 0.982 and 3 degrees of freedom ($\chi^2(3) = 0.558$, $p = 0.906$). This suggests that the type of verbs does not significantly affect the choice between verbal and nominal classifiers in the NV pattern.

Table 7: NV with different verb types

Verb types	**Number of verbal classifier**	**Number of nominal classifier**	**Percent of verbal classifier**	**Percent of nominal classifier**	**Significance**
Unaccusative Monovalent Verbs	137	53	72.1	27.9	$P < 0.001$*
Unergative Monovalent Verbs	132	51	72.1	27.9	$P < 0.001$*
Unaccusative Divalent Verbs	129	57	69.4	30.6	$P < 0.001$*
Unergative Divalent Verbs	131	50	72.4	27.6	$P < 0.001$*

As for the VN pattern, as illustrated in Table 8, participants only showed a significant preference for the nominal classifier only with unaccusative monovalent verbs ($P < 0.001$). In the cases of the other three types of verbs, namely unergative monovalent verbs, unaccusative divalent verbs, and unergative divalent verbs, there were no significant preferences for either verbal or nominal classifiers. The chi-square test was also performed to investigate the influence of different verb types. The findings demonstrated a significant association between verb type and classifier

distribution, yielding a value of 14.879 with 3 degrees of freedom ($\chi^2(3) = 15.884$, $p = 0.0012$). This indicates that in the VN pattern, the type of verbs significantly affects the choice of classifiers, with different verb types preferring different classifiers.

Table 8: VN with different verb types

Verb types	**Number of verbal classifier**	**Number of nominal classifier**	**Percent of verbal classifier**	**Percent of nominal classifier**	**Significance**
Unaccusative Monovalent Verbs	63	118	34.8	65.2	P < 0.001*
Unergative Monovalent Verbs	87	99	46.8	53.2	P = 0.42
Unaccusative Divalent Verbs	82	103	44.3	55.7	P = 0.141
Unergative Divalent Verbs	104	84	55.3	44.7	P = 0.166

In sum, while different verb types did not significantly affect the results for the NV pattern, they had a notable impact on the outcomes for the VN pattern. Therefore, the null hypothesis was retained for the NV pattern, and the alternative hypothesis was supported for the VN pattern.

3.5.3 Test 2

As for this phrasal acceptability test, the null hypothesis (H0) posited that participants have neutral acceptance towards these phrases with neologisms. In other words, participants neither strongly favored nor strongly opposed the existence of these phrases. Since the scale completely unacceptable, largely unacceptable, somewhat unacceptable, neutral, somewhat acceptable, largely acceptable, and completely acceptable are rated respectively as 0, 1, 2, 3, 4, 5 and 6, this null hypothesis also indicated an average score level of 3, the average and medium of scores from 0 to 6. In contrast, the alternative hypothesis (H1) proposed that the average acceptance level differed from 3, indicating participants gave category-specific judgments regarding the appropriateness of these phrasal combinations.

Table 9 presents the results of nominal functional structures combined with four types of disyllable patterns. The four cases of nominal functional structures are denoted as N1 “some”, N2 all, N3 “three kinds of”, and N4 “like” +IA. Table 10 presents verbal functional structures combined with the same disyllable patterns, with the four verbal combination cases denoted as V1 “a bit”, V2 *le* (aspect marker), V3 “please don’t”, and V4 “slowly”. Each phrasal combination’s outcome is displayed alongside its corresponding p-value below. Significant results, with p-values less than 0.05, are shaded in grey in the table. Under such significant situations, the H0 is not supported, and participants exhibit clear preferences for those phrases.

Table 9: Nominal functional structures with four disyllable patterns

Nominal structures	**NN**	**NV**	**VN**	**VV**
N1 "some"	4.5	2.8	3.8	2.77
	(p < 0.001*)	(p= 0.265)	(p < 0.001*)	(p= 0.235)
N2 "all"	4.14	3.04	3.36	2.7
	(p < 0.001*)	(p= 0.835)	(p= 0.06)	(p= 0.126)
N3 "three kinds of"	4.04	2.76	3.08	2.95
	(p < 0.001*)	(p= 0.184)	(p= 0.712)	(p= 0.804)
N4 "like" + IA	4.77	3.11	3.78	3.81
	(p < 0.001*)	(p= 0.601)	(p < 0.001*)	(p < 0.001*)
Mean	**4.36**	**2.93**	**3.51**	**3.06**
	(p < 0.001*)	(p= 0.438)	(p < 0.001*)	(p= 0.565)

Table 10: Verbal functional structures with four disyllable patterns

Verbal structures	**NN**	**NV**	**VN**	**VV**
V1 "a bit"	2.11	3.51	3.07	3.84
	(p < 0.001*)	(p= 0.008*)	(p= 0.739)	(p < 0.001 *)
V2 *le* (aspect marker)	2.2	3.3	3.46	4.14
	(p < 0.001*)	(p= 0.132)	(p= 0.021*)	(p < 0.001 *)
V3 "please don't"	2.27	3.23	3.45	4.08
	(p < 0.001*)	(p= 0.301)	(p= 0.033*)	(p < 0.001 *)
V4 "slowly"	2.01	2.97	3.55	4.08
	(p < 0.001*)	(p= 0.895)	(p= 0.008*)	(p < 0.001*)
Mean	**2.15**	**3.25**	**3.38**	**4.03**
	(p < 0.001*)	(p= 0.013*)	(p < 0.001*)	(p < 0.001*)

For nominal functional structures, participants exhibited a clear preference for the NN pattern, as all functional structures involving NN were significantly accepted. As for the NV pattern, participants showed no particular preference, with all results being nonsignificant ($p > 0.05$). Regarding the VN pattern, participants notably accepted functional structures with N1 "some" and N4 "like" + IA, while showing no significant judgment for the other two functional structures. For the VV pattern, participants only expressed acceptance for the N4 "like" + IA functional structure, with no significant judgments for the other functional structures. Notably, none of the 16 cases of nominal functional structures were significantly rejected.

In terms of verbal functional structures, participants favored the VV pattern, with all functional structures involving VV being significantly accepted. Conversely, participants explicitly rejected the NN pattern, as all functional structures involving NN were significantly rejected. For the NV pattern, participants only demonstrated a preference in the case of V1 "a bit", with no significant

judgments for the remaining functional structures. Regarding the VN pattern, participants exhibited a clear preference for functional structures involving V2 *le* (aspect marker), V3 “please don’t” and V4 “slowly”, with no significant judgments for the other two functional structures.

Among all the four disyllable patterns, the NN pattern reacts most significantly, which was strongly accepted by participants in all the nominal functional structures and strongly rejected in all the verbal functional structures. Participants generally do not show significant preferences for the NV pattern, except in the case of V1 “a bit”. The VN and the VV patterns are both accepted in several nominal functional structures and verbal functional structures, showing malleability under functional structures.

2.6 Conclusion

This chapter outlines the experimental design and results of Test 1 and Test 2. Test 1 focused on the default category perception of neologisms by native Mandarin speakers, revealing that participants typically identified NN patterns as nouns, and NV and VV patterns as verbs, with a tendency to interpret VN patterns as nouns. Notably, the perception of the VN pattern varied with the type of verb. Unaccusative monovalent verbs were more likely to be perceived as nouns, whereas other verb types did not show a significant preference.

The results also revealed that the protolinguistics hypothesis (Jackendoff 2002, 2009, Progovac 2006, 2009) is not valid for Mandarin compounds. The results observed in this experiment show systematic patterns without meaningful functional structures. If the hypothesis of protolinguistics works, participants cannot access the fossilized compounds, and the nominal and verbal preferences should be in equal proportions across four types of compounding, i.e., NN, NV, VV and VV compounds. Yet the results of the experiment were not. Participants showed type-specific preferences for these compounding patterns, given the result from the Chi-square test ($\chi^2(3) = 1238.99$, $p < 0.001$).

Test 2 explored the malleability of disyllabic neologisms in nominal and verbal functional structures. The data from 72 participants showed that the NN pattern was the least malleable, being strongly accepted in nominal functional structures and rejected in verbal ones. The NV pattern was significantly accepted only in verbal functional structures involving verbal classifiers, i.e., only with V1 “a bit”. Conversely, the VN pattern exhibited higher malleability, showing significant acceptability in both nominal and verbal functional structures. The VV pattern displayed the strongest acceptance for verbal functional structures, and can also survive with N4 “like” + IA.

This experiment highlights that participants indeed have distinct preferences and judgments regarding these disyllabic neologisms. Nevertheless, the results give rise to several pertinent questions. In Test 1, why is the NV pattern predominantly interpreted as a verb, while the VN pattern leans toward a nominal interpretation? How does the verb type impact the perception of

the VN pattern, especially unaccusative monovalent verbs? In Test 2, what explains the limited malleability of the NN pattern? Given the clear preference for the verbal properties of NV forms in Test 1, why is there a reluctance to accept NV forms in most verbal functional structures? How can the pronounced malleability of the VN pattern be explained? Considering the verbal preference for VV forms in Test 1, why are these forms also accepted as nominal arguments, as illustrated in N4. These questions are discussed further in the following chapters.

Chapter 3 Headedness and Probability

3.1 Introduction

In this study, I aim to integrate the experimental evidence for right-headedness with the Headedness Principle from previous research to propose a new headedness model for Mandarin disyllabic compounds. In Test 1, the hypothesis concerning headedness received substantial support. Specifically, I observed significant nominal judgments for NN compounds and VN compounds, and verbal preferences for NV compounds and VV compounds. The experimental results clearly indicate an inclination for right-headedness, especially because VN compounds were more likely to be nominal and NV compounds exhibited a stronger verbal inclination. However, according to Packard's (2000) Headedness Principle for Mandarin compounds, nominal compounds are right-headed, and verbal compounds are left-headed. This principle does not fully account for the phenomena observed in this experiment.

The experiment is of course a test on language perception. To account for the experimental results, in this section I propose a language perception model with probability, which mirrors the language generation model such as the Y-model proposed in Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999) and Minimalist Program (Chomsky 1995). Drawing inspiration from the weighted constraints in the Optimality Theory (OT) applied to Harmonic Grammar (Pater 2009), this headedness model also assigns weights to various constraints and calculates the likelihood of compounds being nominal and verbal based on their scores.

This chapter is organized as follows. Section 2 explores headedness in Mandarin compounds, drawing from both literature research and results in the current experiment. Section 3 proposes a language perception model that incorporates probabilistic factors. Section 4 proposes a new model for native Mandarin speakers to perceive categories of disyllabic compounds. This Headedness Model is based on the structure and monosyllabic element of disyllables. Section 5 examines the underlying morphosyntactic structures of Mandarin compounds within the framework of Distributed Morphology. Section 6 concludes the chapter.

3.2 Headedness in Mandarin Literature

3.2.1 The Mandarin Headedness Principle

Packard (2000) introduces the Mandarin Headedness Principle to analyze the structure of Mandarin disyllabic compounds. According to this principle, nominal compounds are right-headed, whereas verbal compounds are left-headed.

> **Headedness Principle**: (bisyllabic) noun words have nominal constituents on the right and verb words have verbal constituents on the left. (Packard 2000: 39)

Packard's analysis begins with the examination of disyllabic compounds formed from unambiguous nouns and verbs. He uses 纸 *zhǐ* "paper" as an example of unambiguous nouns and 走 *zǒu* "to walk" as an example of unambiguous verbs. For compounds involving 纸 *zhǐ* "paper", they are all nominal and they all have the right-hand constituents being nominal. Similarly, compounds incorporating 走 *zǒu* "to walk" retain their verbal nature all have the left-hand constituents being verbal. The principle is further examined with monosyllables that have multiple potential lexical categories, such as 画 *huà* "picture, to draw" and 排 *pái* "platoon, to arrange, to row". Compounds with these morphemes also largely exhibit verbal properties when a verb is on the left as well as nominal properties when a noun is on the right, aligning with the Headedness Principle. This pattern is also consistent with findings involving the nominal bound morpheme 石 *shí* "stone", the verbal bound morpheme 助 *zhù* "to help", and the categorically ambiguous bound morphemes 证 *zhèng* "proof, to prove". In nominal compounds with 石 *shí* "stone" and 证 *zhèng* "proof, to prove", the nominal morpheme is mostly at right. Whereas, in verbal compounds with 助 *zhù* "to help" and 证 *zhèng* "proof, to prove", the verbal morpheme usually appears at left.

Huang (1997) also works statically on the headedness of disyllabic compounds in Mandarin. In his statistical research, 24,000 disyllabic compounds were analyzed. Although the results do not give an overall picture of headedness for all the compounds, Huang (1997) found category-specific results for headedness, and some interesting patterns were found for nominal and verbal compounds. According to this analysis, noun compounding is more right-headed than left-headed (91.6% vs 59.2%), whereas verb compounding is more left-headed than right-headed (85.1% vs 58.4%). This also aligns with the Headedness Principle proposed by Packard (2000) afterwards.

However, several exceptions challenge the Headedness Principle, in patterns such as $[V\ V]_N$, $[X\ V]_V$, $[V\ N]_{SV}$, $[N\ V]_N$, $[N\ V]_V$ and $[Adv\ V]_N$[4]. For example, the compound 彩排 *cǎipái* "colour-rehearse = to rehearse" is a $[N\ V]_V$ compound that behaves verbally despite not having a verbal constituent on the left, representative of a systematic deviation from the principle. Packard (2000) argues that these exceptions are heavily lexicalized and thus do not conform to the typical structural expectations. He claims that lexicalized compounds are more likely to get a virtual head, rather than a canonical head. In other words, these compounds are exocentric rather than endocentric.

Although the lexicalized and exocentric explanation might function with extant exceptions, this explanation cannot hold water for the experimental results of neologisms I presented in Chapter 2. In this experiment, newly-composed NV compounds are largely regarded as verbs (72.2%, $P < 0.001$). Participants in the study could only rely on the characters and structures presented to them.

[4] For a compounding pattern $[X\ Y]_Z$, X stands for the dominant lexical category of the left component, Y for the category of the right component, and Z for the lexical category of the whole compound.

Either lexicalization or exocentric analysis requires additional knowledge fossilized before, which is not available in this case. Hence, there is a very limited chance of applying the explanation of lexicalization or the exocentric analysis for these NV compounds. I will further discuss this contradiction in Section 3.2.4.

