

CONTRIBUTION OF MORPHOLOGICAL AWARENESS TO WORD  
SEGMENTATION AMONG ADULT L2 CHINESE SPEAKERS

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## ABSTRACT

Jiefang Li: Contribution of Morphological Awareness to Word Segmentation  
among Adult L2 Chinese Speakers  
(Under the direction of Katya Pertsova)

The current study aims to investigate the causal correlation between Chinese morphological awareness and word segmentation among intermediate adult speakers who learn Chinese as their second language (L2). In particular, we intend to determine the role of a potential mediator, vocabulary knowledge in this relationship. A total of 45 intermediate adult L2 Chinese speakers participated in the experiment and finished three separate tasks on Chinese morphological awareness, Chinese word segmentation, and vocabulary size. The logistic regression on the results of Chinese morphological awareness task fails to prove that the L2 Chinese speakers are sensitive to the degree of compositionality of Chinese compounds. Multi-linear regressions were conducted to test the mediation effects, and the results demonstrate that: (1) Chinese morphological awareness didn't directly predict participants performance in word segmentation; (2) Chinese morphological awareness didn't indirectly exert a strong effect on word segmentation via vocabulary knowledge. Although the current study didn't find evidence to verify the relationship between morphological awareness and word segmentation nor the mediation effects of vocabulary knowledge, it establishes a foundation for future research design and implementation.

## **ACKNOWLEDGEMENTS**

To my mentors, parents, and friends, I couldn't have done this without your support. Thank you for all your help along the way.

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## **1. Background**

### **1.1 The role of morphological awareness in word reading**

Over the past decades, researchers have been studying how words are stored and represented in the mental lexicon from different aspects. One aspect is the process of word decomposition according to certain morphological rules (Taft, 2004). For instance, an English word can be constructed with a prefix, a root, and a suffix (e.g., dis-agree-ment). Such morphological rules are based on the explicit awareness of the internal morphological structures, i.e., morphological awareness. Carlisle & Feldman (1995, p.194) define morphological awareness as the “conscious awareness of the morphemic structure of words and the ability to reflect on and manipulate that structure.” In other words, morphological awareness enables speakers to decompose the word structure and to reconstruct new word-forms with complex morphological structures (McBride-Chang et al. 2005). Morphological awareness is one important aspect of metalinguistic awareness that can enhance learning-to-read abilities among native language speakers (Singson et al., 2000; Liu & McBride-Chang, 2010). Singson et al. (2000) reported that for English as a first language (L1) speakers, the knowledge of derivational suffixes uniquely contributes to decoding over and above phonemic awareness and vocabulary.

Subsequent studies further demonstrated the specific correlation between morphological awareness and reading morphologically complex words (Nagy et al., 2003, 2006; Liu & McBride-Chang, 2010). In a study focusing on English-speaking children, Nagy et al. (2006) found that there was a stronger correlation between morphological awareness

and the decoding of morphologically complex words compared to morphologically simple words. Similarly, Liu & McBride-Chang (2010) conducted an open-ended lexical compounding production task to assess morphological awareness involving Chinese third-grade students. Their results again identified a unique variance in the process of Chinese character reading and vocabulary knowledge when the influence of phonological awareness and nonverbal intelligence was controlled. What's more, previous research also reveals that morphological awareness contributes to successful word meaning inference among L2 speakers (Park, 2004; Zhang, Koda, and Leong, 2016). Specifically, L2 speakers must infer the meaning of an unfamiliar word based on the information provided by the word and that afforded by the context. To construct the meaning of the new words, L2 speakers need to have the awareness to analyze the internal structures and the morphological constituents. Also, for adult L2 speakers with limited L2 linguistic knowledge, morphological awareness can facilitate word retrieval while reading (Parel, 2004). In sum, the contribution of morphological awareness to word reading in both L1 and L2 speakers has been validated in previous studies.

## **1.2 Morphological properties and morphological awareness in Chinese**

A word can be defined as “an independent occupant of a syntactic form class slot” (Packard, 2000, p.12). Orthographic words in written English are quite salient as the spaces in written texts directly indicate the word boundaries. English orthography is morphophonemic in that the smallest grapheme unit is an alphabetic letter which also roughly represent phonemes.

The written texts in Chinese, however, are not word-based but morpheme-based (with morphemes represented by characters), without spaces inserted between words or characters.