3.2.2 NN: Right-headed Compounds

It is evident from Test 1 that newly-composed NN compounds are predominately regarded as nominal compounds by native Mandarin speakers, with 95.3% getting matched to the nominal classifier 一种 *yīzhǒng* "a kind" ($p < 0.001$). If the endocentric analysis is taken for these compounds, there are two possible nominal heads in NN compounds, namely the first nominal constituent N1 and the second nominal constituent N2. Unfortunately, this experiment does not explicitly elicit the headedness of these NN compounds, and I need to get back to the previous research on Mandarin NN compounds.

From the literature, it is argued that Mandarin NN compounds are mostly right-headed (Huang 1997, Packard 2000, Basciano 2010, Basciano et al. 2011). In this sense, Basciano et al. (2011) mention that Mandarin shares the same pattern of headedness with Germanic languages, contrary to the left-headed NN compounds in Romance and Bantu languages. Basciano et al. (2011) also propose the classifier test to support the right-headedness of NN compounds. As exemplified from (6) to (9), the classifier for the entire compound can be the same as the classifier for the second nominal constituent N2, but cannot take the classifier from the first nominal constituent N1. To be specific, such as in (6), the usually used classifier for 鸡 *jī* "chicken" is 只 *zhī* (the classifier for animals and certain objects), and the classifier for 毛 *máo* "feather" is 根 *gēn* (the elongated object). The NN compound 鸡毛 *jī-máo* "chicken feather" can be matched with the classifier 根 *gēn,* or other classifiers that are compatible with 毛 *máo "*feather" like 把 *bǎ*, but cannot be matched with the classifier 只 *zhī.* The same mechanism also works for other NN compounds like 草鞋 *cǎo-xié* "straw sandals"(7), 车灯 *chē-dēng* "car lamp" (8) and 灯船 *dēng-chuán* "lightship" (9).

(6)	一	根/*只	鸡毛
	yī	*gēn/zhī*	*jī-máo*
	one	CLF	chicken (CLF: 只 *zhī*) - feather (CLF : 根 *gēn*)
	"one/a chicken-feather"		
(7)	一	双/只/*根	草鞋
	yī	*shuāng/zhī/gēn*	*cǎo-xié*
	one	CLF	straw (CLF: 根 *gēn*) - shoe (CLF: 双 *shuāng* / 只 *zhī*)
	"a pair of/one straw sandal(s)"		
(8)	一	盏/*辆	车灯
	yī	*gēn/ liàng*	*chē-dēng*
	one	CLF	vehicle (CLF: 辆 *liàng*) - light (CLF: 盏 *zhǎn*)
	"one/a vehicle headlight"		
(9)	一	艘/*盏	灯船
	yī	*gēn/ zhǎn*	*dēng-chuán*
	one	CLF	light (CLF: 盏 *zhǎn*) - ship (CLF: 艘 *sōu*)

"one/a lightship" (Basciano et al. 2011)

As for neologisms, it would be interesting to test if native speakers have intuitions on different nominal classifiers for those novel NN compounds. Although this was not tested in the conducted experiment, a quick check about reversed NN compounds can be done below. Taking 鸡毛 *jī-máo* "chicken feather" (6), 草鞋 *cǎo-xié* "straw sandals" (7), 车灯 *chē-dēng* "car lamp" (8) and 灯船 *dēng-chuán* "lightship" (9) as N1N2 compounds, the reversed pattern, N2N1 compounds, are 毛鸡 *máo-jī* "feather-chicken" (10),鞋草 *xié-cǎo* "shoe-straw" (11),灯车 *dēng-chē* "light-car" (12) and 船灯 *chuán-dēng* "ship-light" (13). Among these four N2N1 compounds, 船灯 *chuán-dēng* "ship-light" is already present, and the other three have not yet been included in Mandarin vocabulary. Nevertheless, the intuition about right-headed classifiers is still effective for these newly-composed N2N1 compounds. For example, for 毛鸡 *máo-jī* "feather-chicken" in (10), if I assume this is a new word in Mandarin, it is only appropriate to use the classifier 只 *zhī* (the classifier for animals and certain objects), and cannot be compatible with 根 *gēn* (the elongated object), when there is no further information. Likewise, 鞋草 *xié-cǎo* "shoe-straw" can only accept the classifier that also matches 草 *cǎo* "grass", and 灯车 *dēng-chē* "light-car" is also more compatible with the classifier that also matches to 车 *chē* "car". Although not tested in the experiment, this intuition is strongly shared by native Mandarin speakers through investigation.

(10)	一	*根/只	毛鸡
	yī	*gēn/zhī*	*máo-jī*
	one	CLF	feather (CLF : 根 *gēn*) - chicken (CLF: 只 *zhī*)
	"one/a chicken-feather"		
(11)	一	*双/*只/根	鞋草
	yī	*shuāng/zhī/gēn*	*xié-cǎo*
	one	CLF	shoe (CLF: 双 *shuāng* / 只 *zhī*) - grass (CLF: 根 *gēn*)
	"a pair of/one straw sandal(s)"		
(12)	一	*盏/辆	灯车
	yī	*gēn/ liàng*	*dēng-chē*
	one	CLF	light (CLF: 盏 *zhǎn*) - vehicle (CLF: 辆 *liàng*)
	"one/a vehicle headlight"		
(13)	一	*艘/盏	船灯
	yī	*gēn/ zhǎn*	*chuán-dēng*
	one	CLF	ship (CLF: 艘 *sōu*) - light (CLF: 盏 *zhǎn*)
	"one/a lightship"		

As mentioned by Basciano et al. (2011) that the whole compound tends to take the same classifier as the head noun, it is reasonable to propose that these NN compounds are right-headed rather than left-headed.

3.2.3 VV: Different Underlying Structures

Similar considerations as those that applied to NN compounds also apply to VV compounds. Firstly, a significant majority of bare VV compounds were matched to the verbal classifier 一次

yīcì “once”, with a notable proportion of 91.2% ($p < 0.001$). Secondly, it remains challenging to tell which part of the verbal compounds, V1, V2, or other exocentric constituents, determines the verbal property of VV compounds based solely on the experimental results. Within the endocentric scenario and assumption of the experiment, either V1 or V2 should act as the head of the entire VV compound.

Following the Headedness Principle proposed by Packard (2000), V1, the lefthand constituent of the verbal compound, is typically considered as the head of these VV compounds. According to Ceccagno and Basciano (2007), however, the internal structure of VV compounds actually allows for varied types of headedness, reflecting different types of compounding structures. Ceccagno and Basciano (2007), along with Basciano (2010), categorize Mandarin compounds into three macro-types: subordinate compounds, attributive compounds, and coordinate compounds. VV compounds also share these three types. Subordinate VV compounds, where V2 functions as the complement of V1, are left-headed, such as 示爱 *shì'ài* “show-love = show one's love” with 爱 *ài* “love” as the complement of 示 *shì* “show”, and 拒载 *jùzǎi* “refuse-carry = (of a taxi driver) refuse to take a passenger” with 拒 *jù* “refuse” taking the complement 载 *zǎi* “carry”. Attributive VV compounds are right-headed, where V1 acts as the modifier of V2, as seen in 坐等 *zuòdài* “sit-wait = wait at ease” and 盗猎 *dàoliè* “steal + hunt = poach”. Coordinate VV compounds often feature V1 and V2 as synonyms, as exemplified by 攻击 *gōngjī* “attach-hit = attach” and 教导 *jiàodǎo* “teach-guide = instruct”. These compounds are analyzed as double-headed by Ceccagno and Basciano (2007). However, under the generative theoretical framework, it is more systematic for them to have a coordinate head, as in the analysis of English nominal coordinate compounds (Di Sciullo 2005, 2020).

Alternatively, Hong (2004) categorizes [V V]v compounds into different subtypes other than Ceccagno and Basciano (2007): the serial verb construction, the resultative construction and the coordinate construction. The serial verb construction arranges that two verbal constituents in a temporal or logical sequence. However, as pointed out by Paul (2008) and Basciano (2010), this label “serial verb construction”, though frequently used before (since Li and Thompson 1981), may be overly broad for VV compounds, given that it encompasses a variety of constructions with fundamentally different underlying structures.

To sum up, while the Headedness Principle provides a foundational guideline for determining the headedness of VV compounds, the actual analysis of these compounds requires a more nuanced examination of the relationships between the verbal constituents.

3.2.4 NV: Right-headed Compounds

Similar to VV compounds, NV compounds were also predominantly perceived as verbs, with 72.2% of NV compounds being matched to the verbal classifier ($p < 0.001$). Unlike VV compounds, NV

compounds feature a nominal constituent on the left and a verbal constituent on the right, suggesting a potential analysis of taking NV compounds as right-headed compounds. Basciano (2010) actually supports this inclination. She argues that compounds in the [N V]$_V$ pattern are right-headed, and the nominal constituent usually acts as the modifier of the compound.

However, the findings for NV compounds can challenge the Headedness Principle (Packard 2000). The Headedness Principle posits that verbal compounds should have their verbal constituents on the left hand functioning as the head. Contrary to this, in this experiment, most NV compounds were regarded as verbal compounds by participants but with verbal constituents on the right hand rather than the left hand. Furthermore, approximately 27.8 % of NV compounds were considered nominal compounds. As per the Headedness Principle, nominal compounds are supposed to possess the nominal constituent on the right hand. Yet, these nominal NV compounds do not have nominal constituents on the right hand either. Therefore, on the basis of the Headedness Principle, NV compounds cannot be categorized as either strictly nominal or verbal, which conflicts with the nominal or verbal characteristics of NV compounds observed in Mandarin.

If I reconsider the interaction between the Headedness Principle and NV compounds by suggesting that NV compounds could be either nominal or verbal without having to strictly adhere to this principle, then this also still fails to explain why people prefer verbal interpretations. This theoretical flexibility should lead to a more balanced distribution between nominal and verbal perceptions. In contrast, the empirical data for NV compounds show robust verbal preferences, with the four types of verbs exhibiting a consistent proportion of nominal and verbal perceptions.

This analysis suggests that the simple use of right-headedness is more explanatory and persuasive than the application of the Headedness Principle for NV compounds.

3.3 The Language Perception Model with Probability

As per the results from the experiment, there are different probabilities of NN, NV, VN and VV compounds being nominal or verbal. The problem is, in different linguistic modules, where to put the variables for probabilities.

In terms of language generation, the Y-model is proposed, as illustrated before in Figure 1. According to the inverted Y-model in Distributed Morphology and the Minimalist Program (Halle and Marantz 1993, Chomsky 1995, Harley and Noyer 1999), syntax is the center for operations on morphosyntactic features. The morphemes and features at syntax are spelled out at the Phonological Form (PF) and the Logical Form (LF).

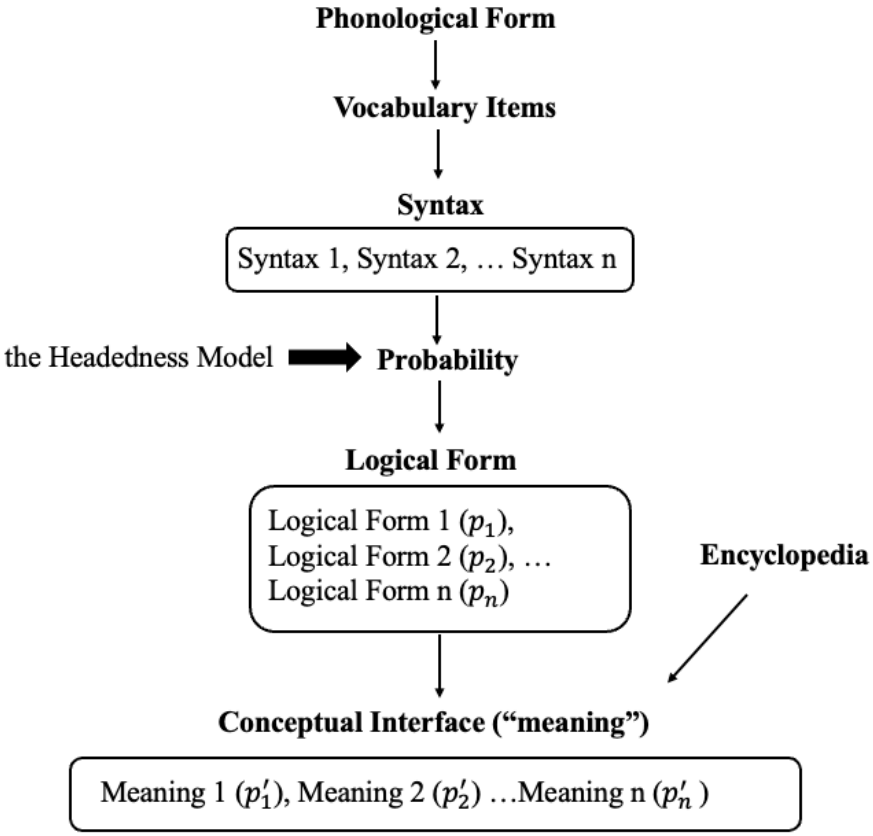
Based on the experiment conducted in this study, I propose a language cognitive model from a perception perspective, grounded in the assumption of different language modules like the Y-model, as illustrated in Figure 2. From a perspective aspect, the initial stage involves the perception

of the phonological form (PF), followed by the recognition of the vocabulary items. People discern vocabulary items between lexical morphemes (l-morphemes) and functional morphemes (f-morphemes). The results are sent to syntax for the morphosyntactic analysis. Upon transmission to the syntax module, all possible morphosyntactic operations are generated, denoted as syntax1, syntax2, syntax3, and so on. Syntax is essentially blind in this respect; it generates both nominal and verbal structures for NV and VN compounds.

These syntactic structures subsequently undergo probability analysis, which is likely to be based on the participants' linguistic knowledge. In the present experiment, the probability of choosing either a nominal head or a verbal head is influenced by the Headedness Model, in particular, by four factors (see below for discussion): *Right-headedness*, *Verbal Constituent at the Left, Presence of Nominal Constituents*, and *Presence of Verbal Constituents*. Native speakers recognize these factors through their knowledge of the compounds. This is demonstrated by the experimental data on NV and VN compounds in Test 1, where different possibilities arise from combined probabilistic factors.

Following the probability analysis, different syntactic forms correspond to different potential logical forms, denoted as Logical Form *1* (p_1), Logical Form *2* (p_2), etc., with p_n representing the probability of Logical Form *n*. Accordingly, these logical forms and the vocabulary items' potential encyclopedic knowledge output meanings such as Meaning *1* (p_1'), Meaning *2* (p_2'), etc. Due to the influence of encyclopedic knowledge, these meanings are not necessarily directly equivalent to their corresponding logical forms. In this experiment, however, I controlled the influence of encyclopedic knowledge as much as possible by using words that are in some way unfamiliar and illogical. Thus, the results of p_n' can largely reflect the results of p_n.

Figure 2. The Language Perception Model with Probability



3.4 A Weighted Constraints Model for Headedness in Mandarin

In the exploration of Harmonic Grammar (HG), Pater (2009) introduces weighted constraints in Optimality Theory (OT) and claims that it has a strong applicability to Universal Grammar (UG). In this theoretical context, our study uses the OT model with weighted constraints to analyze headedness. I chose this model for several reasons: First, headedness is influenced by various factors, none of which are decisively dominant, as illustrated in the discussion of VV and NV compounds. Second, while some factors have a stronger influence on participants' interpretations, others have less of an impact. Third, this approach fits well with the statistical model I employed in our experiment, thus enhancing the interpretability of our findings. Finally, at this stage, I can ignore precise semantic differences, because the compounds I analyzed are unfamiliar neologisms in Mandarin, which reduces the potential semantic impact.

3.4.1 The constraint set for headedness

Four constraints were chosen for the model, namely, *Right-headedness*, *Verbal Constituent at Left*, *Presence of Nominal Constituents*, and *Presence of Verbal Constituents*.

Based on the experimental data, I first posit that the default headedness principle for Mandarin compounds is right-headedness. The Headedness Principle proposed by Packard (2000) can be divided into two principles: (1) for nominal compounds, nominal constituents are located on the right and (2) for verbal compounds, verbal constituents are on the left. Thus, nominal compounds are inherently right-headed. As discussed in Section 3.2.4, this right-headed principle also applies to NV compounds, while the Headedness Principle cannot be used to accurately predict the results of NV compounds. The prevalence of right-headedness in Chinese compounds is also supported by Ceccagno and Scalise (2006). They state that "the canonical position of the head in Chinese compounds is on the right."

The second article from the Headedness Principle regarding the position of the verbal constituent is also identified as an important constraint. Using statistical data and case studies, Huang (1997) and Packard (2000) confirm that verbal compounds typically feature the verbal constituent on the left. In addition, Ceccagno and Basciano (2007) observe that among the subordinate compounds, nominal subordinate compounds consistently exhibit right-headedness, while verbal subordinate compounds exhibit left-headedness.

Moreover, I include the *Presence of Nominal Constituents* and the *Presence of Verbal Constituents* as additional constraints, because the presence of both nominal and verbal constituents can provide corresponding nominal and verbal heads. If these heads exert a strong influence on the compound, they may change the overall head of the compound.

3.4.2 Weights for constraints and outcomes

Constraints *Right-headedness*, *Verbal Constituent at Left*, *Presence of Nominal Constituents*, and *Presence of Verbal Constituents*, are respectively weighted 2, 2, 1, and 1. Instead of using the binary +1/-1 system, I employ a +N/+V system to calculate the proportions of occurrences as nominal and verbal constituents.

Given both *Right-headedness* and *Verbal Constituent at Left* have a stronger impact on determining the final head of a compound, they are assigned a weight of 2. *Right-headedness* is a neutral designation that can be applied to both nominal and verbal properties, provided they are located on the right side of a compound. V*erbal Constituent at Left* assigns value exclusively to verbal properties, and are considered invalid if there is no verbal constituent present on the left.

Presence of Nominal Constituents and *Presence of Verbal Constituents* have a smaller effect on headedness and are therefore only assigned a weight of 1. The weights for the *Presence of Nominal Constituents* and the *Presence of Verbal Constituents* are multiplied by the frequency of occurrence. For example, if a nominal constituent occurs twice, as in NN compounds, weight 1 is multiplied by 2 to give the final value of 2N. When there is no nominal or verbal constituent in the targeted compound, these constraints do not apply and therefore have no effect.

The assignments are as follows: 4N for NN compounds, 1N and 3V for NV compounds, 3N and 3V for VN compounds, and 6V for VV compounds, as shown in Table 11 below.

Table 11: The Headedness Model for Mandarin compounds (with weighted constraint)

	Right-headedness (2)	**Verbal Constituent at Left (2)**	**Presence of Nominal Constituents (1)**	**Presence of Verbal Constituents (1)**	In total (nominal prediction)
NN	2N	/	2N (1×2)	/	4N (100%)
NV	2V	/	1N	1V	1N, 3V (25%)
VN	2N	2V	1N	1V	3N, 3V (50%)
VV	2V	2V	/	2V (1×2)	6V (0%)

According to this model, the corresponding proportions for nominal properties are 100%, 25%, 50%, and 0%, and 0%, 75%, 50%, and 100% for verbal properties. These results are in good agreement with the results from Experiment Test 1. Table 12 reorganized the nominal and verbal responses for NN, NV, VN, and VV compounds as follows:

Table 12: Predictions and actual responses for Mandarin compounds

	Verb types	**Nominal Predictions**	**Verbal Predictions**	**Nominal Responses**	**Verbal Responses**	**F1 score (nominal)**	**F1 score (verbal)**
NN	/	100%	0%	95.1%	4.9%	0.975	0.0
NV	unaccusative monovalent verbs	25%	75%	27.9%	72.1%	0.945	0.980
	unergative monovalent verbs	25%	75%	27.9%	72.1%	0.945	0.980
	unaccusative divalent verbs	25%	75%	30.6%	69.4%	0.899	0.961
	unergative divalent verbs	25%	75%	27.6%	72.4%	0.951	0.982
VN	unaccusative monovalent verbs	50%	50%	65.2%	34.8%	0.868	0.821
	unergative monovalent verbs	50%	50%	53.2%	46.8%	0.969	0.967

	unaccusative divalent verbs	50%	50%	55.7%	44.3%	0.946	0.940
	unergative divalent verbs	50%	50%	44.7%	55.3%	0.944	0.950
VV	/	0%	100%	8.8%	91.2%	0.0	0.954

Nominal and verbal F1 scores were calculated for each category based on precision and recall. The F1 scores range from 0 to 1, with scores closer to 1 indicating that the model performs better in terms of precision and recall. Except for VN compounds with unaccusative monovalent (intransitive) verbs, all other compound types showed F1 scores greater than 0.9, indicating that the model generally predicts the experimental results well. VN compounds with unaccusative monovalent verbs will be discussed in more detail in the next chapter.

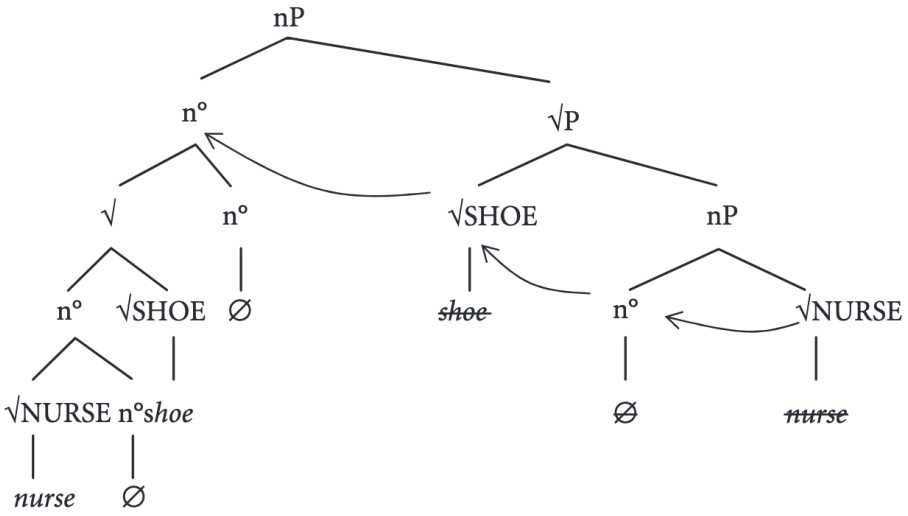
Overall, this model explains the experimental results well and accurately describes all cases except for the special case involving unaccusative monovalent verbs in VN compounds. The explanatory power of this model is also evidenced by the approximately 75% acceptability observed for the various verb types in NV compounds. Although there is some sense of ad hoc reasoning in the assignment of weights and values, these assignments are tenable and justified. Intermediate results, like approximately 25% nominal and 75% verbal, were found in the experiment data. This indicates that there should be multiple factors rather than one binary factor influencing participants' judgments.

3.5 The Morphosyntactic Analysis of Mandarin Compounds

Harley (2009) uses Distributed Morphology to analyze English compounds and examines synthetic argument compounds, synthetic modifier compounds, primary compounds (root compounds), and phrasal compounds. In this study, I adopt the framework of primary compounds to analyze the Mandarin disyllabic compounds in our experiment, particularly for NN, NV and VV compounds, since there is no argument or event structure between compounding elements.

For the NN primary compound *nurse shoe*, Harley (2009) analyzes its underlying structure as follows in (14). √NURSE first merges with a nominalizing head n^o, and then incorporates to √SHOE. Then the structure with the complex head merges with the categorizing head n^o.

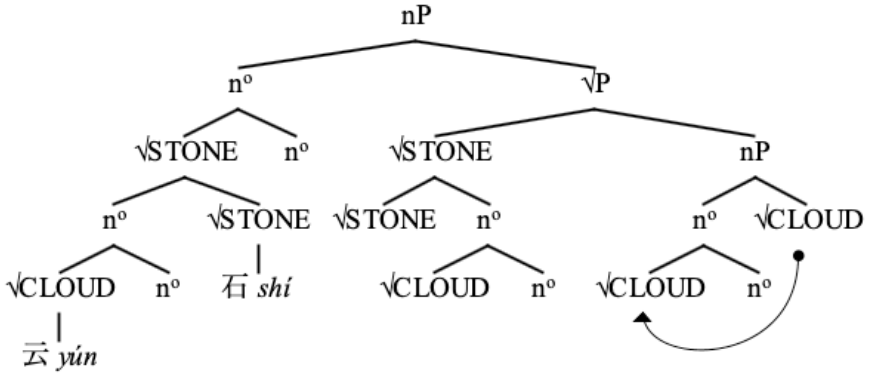
(14)



This analysis proposes that the modifying nominal, such as √NURSE, is introduced to the head noun, i.e., √SHOE in the example, before the head noun gets its categorical head. Since in Mandarin, compounds are mostly right-headed, in most cases the lefthand constituent incorporates into the righthand constituent. Respectively, N1 incorporates into N2 in $[N1\ N2]_N$ compounds, N incorporates into V in $[N\ V]_V$ compounds, V incorporates into N in $[V\ N]_N$ compounds, and V1 incorporates into V2 in $[V1\ V2]_V$ compounds.

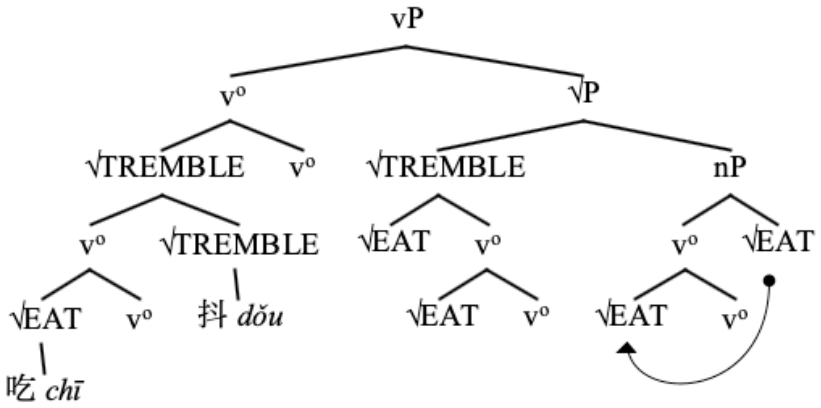
The NN structure is exemplified with 云石 *yún-shí* "cloud-stone" in (15). The root √CLOUD and √STONE are first nominalized by merging to the nominalizing head n°, as this root is always merged to the nominal head in Mandarin. The nominalized nP then incorporates to the righthand root √STONE, and the whole structure gets nominalized since √STONE is also only used as a nominal constituent in Mandarin. After the categorizing stage, the constituents are spelled out at PF as 云 *yún* "cloud" and 石 *shí* "cloud-stone".

(15)



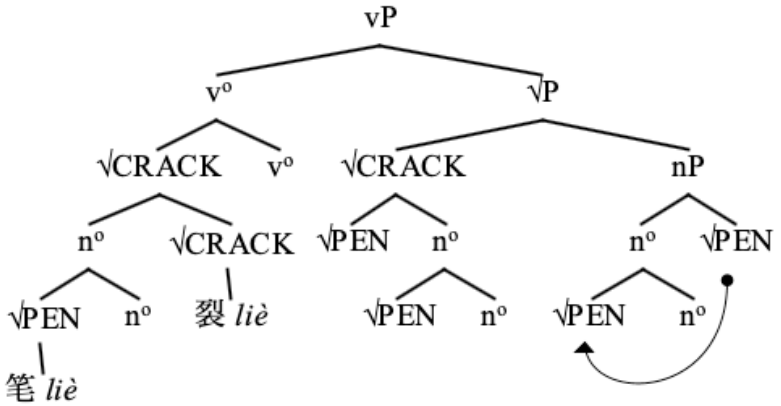
As for VV compounds, similar operations happen in morphosyntax. Here I take 吃抖 *chī-dǒu* "eat-tremble" as an example. At first, the lefthand constituent √EAT merges with the verbalizing head v^o through head-movement, determined by the verbal property of √EAT in Mandarin. This structure incorporates to the righthand constituent √TREMBLE also through head-movement. Since √TREMBLE also contains strong verbal properties, the whole structure merges again to the verbalizing head v^o. Afterwards, they are spelled out at PF as 吃 *chī* "eat" and 抖 *dǒu* "tremble" respectively.

(16)



Categorical alternations occur in NV and VN compounds. In NV compounds, the lefthand is first nominalized, as in (17), the root √PEN from the NV compound 笔裂 *bǐ-liè* "pen-crack" first merges to n^o. Then the structure incorporates to the root √CRACK. The complex constituent merges with the verbalizing head v^o since √CRACK is always verbalized in Mandarin. This nP spells out as 笔裂 *bǐ-liè* "pen-crack" at PF.