Chinese orthography is morphosyllabic because the basic grapheme unit is a character, which maps onto a morpheme that corresponds to only one syllable in most cases. Although most characters can be used independently with their specific meanings, new word forms with new meanings will also be created when combining two or more characters. Also, most Chinese characters can occur in different positions in different words. Examples in Table 1 show how the Chinese character 学 (xue2, “to study”) can occur in four different positions.

*Table 1. A character can occur in multiple word-internal positions*

Position	Example
Left	学习 xue2xi2, ‘to study’
Right	博学 bo2xue2, ‘knowledgeable’
Word by itself	学英语 xue2ying1yu2, ‘to study English’

Just like the examples in Table 1, around 94% of printed words in Chinese are multi-character words (Lexicon of Common Words in Contemporary Chinese Research Team, 2008, as cited in Li et al., 2014). A complex Chinese word can be classified into one of the three morphological structures: root +inflection, root+derivation, and compound. Among these three structures, compounding noun is most productive and dominant (Ceccagno & Basciano, 2007) and therefore, the awareness of the compounding structure is of great importance for Chinese speakers.

Based on the characteristics of Chinese compounds, Chen et al. (2009) propose a two-layer definition of Chinese compound awareness: (1) the ability to recognize and identify the head of a compound noun; (2) the ability to construct a new morphologically complex word from previously known morphemes. Chen et al. (2009) reported that the

conscious awareness of compounding structure facilitated young children's literacy development, both in character reading and vocabulary development. In a more recent longitudinal study, Pan et al. (2016) tracked the developmental relationship between phonological awareness, morphological awareness, and Chinese literacy skills among 294 Chinese children since age 4. Their results demonstrated that morphological awareness significantly affects lexical access and text comprehension. Another reason why morphological awareness may be valuable for Chinese reading development is that the phonological cues that support reading are less reliable in Chinese (Zhang et al., 2013). A few studies also pay attention to how morphological awareness helps L2 Chinese speakers during word reading. Ke & Koda (2017) is the first study trying to provide empirical evidence to validate the utility of morphological awareness in L2 Chinese word reading and their results revealed that L2 Chinese morphological awareness contributes to L2 word-meaning inferencing indirectly through L2 linguistic knowledge among American college students. In short, the role of morphological awareness in Chinese has common characteristics like in English but it also demonstrates its particular contribution to word recognition and word inferring given the unique properties of Chinese morphology. Given the research goal, the definition of morphological awareness in the current study is the ability to recognize if there is a head in a multi-character word and the ability to determine if it can be compositional.

### **1.3 Potential contribution of Chinese morphological awareness to word segmentation**

Chinese reading contains three components: character recognition, word segmentation, and lexical access (Shen, 2008; 2011). Among these three components, the most difficult one for L2 Chinese speakers will be the word segmentation due to the lack of

unambiguous word boundary indicators (see Table 1). L2 Chinese speakers whose native language is English will face greater challenges because of the salient orthographic discrepancy between Chinese and English. They need to decide which characters can stand alone and which characters should be grouped together during text reading. Consider the following two sentences:

(1) 她 买了 新 手机 用来 练习 口 语

She buy-PST new hand-machine used to practice mouth language

She bought new phone to practice speaking

‘She bought a new phone to practice speaking.’

(2) 他 认为 新手 机会 多

He think new-hand opportunity more

He think beginner opportunity more

‘He thinks that beginners have more opportunities.’

The same character chain shows up in both sentences, 新手机 (xin1shou3ji1). In (1), it means “new phone” with a word boundary between the first and the second character as the last two characters should be counted as a compound meaning “phone”. In (2), however, the character 机 (ji1) needs to be grouped with the character following it (会hui4), making them mean “opportunities”. In this case, the word boundary between this word chain is located between the second character and the third character.

Therefore, placing the correct word boundaries requires not only knowing the meaning of individual characters but also grouping the characters into appropriate compounds based on the context. This example also demonstrates that lexical access is

directly affected by word segmentation, which in turn will affect higher-level reading comprehension. To achieve a successful word segmentation, L2 Chinese speakers can first try to access the multi-character words which have been memorized as a chunk. However, this automatic processing may not be efficient or accurate enough. Theoretically, the three sub-processes of lower-level reading processing should be sequential; that is the successful character recognition assists word segmentation, and accurate word segmentation facilitates lexical access. In fact, it is usually an interactive process: imprecise lexical access may lead to trouble in text comprehension, informing the reader that they might need to reassess the decision of the initial word segmentation (Shen, 2013). Bassetti (2005) compared the performance of word segmentation between native Chinese speakers and L2 Chinese speakers. Although the research focus was not on the accuracy of word segmentation, Bassetti confirmed that English learners of Chinese as a foreign language (CFL) were affected by their native language because they tend to separate strings of characters into smaller units while Chinese native speakers would combine several two-character compounds as a longer expression.