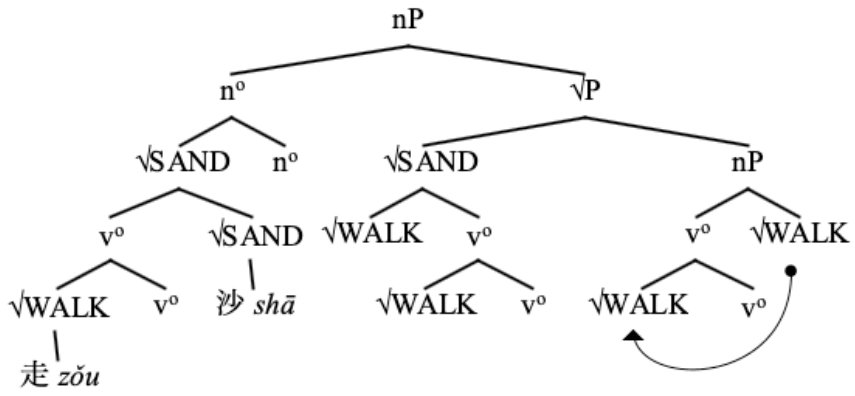
(17)



With regards to VN compounds, the lefthand component first merges to the verbalizing head v^o, such as the root √WALK in (18) 走沙 *zǒu-shā* "walk-sand". The verbalized structure incorporates

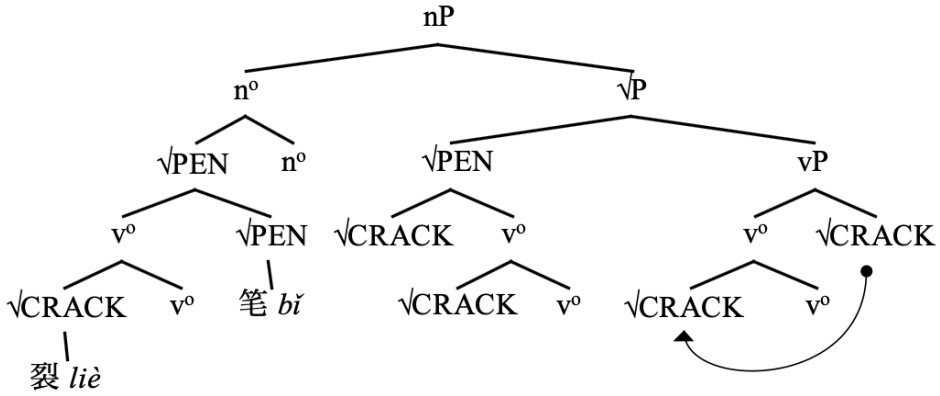
again to the righthand root √SAND. The complex structure merges to the nominalizing head n^o, and is finally spelled out as 走沙 *zǒu-shā* "walk-sand". As mentioned before, VN compounds have a more complex argument structure, thus will be discussed further in Chapter 4. Here is just a tentative analysis based on the hypothesis of right-headedness.

(18)

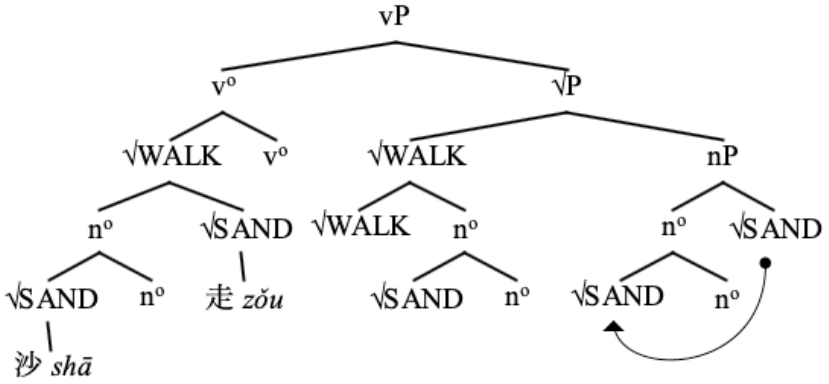


According to the Language Perception Model with Probabilities, syntax operates without bias, generating all the possible structures. Based on the model, the nominal interpretations of NV compounds and the verbal interpretations of VN compounds are also generated in syntax. In such situations, the actual heads of these compounds are left-handed. Their underlying morphosyntactic structure also differentiates with the right component incorporating to the left component.

(19)



(20)



(19) is the nominal structure for the NV compound 笔裂 *bǐ-liè* "pen-crack", and (20) is the verbal structure for the VN compound 走沙 *zǒu-shā* "walk-sand".

3.6 Conclusion

This chapter examined current studies on headedness in Mandarin compounds using data collected from Test 1 of the experiment. I put forward a new Language Perception Model with Probabilities, mirrored to the Y-model in language generation. While Syntax remains blind and neutral to potential structures, generating both nominal and verbal structures for NV and VN compounds, the probabilities of using them as nominal or verbal compounds are constrained by the previous language knowledge, thus influencing their corresponding logical forms and meanings.

To better integrate the theoretical and experimental observations, I proposed a new model for the headedness of Mandarin compounds, inspired by the weighted constraints in Optimality Theory proposed in Harmonic Grammar (Pater 2009). In this new model, four constraints are posited: *Right-headedness*, *Verbal Constituent at Left*, *Presence of Nominal Constituents*, and *Presence of Verbal Constituents*, with respective weights of 2, 2, 1, and 1. This weighting system greatly enhances explanatory power of the moded for experimental results and provides a more nuanced understanding of the headedness for Mandarin compounds. Besides, I analyzed the morphosyntactic structures of these compounds within the framework of Distributed Morphology.

Chapter 4 VoiceP and Nominalization

4.1 Introduction

The results of Test 1 revealed an additional puzzle: newly-composed VN compounds were only significantly regarded as nouns, in the way of matching with the nominal classifier, when the verbal constituent of VN compounds was an unaccusative monovalent verb. For the other three verb types, unergative monovalent verbs, unaccusative divalent verbs, and unergative divalent verbs, participants did not exhibit significant preferences for either nominal or verbal interpretations.

This chapter aims to investigate the argument structure behind VN compounds, and explain the reason why unaccusative monovalent verbs are judged differently than other verb types. Alexiadou, Anagnostopoulou and Schäfer (2015, henceforth AAS 2015) claims that the underlying difference between unaccusative monovalent verbs and others verbs is the Voice Phrase (VoiceP). While all other three types of verbs have VoiceP to introduce external argument, unergative monovalent verbs do not have VoiceP. The same framework and discussion also apply to Mandarin unaccusatives. I propose that the lack of VoiceP enhances the nominal properties of VN compounds.

This chapter is organized as follows: Section 2 introduces the types of verbs used in the experiment and specifies the difference of unaccusative monovalent verbs. Section 3 discusses the correlation between VoiceP and nominalization and examines the morphosyntactic structure of VN compounds. Section 4 concludes.

4.2 Verb Types

4.2.1 Four types of verbs used in this study

Under the Unaccusative Hypothesis (Perlmutter 1978, Burzio 1986), unaccusative verbs have their subjects first generated at the object position. In contrast, unergative verbs have their subjects directly generated at the subject position. From the analysis on the argument structure (Williams 1981, Levin and Rappaport 1986), unaccusative verbs only have internal arguments and do not have external arguments, while unergative verbs only have external arguments rather than internal arguments.

Huang (1989, 2007) employs this distinction on unaccusatives and unergatives in his analysis for Mandarin verbs. However, he only takes the idea that unaccusatives can have their subjects first generated as internal arguments, and unergative only have their subjects first generated as external arguments, without restricting the number of arguments unaccusatives and unergatives can take. As a result, there are monovalent, divalent, and even trivalent unaccusatives and unergatives in

Mandarin according to Huang (1989, 2007). For instance, 摇 *yáo* "shake" can be monovalent in example (21a), with only the internal argument 杯子 *bēizi* "cup", and can be divalent in sentence (21b) with an internal argument 杯子 *bēizi* "cup" and an external argument 他 *tā* "he". Since 摇 *yáo* "shake" in (21b) can possibly take only the internal argument as in (21a), 摇 *yáo* "shake" in (21b) is regarded as a divalent unaccusative verb rather than a divalent unergative verb.

(21a)	杯子	摇了。	
	bēizi	*yáo-le*	
	cup	shake-PFV	
	The cup shaked.		
(21b)	他	摇了	杯子
	tā	*yáo-le*	*bēizi*
	He	shake-PFV	cup
	He shaked the cup.		

Unergative verbs like 吃 *chī* "eat", in contrast, cannot only take the internal argument, such as in (22a)[5]. The verb 吃 *chī* "eat" requires the occurrence of an external argument. When there is only the external argument there, such as in (22c), 吃 *chī* "eat" is a monovalent unergative verb, according to Huang (1989, 2007). When both the external argument and internal argument appear, as in (22b), 吃 *chī* "eat" is a divalent unergative verb.

(22a)*/?	沙拉	吃了。	
	shālā	*chī-le*	
	salad	eat-PFV	
	The salad ate.		
(22b)	他	吃了。	沙拉
	tā	*chī-le*	*shālā*
	He	eat-PFV	salad
	He ate the salad.		

[5] (22a) is grammatical when 沙拉 *shālā* "salad" is taken as the topic of the sentence. However, even in topicalization, there is still the external argument in the context. For example, the topicalization can be elicited in the following question:

(23)A:	小刘	什么	吃了，	什么	没	吃？
	xiǎoliú	*shénme*	*chī-le*	*shénme*	*méi*	*chī*
	Xiaoliu	what	eat-PFV	what	NEG	eat
	What did Xiaoliu eat, and what didn't he eat?					
B:	沙拉	吃了，	米饭	没	吃。	
	shālā	*chī-le*	*mǐfàn*	*méi*	*chī*	
	salad	eat-PFV	rice	NEG	eat	
	The salad, (he) ate.	The rice, (he) didn't eat.				

(22b) 他 吃了。
tā *chī-le*
He eat-PFV
He ate.

In this study, in order to separate those verbs that have the potential to take either one or two arguments and those can only take one argument, I name the former with a maximum ability as divalent verbs, and the latter as monovalent verbs. For instance, 摇 *yáo* "shake" has the potential to be transitive and divalent, and there are verbs like 落 *luò* "fall" can hardly be divalent. I only categorize the verbs represented by 落 *luò* "fall" as monovalent verbs, and make verbs like 摇 *yáo* "shake" into the group of divalent verbs. Limited by the size and complexity of the experiment, trivalent verbs are not taken into account in the present study. In this way, I have four types of verbs, namely, unaccusative monovalent verbs exemplified by 落 *luò* "fall", unergative monovalent verbs such as 走 *zǒu* "walk", unaccusative divalent verbs like 摇 *yáo* "shake", and unergative divalent verbs like 喝 *hē* "drink".

4.2.2 The uniqueness of unaccusative monovalent verbs

Syntactically, the main difference between unaccusatives and unergatives is that the unaccusatives can take internal arguments as subjects while unergatives cannot. Unaccusatives divalent verbs are also labelled as causative verbs, and transitive verbs for unergative divalent verbs (Burzio 1986). In Mandarin, Li (1985), Lyu (1987) and Huang (1989) also find these divalent unaccusatives have a stronger causative implication than other types of verbs. In other words, unaccusative divalent verbs can have the *causative alternation* (Levin and Rappaport Hovav 1995, Schäfer 2009), while unaccusative monovalent verbs cannot. Here I take unaccusative divalent verbs *break* in English and 转 *zhuǎn* "rotate" in Mandarin as examples. Examples (24a) and (25a) are the *anticausative variants of break and* 转 *zhuǎn* "rotate", in which only an internal argument functions as the subject. Examples (24b) and (25b) are the causative variant of *break* and 转 *zhuǎn* "rotate", with boy in (24a) causing the window to be broken and 小李 Xiaoli in (25b) making the fan to rotate.

(24) a. The window broke.
b. The boy broke the window.

(Schäfer 2009)

(25a) 电风扇 转了。
diànfēngshàn *zhuǎnle*
fan rotate-PFV
"The fan rotated." (The fan rotated on its own.)

(25b) 小李 转了 电风扇。
xiǎolǐ *zhuǎnle* *diànfēngshàn*
Xiaoli rotate-PFV fan

"I rotated the fan." (I made the fan rotate.)

Nevertheless, Alexiadou, Anagnostopoulou and Schäfer (2015, henceforth AAS 2015) claim that anticausatives also contain a cause component, even though there is a restriction on *causative alternation*. AAS (2015: 36) argues that the actual difference between causative and anticausative predicates lies in the Voice head, and "the causative alternation is a Voice alternation". This claim follows Kratzer's (1996) proposal that Voice is responsible for the introduction of the external argument, and external arguments are base-generated in SPEC of VoiceP.

There are two tests to show the causativity embedded in unaccusative verbs. First, the cause component can be found through PPs. There are causer PPs licensed by the anticausative verb *wilt*, see (26).

(26) The flowers wilted from the heat. (AAS 2015: 30)

Second, anticausatives can also license the phrase *by itself*, with the interpretation "no particular cause", such as in (27).

(27) The plate broke by itself. (AAS 2015: 31)

Cause PPs also work for anticausative verbs in Mandarin. The typical prepositions for cause PPs are 因 *yīn* "because of", 由于 *yóuyú* "due to" and 因为 *yīnwèi* "because, because of". For example, in (28a), all the leaves on the tree fell because of the typhoon. 台风 *táifēng* "typhoon" became the causer of the event in which the leaves fell. Similarly, in (28b) and (28c), 温度变化 *wēndùbiànhuà* "temperature changes" is the causative reason for the wooden board to crack, and 病 *bìng* "illness" is the causer of Xiaowang lying at home.

(28a)	树上	的	叶子	因为	台风	都	落了。
	shùshàng	*de*	*yèzi*	*yīnwèi*	*táifēng*	*dōu*	*luò-le*
	tree-on	MM	leaf	because of	typhoon	all	fall-PFV
	All the leaves on the tree fell because of the						
(28b)	木板	由于	温度	变化	完全	裂了。	
	mùbǎn	*yóu yú*	*wēndù*	*biànhuà*	*wánquán*	*liè-le*	
	wooden board	due to	temperature	change	completely	crack-PFV	
	The wooden board completely cracked due to temperature changes.						
(28c)	小王	还	在	家里	因	病	躺着。
	xiǎowáng	*hái*	*zài*	*jiālǐ*	*yīn*	*bìng*	*tǎng-zhe*
	Xiaowang	still	at	home-in	because of	illness	lie-IPFV
	Xiaowang is still lying at home because of illness.						

Moreover, Mandarin also has the counterpart of *by itself* in the form of 自己 *zìjǐ* "self".自己 *zìjǐ* "self" can be used as an adverb directly on its own, see examples (29a) and (29b).

(29a) 电风扇 自己 转了。
diànfēngshàn *zìjǐ* *zhuǎn-le*
fan self rotate-PFV
"The fan rotated by itself."
(29b) 叶子 自己 落了。
wǒ *zìjǐ* *luò-le*
leaf self fall-PFV
"Leaves fell by themselves."

According to the causer component tests employed above, Mandarin unaccusatives also contain causers. The underlying structural difference between Mandarin unaccusative monovalent verbs and unaccusative divalent verbs is also not the causativity but the presence of VoiceP. While unaccusative divalent verbs have the VoiceP to introduce external arguments, unaccusative monovalent verbs are in lack of the VoiceP.

4.3 VoiceP

4.3.1 VoiceP in Distributed Morphology

In the discussion about the morphology of nominalization, Harley (2009) compares Kratzer's Voice^o to the verbalizing head v^o. Although there is an inclination of taking Kratzer's Voice^o as equivalent to the verbalizing head v^o, there are still reasons to distinguish these two functional heads. First, verbalizing affixes like *-ify*, *-en*, *-ize* and *ate* usually carry a causative reading, but they also appear with inchoative/causative alternating verbs. A few *-ate*, *-ify* and *-ize* verbs can be purely unaccusative, such as *capitulate*, *qualify*, and *acclimatize* (Harley 2009). Second, the head v^o is also present in unaccusative verbal structures (Harley 1995, Marantz 1997). The semantic meaning of the head v^o is closer to *become* than to *cause*. This also gives room to propose different varieties of v^o, called flavors of v°, such as four types of verbalizers in (30).

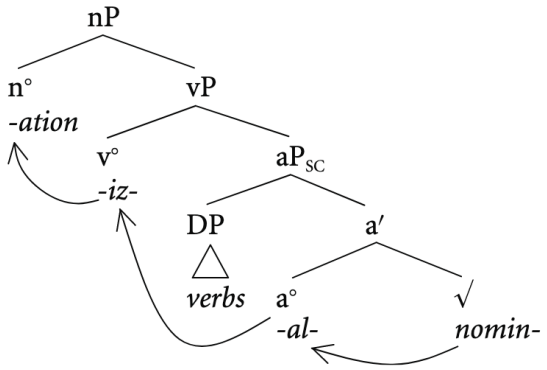
(30)

a. v_{CAUS} [+dynamic], [+change of state], [+cause]
b. v_{BECOME}: [+dynamic], [+change of state], [−cause]
c. v_{DO}: [+dynamic], [−change of state], [−cause]
d. v_{BE}: [−dynamic], [-chage of state], [−cause]

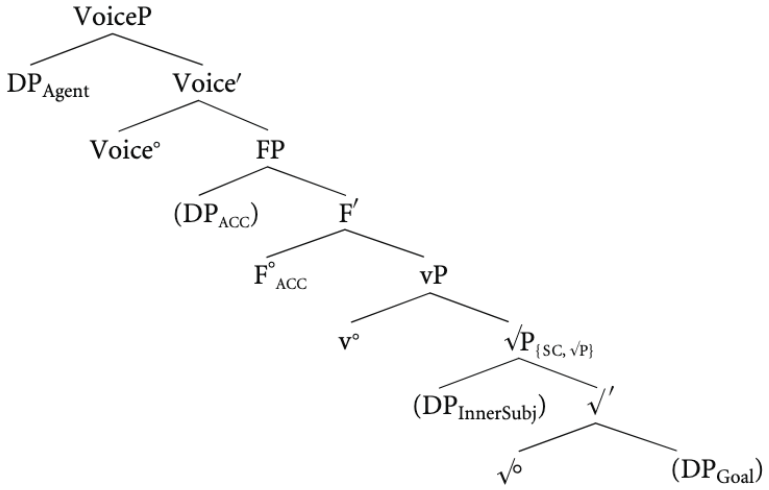
Harley (2009) further proposes that the verbalizer v^o does not select for the Case-checking head, and there is a separate external-argument-introducing head that does. If the structure only has the verbalizer v^o, the verbal extended projection with the external argument and accusative case should be available in nominalized vocabulary items such as *nominalization* and *internationalization*. In (31), *nominalization* has the the verbalizing head *-ize* embedded, but it generally functions as a

noun rather than a verb. In other words, *nominalization* cannot take external arguments like many verbs.

(31) The structure of *nominalization of verbs* (Harley 2009: 336)



(32) Full verbal structure thus far including agent-introducing head (Harley 2009: 335)



Hence, it is necessary to introduce another head to take on these functions, and Harley (2009) proposes the Voice^{o} to introduce external arguments in VoiceP. The full verbal structure with VoiceP is illustrated in (32).

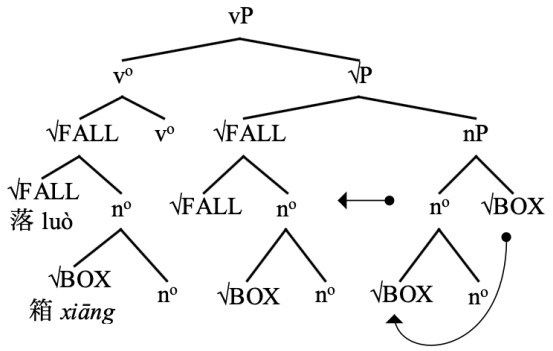
4.3.2 Morphosyntactic Structures of VN compounds

As noted by Harley (2009), it is possible and necessary to distinguish between a VoiceP and the verbalizing phrase vP. For four types of verbs in VN compounds, the status of VoiceP varies. Below, I provide the underlying structures for VN compounds with unaccusative monovalent verbs, unaccusative divalent verbs, unergative monovalent verbs, and unergative divalent verbs. In this

analysis, I propose that the properties of the verbal component remain transparent at the compound level through headedness; that is, the verbal compounds retain the properties of the verbal components.

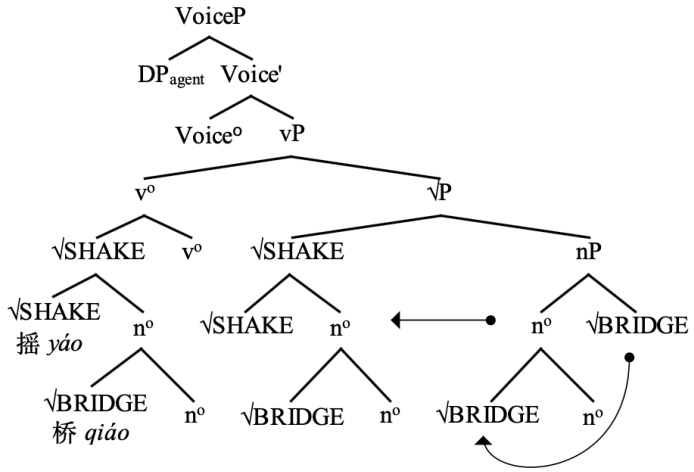
As for VN compounds with unaccusative monovalent verbs, such as 落箱 *luò-xiāng* "fall-box" newly-composed in this experiment, there is no VoiceP as previously discussed, but the verbalizing phrase vP is still present. The morphosyntactic structure of 落箱 *luò-xiāng* "fall-box" is illustrated in (30). The unaccusative properties of the verb 落 *luò* "fall" remain in the verbal compound made by it, especially when 落 *luò* "fall" acts as the head of the neologism.

(30)



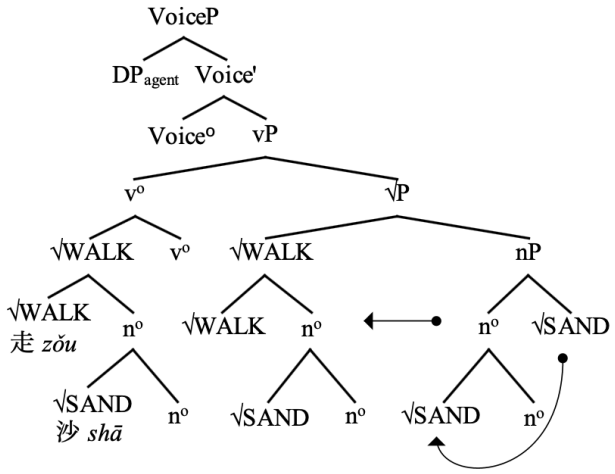
In contrast, since unaccusative divalent verbs have both VoiceP and vP, VN compounds with these verbs also have both VoiceP and vP, as exemplified by 摇桥 *yáo-qiáo* "shake-bridge" in (31). It is also possible for these compounds to get an external argument.

(31)



For VN compounds with unergative monovalent verbs, it is still possible to get a VoiceP. Although unergative verbs are intransitive and typically take only one argument, they can incorporate a nominal component through compounding. When this happens, the nominal part becomes integrated into the verb, resulting in a VN compound. This new VN compound functions as a complex unergative verb, which is still monovalent. For example, 走 *zǒu* "walk" is an unergative monovalent verb. The neologism 走沙 *zǒu-shā* "walk-sand" used in this study is made of 走 *zǒu* "walk" through incorporating the nominal component 沙 *shā* "sand" into it. As 走 *zǒu* "walk" functions as the head of the compound, the new compound 走沙 *zǒu-shā* "walk-sand" still keeps the properties the 走 *zǒu* "walk", and the new compound 走沙 *zǒu-shā* "walk-sand" also performs as an unergative monovalent verb.

(32)

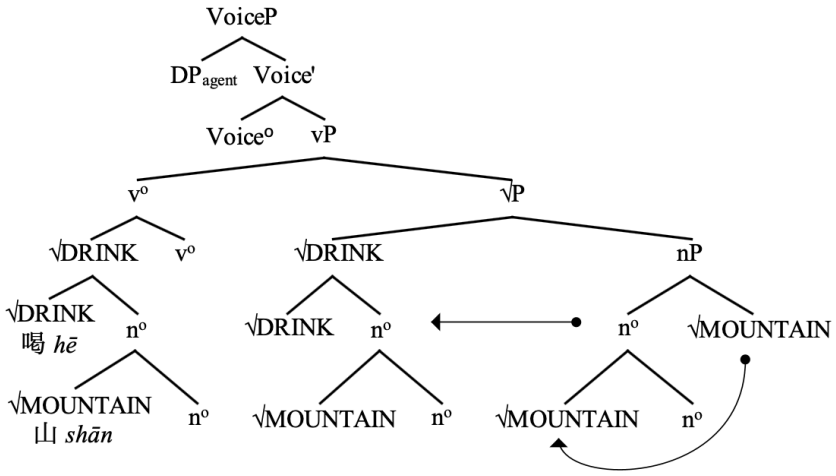


When the verb is transitive, i.e., unergative divalent, it is also natural to keep the transitivity. The nominal element incorporated into the verbal complex head can be regarded as the internal argument of the verb, and there is still the position for the external argument introduced by the Voiceº. For example, 喝山 *hē-shān* "drink-mountain" is a newly-composed compound with the the unergative divalent verb 喝 *hē "*drink", and the structure is illustrated in (33b). Regardless of the anomalous meaning, the phrase (33a) with the agent 她 *tā* "she" and the VN 喝山 *hē-shān* "drink-mountain" is acceptable to native speakers. Native speakers can either interpret the phrase in a tight SVO structure as (i) "She drinks mountain", or in a more compacted way as (ii) "She drink-mountains". In (ii), *drink-mountain* becomes a specific action with less compositionality. This also makes

(33a) 她 喝山

tā *hē-shān*
she drink-mountain
(i) She drinks mountain
(i) She drink-mountains

(33b)



As such, I claim that morphosyntactic structure of VN compounds is largely determined by the properties of the verbal component. Given that unaccusative monovalent verbs lack VoiceP, VN compounds formed with these verbs also lack VoiceP. In contrast, VN compounds involving unaccusative divalent, unergative monovalent, or unergative divalent verbs maintain the potential to include VoiceP derived from their verbal components.

5.3.3 From VoiceP to nominalization

In the discussion of argument-taking nominals, Grimshaw (1990) proposes that the external argument of the base verb is suppressed. She also points out that suppression of the external argument not only goes for nominalization, but also for passivization. She uses the annotation Ø to indicate that the argument has been suppressed, as exemplified in (34). Those suppressed positions cannot take arguments, but can still license argument adjuncts (a-adjuncts), such as the *by* phrase *by the enemy* in (34c) and the possessive *the enemy's* in (34b). Although these a-adjuncts resembles arguments, Grimshaw (1990) argues that they are indeed adjuncts rather arguments since they are not theta-marked and are not required to appear to satisfy argument structure. Both the *by* phrase *by the enemy* and the possessive *the enemy's* are optional.

(34a) The enemy destroyed the city.
destroy (x (y))
Agent Theme
(34b) The enemy's destruction of the city

destruction (R (x-Ø (y)))
Agent Theme

(34c) The city was destroyed by the enemy.
destroyed (x-Ø (y))
Agent Theme

Here is the annotation adopted from Grimshaw (1990) for 4 verb types discussed in this study. As for unaccusative monovalent verbs, they just have the Theme, and the Agent is absent, as in (35a). Unergative monovalent verbs are the opposite, only with the Agent but not the Theme. Both unaccusative divalent and unergative divalent verbs have their Agent and Theme for the transitivity, as in (35c) and (35d).

(35a) Unaccusative monovalent
((x))
Theme

(35b) Unergative monovalent
((x))
Agent

(35c) Unaccusative divalent
(x (y))
Agent Theme

(35d) Unergative divalent
(x (y))
Agent Theme

If nominalization requires that the Agent, the external argument, be suppressed, as stated by Grimshaw (1990), then unaccusative monovalent verbs naturally satisfy this criterion, since there is no Agent, only the Theme exists. The other three verb types include the Agent as the external argument, which sets up a less economical structure for nominalization, and at least requires suppression before nominalization can be completed.

Following the proposal that VoiceP introduces the external argument (Kratzer 1996, AAS 2015), I propose that nominalization is rooted in VoiceP. The suppression of the external argument is the suppression of Voice^{o}. Since there is no VoiceP for unaccusative monovalent verbs, but is VoiceP for other types of verbs, unaccusative monovalent verbs can be nominalized in an easier way due

to the lack of VoiceP, while the other three types still need to take an effort to suppress Voice^{o} and as a consequence, suppressing the external argument.[6]

4.4 Conclusion

This chapter delves into the distinction between unaccusative monovalent verbs and the other three verb types used in the experiment, i.e., unergative monovalent verbs, unaccusative divalent verbs, and unergative divalent verbs. Based on AAS (2015), the structural difference is that unaccusative monovalent verbs do not have VoiceP, which takes the responsibility of introducing the external argument. I further propose that VoiceP is relevant to nominalization. The VoiceP must be suppressed to satisfy the requirement on nominalization, as built on Grimshaw's (1990) theory with the suppression of the eternal argument for nominalization. Since unaccusative monovalent verbs do not have VoiceP, it makes this type of verb much easier to be nominalized by participants.

[6] In English the situation is more complex. An interesting phenomenon about unaccusative predicates mentioned by Borer (2012) is that synthetic compounds formed by unaccusative predicates can only get their transitive readings, which is the causative reading in this paper. For example, the synthetic compound *ship sinking* can only be interpreted with *sink* as a transitive verb, the same with *tomato growing*. As for those unaccusative verbs that do not have the causative alternation, they cannot form synthetic compounds either, such as **tree falling* and **train arriving*. This phenomenon is called the obligatory transitivity of synthetic compounds.

Chapter 5 Malleability and Productivity

5.1 Introduction

With poor morphological derivations for categorical shifts in Mandarin, there are many compounds that can function either as a verb or as a noun, such as 跑步 *pǎobù* "run-step" "to run; running". Test 2 examined the malleability of each compounding form by embedding them into different verbal and nominal functional structures. Participants were asked to what extent they could accept phrases embedding new compounds on a 7-degree Likert scale. When they significantly accept these phrases with nominal functional structures, it suggests that these compounds can be regarded as nouns. Likewise, when they accept compounds with verbal functional structures, these compounds are regarded as verbs.

This chapter mainly discusses the phenomena observed in Test 2 and tries to explain the puzzles behind these phenomena. As for the weak malleability of NN compounds and the strong malleability of VN compounds, we propose that it is important that syntax generates the structure at the initial stage. I claim that the non-preference of NV compounds in functional structures is to be attributed to the non-productivity of NV compounds. Due to their non-productivity, there is no strong rule formed by native speakers for their properties within functional structures.

The structure of this chapter is as follows. Section 2 discusses the malleability for different types of compounds observed under functional structures. Section 3 investigates the productivity of Mandarin disyllables with statistical methods. Based on the discussion with functional structures and productivity, I advance the Language Perception Model with Probability accordingly. Section 4 concludes the chapter.

5.2 Functional Structures and Malleability

5.2.1 Different malleability for four types of compounding

Based on Borer's (2005a, 2005b, 2013, 2014) Exo-skeletal Model, it is the functional structure that determines the lexical property of the vocabulary items, rather than the other way around. Different lexical categories come from distinct syntactic structures. In the present work, we tested if functional structures can influence the acceptability of compounds. Varied results were found among different types of compounding.

NN compounds were significantly rejected within all the verbal functional structures and accepted within all the nominal functional structures, indicating that participants strongly perceived NN compounds strictly as nouns, which also aligns with the results for NN compounds in Test 1. Moreover, these NN compounds are not flexible to categorical shifts.

In the same vein, VV compounds were significantly accepted in all verbal functional structure. I also found VV compounds being accepted in one of four nominal combination, functioning as the internal argument of 喜欢 *xǐhuān* "like" in N4 (as illustrated in Table 4). In this case, VV compounds got an average score of 3.81 out of 6 ($p < 0.001$*). Given the verbal nature of VV compounds, we assume that the nominal use that appears here is deverbal. From the discussion of nominalization in English, there are three different types of deverbal nominals, gerunds, derived nominals, and mixed nominalization (Lees 1960, Chomsky 1970, Kratzer 1993, Marantz 1997, Alexiadou 2001, a.o.). The examples in (36) are given by Alexiadou (2001: 1) for the illustration of these deverbal nominal types. VV compounds in N4 are actually nominalized as gerunds. It is systematic and productive for Mandarin disyllabic verbs to be nominalized as gerunds (Cheng and Cheng 2022). This form of nominalization is also very productive in English (Alexiadou 2001).

(36a) John's criticizing the book (Gerund)

(36b) The barbarian's destruction of the city (Derived Nominal)

(36c) Belushi's mixing of drugs led to his demise (Mixed Nominalization)

Alexiadou (2001: 1)

As for VN compounds, participants accepted them within both nominal and verbal functional structures, and did not show any significant rejection in any cases. The difference from VN compounds and VV compounds is that VN compounds are not only accepted in the functional structure N4, but also in N1 with 一些 *yīxiē* "some". This suggests that VN compounds are very flexible to categorical shifts, and they can function both as verbs and nouns in the same form, not only as gerunds but also as derived nominals.

Interestingly, NV compounds, despite showing significant verbal interpretations in Test 1, exhibited no clear pattern or tendency in Test 2, except the verbal preference by participants for V1 一下 *yīxià* "a bit". In other words, participants did not accept NV compounds as nominalized events (N4) or as verbs (V2, V3, V4) as they did for VV compounds.

5.2.2 Malleability and Syntactic Generation

In Section 3.3, I proposed a Language Perception Model with Probability. Here, I aim to explain the varying performance in malleability using this model. Within the model, syntax operates blindly and can generate all possible structures for compounds. However, there is a limitation on the structures generated by syntax, which reflects their malleability.

For NN compounds and VV compounds, only nominal and verbal structures are generated respectively. This is due to the absence of an additional categorical head for verbal structure in NN

compounding and nominal structure in VV compounding. The nominal use of VV compounds as gerunds occurs after these VV compounds are first verbalized. This can be concluded from the fact that nominal VV compounds are only available in the form of gerunds, which align with the result that nominal VV compounds only appear under N4 喜欢 *xǐhuān* "like".

Regarding VN compounds, both nominal and verbal structures can be generated. Although these compounds can potentially be used as either nouns or verbs, the functional structure specifies the targeted syntactic structure. Within nominal functional structures such as N1 一些 *yīxiē* "some" and N2 所有 *suǒyǒu* "all, they are interpreted as nouns. Conversely, under verbal functional structures like V2 了 *le* (the perfective aspect marker) and V4 慢慢地 *mànmànde* "slowly", these compounds are interpreted as verbs.

5.3 Productivity

As a central concept in derivational morphology, productivity typically denotes the ability to create neologisms using a specific morpheme or a word formation rule (WFR) (Schultink 1961, Aronoff 1976, among others). The discussion on productivity in Mandarin focuses on NN and VN compounds, with less discussion on VV and NV compounds. In the analysis of different compounding strategies, Li and Thompson (1981: 48) highlight the productivity and creativity of nominal compounding in the NN pattern, observing that "native speakers can create new ones in their speech whenever the speech context is appropriate".

Steffen Chung (1994) investigates the productivity of VN function-describing compounds in Chinese, noting their prominence during the early Zhou dynasty (1046 BC-256 BC). According to Steffen Chung, these compounds experienced a peak in productivity followed by a sharp decline—a trend that mirrors the historical development of similar compounds in English. Basciano et al. (2011) agree that the productivity of such compounds in contemporary Mandarin has become limited. However, they identify synthetic VN compounds as an exception, which continue to demonstrate considerable productivity. For example, the suffix 者 *zhě*, used to denote the agent performing the action of the verb, exhibits productivity in the formation of compounds such as 舞者 wǔzhě "dance-zhě = dancer", 造谣者 *zàoyáozhě* "make-rumour-zhě = rumour monger", and 求职者 *qiúzhízhě* "seek-job-zhě = job applicant". The function of 者 *zhě* in Mandarin closely parallels the use of the suffix *-er* in English, which also marks the action verbs into agents. However, these examples are not considered in this study because they depend heavily on the functional suffix 者 *zhě*, and our focus is on primary compounds that do not utilize such functional affixes.

Aronoff (1976) critiques the ambiguous nature of the concept of productivity, a suggestion that also applies to Mandarin compounding patterns. To enhance the understanding of productivity, it is essential to incorporate statistical methodologies into the analysis. In this section, I will

introduce Baayen and Lieber's (1991) and Baayen and Renouf's (1996) methods of quantifying morphological productivity, and Mayers' (2015) application in Mandarin compounds.

5.3.1 Quantifying Morphological Productivity

Aronoff (1976) first proposes a method to measure productivity. For a given WFR, he suggests that productivity can be calculated by dividing the number of types generated by the WFR by the number of potential types. Baayen and Lieber (1991) argue that this type-based approach does not accurately capture native speakers' intuition about productivity. Dissatisfied with Aronoff's (1976) method for calculating the index of productivity, Baayen and Lieber (1991) take tokens into consideration and introduce the concept of hapax legomena to quantify morphological productivity. Hapax legomena refers to word types that appear only once in the sample, making them particularly relevant to neologisms. Baayen and Lieber (1991) argue that the occurrence of hapax legomena with a given affix in the corpus can predict morphological productivity.

Baayen and Lieber (1991) and Baayen and Renouf (1996) propose two statistical methods to quantify the degree of productivity of certain morphological strategies. For a given vocabulary size V_N, the hapax legomena is denotated as $V_N(1)$. When the hapax legomena is associated with a specific affix, such as *c*, it is denotated as $V_N(1, c)$, representing word types with affix c that only occur once in the sample.

The first measurement compares $V_N(1, c)$ to the number of all the hapax legomena tokens in the sample, h_N, regardless of different affixes. The ratio is presented in Equation (37):

$$(37)\ P^*_{N,c} = \frac{V_N(1,c)}{h_N}$$

The second measurement compares $V_N(1, c)$ to the number of tokens with the affix c, N_c, as shown below in Equation (38).

$$(38)\ P_{N_c} = \frac{V_N(1,c)}{N_c}$$

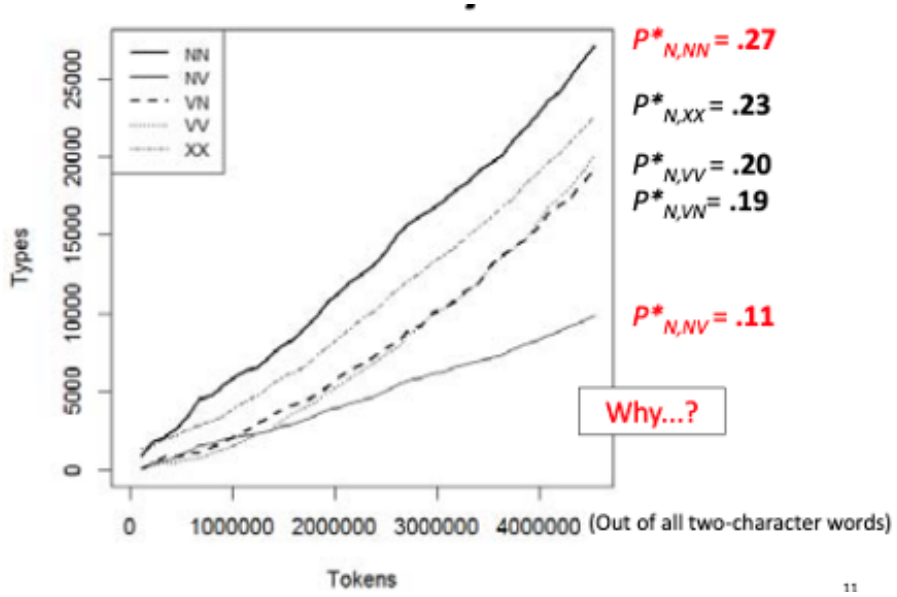
According to Baayen and Renouf (1996), these two measures are complementary. $P^*_{N,c}$ takes the amount of all the hapax legomena tokens in the sample into consideration, and P_{N_c} only focuses on the tokens with the affix c.

5.3.2 Mayers (2015): non-productivity of the NV pattern

Based on the previously mentioned measurement $P^*_{N,c}$ (Baayen and Renouf 1996) and the Mandarin corpus Academia Sinica Balanced Corpus (Huang et al. 1997), Mayers (2015) conducted a corpus study to calculate the productivity of different patterns of compounds in Mandarin. In this study, the targeted affix c in the original equation was substituted with five types of word formation rules, namely five patterns of compounds, NN, XX, VV, VN and NV compounds. Here, N and V represent nominal and verbal constituents, respectively, while X represents constituents with parts of speech other than nouns and verbs, such as prepositions.

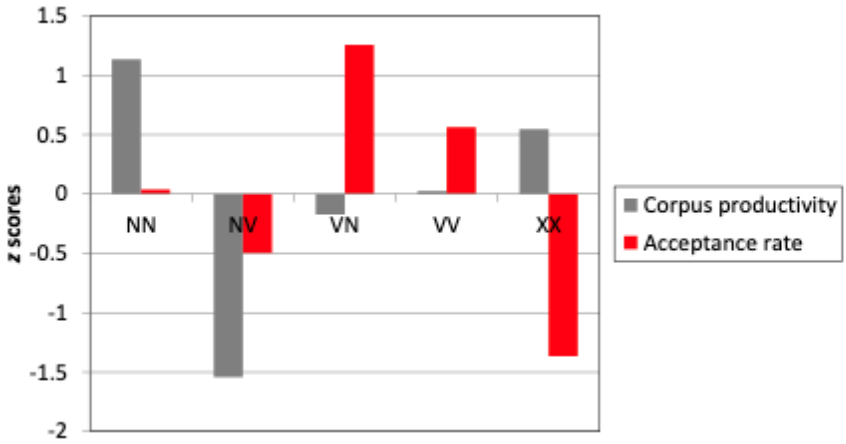
The results of productivity extracted from the corpus are exhibited in Graph 1 (Mayers 2015: 11). The results show that the NN pattern has a $P^*_{N,\,NN}$ value of 0.27, the XX pattern has a $P^*_{N,\,XX}$ value of 0.27, the VN pattern has a $P^*_{N,\,VN}$ value of 0.19, and the NV pattern has a $P^*_{N,\,NV}$ value of 0.11. According to this corpus study, the NN pattern is the most productive pattern, while the NV pattern is the least productive among these five types.

Graph 1: Productivity and POS (Mayers 2015: 11)



Mayers (2015) also conducted a binary judgment test for around 3000 two-character nonword items. In this test, native Mandarin speakers were asked to judge if these words look like Mandarin words or not. According to the acceptance rate, the VN and VV patterns are more acceptable, while the NV and XX patterns are less acceptable, with the overall acceptance ranking as VN > VV > NN > NV > XX.

Graph 2: Corpus Productivity and Acceptance Rate (Mayers 2015: 23)



From the studies by Mayers (2015) on corpus productivity and judgment experiments, it is evident that NV remains the least active pattern, if not take the XX pattern into consideration.

This phenomenon explains why participants found NV compounds in the functional structure to be ambiguous in the current experiment. Since NV compounds are non-productive, native speakers are unable to accurately imagine or judge the use of NV compounds in functional structures. Therefore, in both nominal functional structures and most verbal functional structures, native speakers neither show significant acceptance nor rejection of this structure. In contrast, as for NN compounds, participants do show clear acceptance for nominal functional structures and rejection of verbal functional structures.

Among the mentioned four types of nominal functional structures and four types of verbal functional structures, there is an exception in V1 一下 *yīxià* "a bit". For this verbal functional structure, participants do show significant acceptance, with a mean score of 3.51 (P=0.008). However, this phenomenon can be explained with the following reasons. First, the V1 structure in Test 2 is the same as the structure used in Test 1. In Test 1, the nominal classifier 一种 *yīzhǒng* "a kind" and verbal classifier 一次 *yīcì* "once" are listed as options for participants to choose, and the functional structure of V1 is also a verbal classifier. Participants could learn the pattern with the verbal classifier from Test 1 and transfer that to Test 2. Regarding other verbal functional structures, since there are no previous training and matching tests, participants can show their sheer intuitions about those phrases. The second reason is structural. The V1 phrases are presented as "NV 一下" without any spaces in between, such as in normal Mandarin text. It is likely that participants tend to split the structure "NV 一下" into "N / V 一下" rather than "NV / 一下". For example, 桥摇 *qiáo-yáo* "bridge-shake" in the structure of "NV 一下" is "桥摇一下" *qiáo-yáo yīxià* "bridge-shake a bit". However, "桥摇一下" can also be interpreted as "bridge / shake a bit", which makes more sense than "bridge-shake a bit" and can even be used in Mandarin speech without the

neologism. Thus, splitting the phrase as "N / V一下" could perhaps largely improve the acceptance of the phrase. With no explicit restriction on this specific reading, participants may show preferences for V1 phrases because of this new reading. This phenomenon was also mentioned in the participants' feedback.

5.3.3 Non-productivity and the First Sister Principle

Mayers (2015) explains the phenomenon from the Mandarin Headedness Principle proposed by Packard (2010), which is not sufficient for explaining NV compounds as discussed in Section 3.2.4.

I argue that the First Sister Principle (FSP henceforth, Roeper and Siegel 1978) is more explanatory for the non-productivity of NV compounds. Roeper and Siegel (1978: 208) proposes the FSP which states that "all verbal compounds are formed by the incorporation of a word in first sister position of the verb". Following the common SVO order in Mandarin, the nominal component of NV compounds usually functions as the subject, and in most cases as the external argument of the verbal component.

This is also verified by present NV compounds in Mandarin, among which most are subject-predicate compounds underlyingly (Li and Thompson 1981, Bianca et al. 2011). Moreover, these NV compounds are usually composed with unergative verbs. For instance, the NV compound 地震 *dìzhèn* "earth-quake" means "to have an earthquake" or "earthquake". It is composed of the subject 地 *dì* "earth" and the unergative predicate *ìzhèn* "quake" in sequence. The same happens for 头疼 *tóuténg* "head-hurt" and 脸红 *liǎnhóng* "face-red". 头疼 *tóuténg* "head-hurt" means "to have a headache" or "headache", and 脸红 *liǎnhóng* "face-red" means "to blush" or "blush". In the case of unergative verbs, particularly intransitive unergative verbs that lack an internal argument, the external argument can be considered the first sister of the verb. The appearance of these NV compounds is hence also predicted by the FSP.

5.4 Conclusion

In this chapter, I argue that the varying malleability of NN, VN, and VV compounds is due to limitations on their potential syntactic structures. For NN compounds, only the nominal structure is generated in syntax, whereas for VN compounds, both nominal and verbal structures are generated. The products of syntax, i.e., their logical forms, are mediated by the functional structure. In a nominal functional structure, these compounds are interpretated as nouns, and the same applies for verbal functional structures.

NV compounds, which are largely incompatible with the First Sister Principle (Roeper and Siegel 1978), cannot be generated productively in Mandarin. This non-productivity is confirmed through the statistical analysis conducted by Mayers (2015).

Chapter 6 Conclusion

6.1 Conclusion

This study conducted an experiment on neologisms to investigate four patterns of Mandarin disyllabic compounds in two ways, in their bare forms and in their phrasal forms. In Test 1 about bare forms, I found that NN compounds were predominantly regarded as nominal compounds, and VV compounds were regarded mostly as verbal compounds. As for NV compounds, one-fourth of them were regarded as nouns, and three-fourths were regarded as verbs. VN compounds got almost even results for nominal and verbal interpretations, except for those with unaccusative monovalent verbs.

As for the categorical preferences, I adopted the OT model on Harmonic Grammar with weighted constraints (Pater 2009) and proposed a new probabilistic Headedness Model for Mandarin compounds. In this model, I arrange different weights to four constraints, which are *Right-headedness* (2), *Verbal Constituent at Left* (2), *Presence of Nominal Constituents* (1), and *Presence of Verbal Constituents* (1). The model incorporating weighted constraints was applied for several reasons. First, headedness is influenced by multiple factors, none of which is decisively dominant, as shown in the results with VN and NV compounds. Second, certain factors can exert greater influence than others, a variation that can be expressed through weights. Third, the results generated by our model align closely, in numerical terms, with the experimental findings.

Additionally, I proposed a perception-based model that integrates probabilistic reasoning. In this model, the initial stage of perception involves parsing the Phonological Form (PF), followed by the recognition and retrieval of vocabulary items. These results are then sent to Syntax. For compounding structures, all possible morphosyntactic analyses are generated, labelled as syntax 1, syntax 2, and so on. Syntax, in this context, operates without bias, such as generating both nominal and verbal structures for Mandarin NV and VN compounds. These syntactic structures subsequently undergo probabilistic analysis before being processed by the Logical Form (LF) component, with all structures being assigned a probability value.

As for the nominal inclination observed for VN compounds with the specific type of verb, unaccusative monovalent verbs, I explained it with the lack of VoiceP for these verbs, see Kratzer (1994, 1996) and AAS (2015). The main function of VoiceP is to introduce external arguments. Following Grimshaw's (1990) proposal that the external argument is suppressed in nominalization, I proposed that it is the functional head Voice^{o} being suppressed in nominalization. Since there is no VoiceP for unaccusative monovalent verbs, it is not necessary to make additional efforts to suppress Voice^{o}, thus making compounds with unaccusative monovalent verbs easier to nominalize.

In Test 2, NN compounds were significantly accepted by participants in all the nominal functional structures and strongly rejected in all the verbal functional structures. Likewise, VV compounds were accepted in all the verbal functional structures, but only got accepted in one nominal functional structure N4 喜欢 *xǐhuān* "like". Participants generally do not show significant preferences for NV compounds, neither accepting nor rejecting the phrases composed of NV compounds. VN compounds were accepted in several nominal functional structures and verbal functional structures, showing more malleability under functional structures.

This paper explains the phenomena of NN, VV, and VN compounds based on their distinct potential syntactic structures. For VN compounds, syntax generates both nominal and verbal structures, which makes VN compounds more flexible under different functional structures. In contrast, for VV and NN compounds, only verbal and nominal structures are generated, respectively. VV compounds can also form deverbal nominals, similar to gerunds in English, after initially becoming verbs. This explains why VV compounds can function as internal arguments of the verb 喜欢 *xǐhuān* "like".

The non-preference for NV compounds results from the non-productivity of NV compounds in Mandarin, as shown in the statistical analysis with hapax legomena (Baayen and Renouf 1996, Mayers 2015). Different from Mayers' reasoning for the non-productivity of NV compounds, I argued that non-productivity is under the influence of the First Sister Principle (FSP). Since the nominal component is usually regarded as the external argument, it is hard to compose NV compounds based on FSP which requires the internal argument as the nominal component.

6.2 Limitations and Future Research

Despite the extensive efforts made in this experiment to control variables, certain aspects were inevitably overlooked due to the limitations in scale. Firstly, there is an order difference between nominal classifiers and nominal classifiers. This study adhered to the more default expression, with the nominal classifier preceding the compound and the verbal classifier following compounds. Future research could benefit from balancing the experiment by adding two more conditions, one is the nominal classifier following the compound and the other is the verbal classifier preceding the compound. Secondly, while this study classified verbs into four different types, it did not categorize nouns. I just used inanimate nominal materials in this study. Future studies could enhance the analysis by dividing nouns into different categories, such as animate and inanimate nouns. Additionally, although the experiment considered the frequency of monosyllabic words, it did not analyze their morphological status, i.e., whether they function more frequently as free morphemes or bound morphemes.

Theoretically, it could be beneficial to investigate if polysyllabic compound words in Chinese, such as trisyllabic and tetrasyllabic compound words, still follow the findings based on disyllabic

compounds. It would also be interesting to explore whether the Headedness Model and Probabilistic Language Perception Model proposed in this study can be applied to other languages.

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Appendices

Appendix 1: Lists for Test 1

List 1		N1-N2	N3-V1	V2-N4	V3-V4
		NN	**NV**	**VN**	**VV**
	1	云石	笔裂	走沙	吃抖
		yún-shí	*bǐ-liè*	*zǒu-shā*	*chī-dǒu*
		cloud-stone	pen-crack	walk-sand	eat-tremble
	2	帽月	桌接	落箱	抓溜
		mào-yuè	*zhuō-jiē*	*luò-xiāng*	*zhuā-liū*
		hat-moon	table-connect	fall-box	grab-slide
	3	书鼻	球塌	啃钟	撞躺
		shū-bí	*qiú-tā*	*kěn-zhōng*	*zhuàng-tǎng*
		book-nose	ball-collapse	gnaw-clock	bump-lie down
	4	袋芽	毯吞	转裤	立咳
		dài-yá	*tǎn-tūn*	*zhuǎn-kù*	*lì-ké*
		bag-bud	blanket-swallow	rotate-pants	stand-cough
	5	桥眼	台捏	趴瓶	摇跑
		qiáo-yǎn	*tái-niē*	*pā-píng*	*yáo-pǎo*
		bridge-eye	platform-pinch	lie prone-bottle	shake-run
	6	椅门	盒飞	飘帽	推播
		yǐ-mén	*hé-fēi*	*piāo-mào*	*tuī-bō*
		chair-door	case-fly	float-hat	push-sow
	7	肚帘	山喝	滚板	漂游
		dù-lián	*shān-hē*	*gǔn-bǎn*	*piāo-yóu*
		belly-curtain	mountain-drink	roll-board	drift-swim
	8	河窗	船踢	摔纸	蹦蹲
		hé-chuāng	*chuán-tī*	*shuāi-zhǐ*	*bèng-dūn*
		river-window	boat-kick	throw-paper	jump-squat
	9	杯脚	店碰	浮脸	爬捉
		bēi-jiǎo	*diàn-pèng*	*fú-liǎn*	*pá-zhuō*
		cup-foot	shop-bump	float-face	crawl-catch
	10	霜灯	壳跳	切星	涨逃
		shuāng-dēng	*ké-tiào*	*qiē-xīng*	*zhǎng-táo*
		frost-lamp	shell-jump	cut-star	rise-escape

List 2		N2-N3	N4-V2	V3-N1	V4-V1
		NN	**NV**	**VN**	**VV**

1	石笔	沙走	吃云	抖裂
	shí-bǐ	*shā-zǒu*	*chī-yún*	*dǒu-liè*
	stone-pen	sand-walk	eat-cloud	tremble-crack
2	月桌	箱落	抓帽	溜接
	yuè-zhuō	*xiāng-luò*	*zhuā-mào*	*liū-jiē*
	moon-table	box-fall	catch-hat	slide-connect
3	鼻球	钟啃	撞书	躺塌
	bí-qiú	*zhōng-kěn*	*zhuàng-shū*	*tǎng-tā*
	nose-ball	clock-nibble	bump-book	lie down-collapse
4	芽毯	裤转	立袋	咳吞
	yá-tǎn	*kù-zhuǎn*	*lì-dài*	*ké-tūn*
	bud-blanket	pants-rotate	stand-bag	cough-swallow
5	眼台	瓶趴	摇桥	跑捏
	yǎn-tái	*píng-pā*	*yáo-qiáo*	*pǎo-niē*
	eye-platform	bottle-lie prone	shake-bridge	run-pinch
6	门盒	帽飘	推椅	播飞
	mén-hé	*mào-piāo*	*tuī-yǐ*	*bō-fēi*
	door-case	hat-float	push-chair	sow-fly
7	帘山	板滚	漂肚	游喝
	lián-shān	*bǎn-gǔn*	*piāo-dù*	*yóu-hē*
	curtain-mountain	board-roll	drift-belly	swim-drink
8	窗船	纸摔	蹦河	蹲踢
	chuāng-chuán	*zhǐ-shuāi*	*bèng-hé*	*dūn-tī*
	window-boat	paper-throw	jump-river	squat-kick
9	脚店	脸浮	爬杯	捉碰
	jiǎo-diàn	*liǎn-fú*	*pá-bēi*	*zhuō-pèng*
	foot-store	face-float	climb-cup	catch-collide
10	灯壳	星切	涨霜	逃跳
	dēng-ké	*xīng-qiē*	*zhǎng-shuāng*	*táo-tiào*
	lamp-shell	star-cut	rise-frost	escape-jump

List 3	**N3-N4**	**N1-V3**	**V4-N2**	**V1-V2**
	NN	**NV**	**VN**	**VV**
1	笔沙	云吃	抖石	裂走
	bǐ-shā	*yún-chī*	*dǒu-shí*	*liè-zǒu*
	pen-sand	cloud-eat	tremble-stone	crack-walk
2	桌箱	帽抓	溜月	接落
	zhuō-xiāng	*mào-zhuā*	*liū-yuè*	*jiē-luò*

	table-box	hat-grab	slide-moon	connect-fall
3	球钟	书撞	躺鼻	塌啃
	qiú-zhōng	*shū-zhuàng*	*tǎng-bí*	*tā-kěn*
	ball-clock	book-bump	lie down-nose	collapse-nibble
4	毯裤	袋立	咳芽	吞转
	tǎn-kù	*dài-lì*	*ké-yá*	*tūn-zhuǎn*
	blanket-pants	bag-stand	cough-bud	swallow-rotate
5	台瓶	桥摇	跑眼	捏趴
	tái-píng	*qiáo-yáo*	*pǎo-yǎn*	*niē-pā*
	platform-bottle	bridge-shake	run-eye	pinch-lie prone
6	盒帽	椅推	播门	飞飘
	hé-mào	*yǐ-tuī*	*bō-mén*	*fēi-piāo*
	case-hat	chair-push	sow-door	fly-float
7	山板	肚漂	游帘	喝滚
	shān-bǎn	*dù-piāo*	*yóu-lián*	*hē-gǔn*
	mountain-board	belly-float	swim-curtain	drink-roll
8	船纸	河蹦	蹲窗	踢摔
	chuán-zhǐ	*hé-bèng*	*dūn-chuāng*	*tī-shuāi*
	boat-paper	river-jump	squat-window	kick-fall
9	店脸	杯爬	捉脚	碰浮
	diàn-liǎn	*bēi-pá*	*zhuō-jiǎo*	*pèng-fú*
	shop-face	cup-climb	catch-foot	collide-float
10	壳星	霜涨	逃灯	跳切
	ké-xīng	*shuāng-zhǎng*	*táo-dēng*	*tiào-qiē*
	shell-star	frost-rise	escape-lamp	jump-cut

List 4	**N4-N1**	**N2-V4**	**V1-N3**	**V2-V3**
	NN	**NV**	**VN**	**VV**
1	沙云	石抖	裂笔	走吃
	shā-yún	*shí-dǒu*	*liè-bǐ*	*zǒu-chī*
	sand-cloud	stone-tremble	crack-pen	walk-eat
2	箱帽	月溜	接桌	落抓
	xiāng-mào	*yuè-liū*	*jiē-zhuō*	*luò-zhuā*
	box-hat	moon-slide	connect-table	fall-grab
3	钟书	鼻躺	塌球	啃撞
	zhōng-shū	*bí-tǎng*	*tā-qiú*	*kěn-zhuàng*
	clock-book	nose-lie down	collapse-ball	nibble-bump
4	裤袋	芽咳	吞毯	转立
	kù-dài	*yá-ké*	*tūn-tǎn*	*zhuǎn-lì*

	pants-bag	bud-cough	swallow-blanket	rotate-stand
5	瓶桥	眼跑	捏台	趴摇
	píng-qiáo	*yǎn-pǎo*	*niē-tái*	*pā-yáo*
	bottle-bridge	eye-run	pinch-platform	lie prone-shake
6	帽椅	门播	飞盒	飘推
	mào-yǐ	*mén-bō*	*fēi-hé*	*piāo-tuī*
	hat-chair	door-sow	fly-box	float-push
7	板肚	帘游	喝山	滚漂
	bǎn-dù	*lián-yóu*	*hē-shān*	*gǔn-piāo*
	board-belly	curtain-swim	drink-mountain	roll-float
8	纸河	窗蹲	踢船	摔蹦
	zhǐ-hé	*chuāng-dūn*	*tī-chuán*	*shuāi-bèng*
	paper-river	window-squat	kick-boat	throw-jump
9	脸杯	脚捉	碰店	浮爬
	liǎn-bēi	*jiǎo-zhuō*	*pèng-diàn*	*fú-pá*
	face-cup	foot-catch	collide-shop	float-climb
10	星霜	灯逃	跳壳	切涨
	xīng-shuāng	*dēng-táo*	*tiào-ké*	*qiē-zhǎng*
	star-frost	lamp-escape	jump-shell	cut-rise

Appendix 2: Lists for Test 2

List 1

NN	NV	VN	VV
一些云石	一些笔裂	一些走沙	一些吃抖
yīxiē yún-shí	*yīxiē bǐ-liè*	*yīxiē zǒu-shā*	*yīxiē chī-dǒu*
some cloud-stone	some pen-crack	some walk-sand	some eat-tremble
所有的帽月	所有的桌接	所有的落箱	所有的抓溜
suǒyǒu de mào-yuè	*suǒyǒu de zhuō-jiē*	*suǒyǒu de luò-xiāng*	*suǒyǒu de zhuā-liū*
all the hat-moon	all the table-connect	all the fall-box	all the grab-slide
三种书鼻	三种球塌	三种啃钟	三种撞躺
sān zhǒng shū-bí	*sān zhǒng qiú-tā*	*sān zhǒng kěn-zhōng*	*sān zhǒng zhuàng-tǎng*
three kinds of book-nose	three kinds of ball-collapse	three kinds of gnaw-clock	three kinds of bump-lie down
小李很喜欢袋芽	小李很喜欢毯吞	小李很喜欢转裤	小李很喜欢立咳
XiǎoLǐ hěn xǐhuān dài-yá	*XiǎoLǐ hěn xǐhuān tǎn-tūn*	*XiǎoLǐ hěn xǐhuān zhuǎn-kù*	*XiǎoLǐ hěn xǐhuān lì-ké*
Xiaoli really likes bag-bud	Xiaoli really likes blanket-swallow	Xiaoli really likes rotate-pants	Xiaoli really likes stand-cough

NN	NV	VN	VV
桥眼一下	台捏一下	趴瓶一下	摇跑一下
qiáo-yǎn yīxià	*tái-niē yīxià*	*guā-guǒ yīxià*	*yáo-kěn yīxià*
bridge-eye a bit	snow-catch a bit	scrape-fruit a bit	shake-nibble a bit
昨天椅门了	昨天盒飞了	昨天飘帽了	昨天推播了
yǐ-shū le	*hé-fēi le*	*piāo-mào le*	*tuī-bō le*
yesterday chair-book	yesterday case-fly	yesterday float-hat	yesterday push-sow
请不要肚帘	请不要山喝	请不要滚板	请不要漂游
qǐng bùyào dù-lián	*qǐng bùyào shān-hē*	*qǐng bùyào gǔn-bǎn*	*qǐng bùyào piāo-yóu*
please don't belly-curtain	please don't mountain-drink	please don't roll-board	please don't drift-swim
慢慢地河窗	慢慢地船踢	慢慢地摔纸	慢慢地蹦蹲

mànmàn de hé-chuāng	*mànmàn de chuán-tī*	*mànmàn de shuāi-zhǐ*	*mànmàn de bèng-dūn*
slowly river-window	slowly boat-kick	slowly throw-paper	slowly jump-squat

List 2

NN	**NV**	**VN**	**VV**
一些石笔	一些沙走	一些吃云	一些抖裂
yīxiē shí-bǐ	*yīxiē shā-zǒu*	*yīxiē chī-yún*	*yīxiē dǒu-liè*
some stone-pen	some sand-walk	some eat-cloud	some tremble-crack
所有的月桌	所有的箱落	所有的抓帽	所有的溜接
suǒyǒu de yuè-zhuō	*suǒyǒu de xiāng-luò*	*suǒyǒu de zhuā-mào*	*suǒyǒu de liū-jiē*
all the moon-table	all the box-fall	all the catch-hat	all the slide-connect
三种鼻球	三种钟啃	三种撞书	三种躺塌
sān zhǒng bí-qiú	*sān zhǒng zhōng-kěn*	*sān zhǒng zhuàng-shū*	*sān zhǒng tǎng-tā*
three kinds of nose-ball	three kinds of clock-nibble	three kinds of bump-book	three kinds of lie down-collapse
小李很喜欢芽毯	小李很喜欢裤转	小李很喜欢立袋	小李很喜欢咳吞
XiǎoLǐ hěn xǐhuān yá-tǎn	*XiǎoLǐ hěn xǐhuān kù-zhuǎn*	*XiǎoLǐ hěn xǐhuān lì-dài*	*XiǎoLǐ hěn xǐhuān ké-tūn*
Xiaoli really likes bud-blanket	Xiaoli really likes pants-rotate	Xiaoli really likes stand-bag	Xiaoli really likes cough-swallow

NN	**NV**	**VN**	**VV**
眼台一下	瓶趴一下	摇桥一下	跑捏一下
yǎn-tái yīxià	*píng-pā yīxià*	*yáo-qiáo yīxià*	*pǎo-niē yīxià*
eye-platform a bit	bottle-lie prone a bit	shake-bridge a bit	run-pinch a bit
昨天门盒了	昨天帽飘了	昨天推椅了	昨天播飞了
zuótiān mén-hé le	*zuótiān mào-piāo le*	*zuótiān tuī-yǐ le*	*zuótiān bō-fēi le*
yesterday door-case	yesterday hat-float	yesterday push-chair	yesterday sow-fly
请不要帘山	请不要板滚	请不要漂肚	请不要游喝
qǐng bùyào lián-shān	*qǐng bùyào bǎn-gǔn*	*qǐng bùyào piāo-dù*	*qǐng bùyào yóu-hē*
please don't curtain-mountain	please don't board-roll	please don't drift-belly	please don't swim-drink

慢慢地窗船	慢慢地纸摔	慢慢地蹦河	慢慢地蹲踢
mànmàn de chuāng-chuán	*mànmàn de zhǐ-shuāi*	*mànmàn de bèng-hé*	*mànmàn de dūn-tī*
slowly window-boat	slowly paper-throw	slowly jump-river	slowly squat-kick

List 3

NN	**NV**	**VN**	**VV**
一些笔沙	一些云吃	一些抖石	一些裂走
yīxiē bǐ-shā	*yīxiē yún-chī*	*yīxiē dǒu-shí*	*yīxiē liè-zǒu*
some pen-sand	some cloud-eat	some tremble-stone	some crack-walk
所有的桌箱	所有的帽抓	所有的溜月	所有的接落
suǒyǒu de zhuō-xiāng	*suǒyǒu de mào-zhuā*	*suǒyǒu de liū-yuè*	*suǒyǒu de jiē-luò*
all the table-box	all the hat-grab	all the slide-moon	all the connect-fall
三种球钟	三种书撞	三种躺鼻	三种塌啃
sān zhǒng qiú-zhōng	*sān zhǒng shū-zhuàng*	*sān zhǒng tǎng-bí*	*sān zhǒng tā-kěn*
three kinds of ball-clock	three kinds of book-bump	three kinds of lie down-nose	three kinds of collapse-nibble
小李很喜欢毯裤	小李很喜欢袋立	小李很喜欢咳芽	小李很喜欢吞转
XiǎoLǐ hěn xǐhuān tǎn-kù	*XiǎoLǐ hěn xǐhuān dài-lì*	*XiǎoLǐ hěn xǐhuān ké-yá*	*XiǎoLǐ hěn xǐhuān tūn-zhuǎn*
Xiaoli really likes blanket-pants	Xiaoli really likes bag-stand	Xiaoli really likes cough-bud	Xiaoli really likes swallow-rotate

NN	**NV**	**VN**	**VV**
台瓶一下	桥摇一下	跑眼一下	捏趴一下
tái-píng yīxià	*yáo-qiáo yīxià*	*pǎo-yǎn yīxià*	*niē-pā yīxià*
platform-bottle a bit	shake-bridge a bit	run-eye a bit	pinch-lie prone a bit
昨天盒帽了	昨天椅推了	昨天播门了	昨天飞飘了
zuótiān hé-mào le	*zuótiān yǐ-tuī le*	*zuótiān bō-mén le*	*zuótiān fēi-piāo le*
yesterday case-hat	yesterday chair-push	yesterday sow-door	yesterday fly-float
请不要山板	请不要肚漂	请不要游帘	请不要喝滚

qǐng bùyào shān-bǎn le	*qǐng bùyào dù-piāo le*	*qǐng bùyào yóu-lián le*	*qǐng bùyào hē-gǔn le*
please don't mountain-board	please don't belly-float	please don't swim-curtain	please don't drink-roll
慢慢地船纸	慢慢地河蹦	慢慢地蹲窗	慢慢地踢摔
mànmàn de chuán-zhǐ	*mànmàn de hé-bèng*	*mànmàn de dūn-chuāng*	*mànmàn de tī-shuāi*
slowly boat-paper	slowly river-jump	slowly squat-window	slowly kick-fall

List 4

NN	**NV**	**VN**	**VV**
一些沙云	一些石抖	一些裂笔	一些走吃
yīxiē shā-yún	*yīxiē shí-dǒu*	*yīxiē liè-bǐ*	*yīxiē zǒu-chī*
some sand-cloud	some stone-tremble	some crack-pen	some walk-eat
所有的箱帽	所有的月溜	所有的接桌	所有的落抓
suǒyǒu de xiāng-mào	*suǒyǒu de yuè-liū*	*suǒyǒu de jiē-zhuō*	*suǒyǒu de luò-zhuā*
all the box-hat	all the moon-slide	all the connect-table	all the fall-grab
三种钟书	三种鼻躺	三种塌球	三种啃撞
sān zhǒng zhōng-shū	*sān zhǒng bí-tǎng*	*sān zhǒng tā-qiú*	*sān zhǒng kěn-zhuàng*
three kinds of clock-book	three kinds of nose-lie	three kinds of collapse-ball	three kinds of nibble-bump
小李很喜欢裤袋	小李很喜欢芽咳	小李很喜欢吞毯	小李很喜欢转立
XiǎoLǐ hěn xǐhuān kù-dài	*XiǎoLǐ hěn xǐhuān yá-ké*	*XiǎoLǐ hěn xǐhuān tūn-tǎn*	*XiǎoLǐ hěn xǐhuān zhuǎn-lì*
Xiaoli really likes pants-bag	Xiaoli really likes bud-cough	Xiaoli really likes swallow-blanket	Xiaoli really likes rotate-stand

NN	**NV**	**VN**	**VV**
瓶桥一下	眼跑一下	捏台一下	趴摇一下
píng-qiáo yīxià	*yǎn-pǎo yīxià*	*niē-tái yīxià*	*pā-yáo yīxià*
bottle-bridge a bit	eye-run a bit	pinch-platform a bit	lie prone-shake a bit
昨天帽椅了	昨天门播了	昨天飞盒了	昨天飘推了

zuótiān mào-yǐ le	*zuótiān mén-bō le*	*zuótiān fēi-hé le*	*zuótiān piāo-tuī le*
yesterday hat-chair	yesterday door-sow	yesterday fly-box	yesterday float-push
请不要板肚	请不要帘游	请不要喝山	请不要滚漂
qǐng bùyào bǎn-dù	*qǐng bùyào lián-yóu*	*qǐng bùyào hē-shān*	*qǐng bùyào gǔn-piāo*
please don't board-stomach	please don't curtain-swim	please don't drink-mountain	please don't roll-float
慢慢地纸河	慢慢地窗蹲	慢慢地踢船	慢慢地摔蹦
mànmàn de zhǐ-hé	*mànmàn de chuāng-dūn*	*mànmàn de tī-chuán*	*mànmàn de shuāi-bèng*
slowly paper-river	slowly window-squat	slowly kick-boat	slowly throw-jump