Additional empirical studies determine that morphological awareness can also be beneficial for L2 speakers' reading comprehension. The positive contributions of morphological awareness to reading comprehension among sixth-grade Chinese EFL learners were reported by Zhang & Koda (2013). In their studies, the multiple regression analysis revealed participants' derivational morphology was highly related to English reading comprehension after controlling other factors including grammatical knowledge, vocabulary knowledge, and awareness of inflectional morphology. The recently proposed direct and indirect effects model of reading (DIER; Kim, 2017) hypothesizes that word reading, and

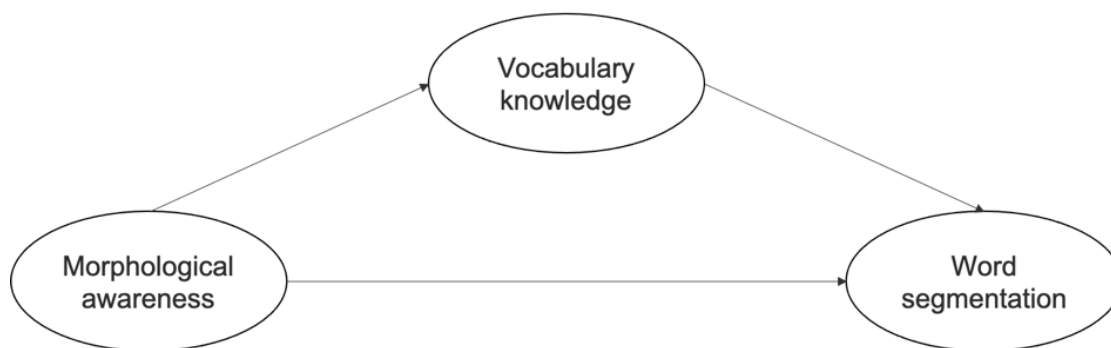
listening comprehension, the two vital skills of reading comprehension, are upper-level skills that link the relationships of component skills of word reading to reading comprehension (e.g., phonological awareness, orthographic awareness, morphological awareness) and of component skills of listening comprehension to reading comprehension (e.g., vocabulary, syntactic knowledge, inference). DIER further theorizes how morphological awareness is related to reading comprehension: *morphological awareness* → *vocabulary* → *listening comprehension* → *reading comprehension*. In addition to this indirect pathway, morphological awareness may also make a direct contribution to reading comprehension. This assumption derives from the metalinguistic awareness account: Speakers with advanced morphological awareness are able to infer the meanings of new, morphologically complex words encountered during online semantic processing, which then would boost reading comprehension (Nagy, 2007). Kim et al. (2020) also found Chinese morphological awareness of compound structure was directly correlated with reading comprehension, mediated by vocabulary, word reading, and listening comprehension. These three components together accounted for 87% of the total variance in reading comprehension. Furthermore, the total effect of compounding morphological awareness on reading comprehension, was quite significant (0.49 standardized regression weight) after accounting for the direct effect (0.18) and indirect effects (0.32) via multiple pathways.

Based on the above review, there are sound theoretical reasons to expect the association of morphological awareness with Chinese word segmentation. Firstly, morphological awareness can facilitate the recognition of complex structure words, which are highly prevalent in Chinese (the large proportion of multi-character words), and assist in inferring the meaning of new words, which is a highly frequent situation in text reading.

Secondly, the established correlation between morphological awareness and reading comprehension serves as strong evidence of the correlation between morphological awareness and Chinese word segmentation because the accuracy of word segmentation will significantly affect the comprehension of each sentence. However, to my knowledge, no previous study has investigated the potential contribution of Chinese morphological awareness to word segmentation both in L1 and L2 Chinese speakers.

## 2. Current study

The current research aimed to explore the causal correlation between Chinese compound awareness and the accuracy of word segmentation in L2 Chinese speakers, which could provide further evidence to support the relationship between morphological knowledge and reading comprehension or reading fluency. Given that previous studies have emphasized the mediation effects of vocabulary knowledge between morphological awareness and reading comprehension, I also hypothesized a mediation model to demonstrate the indirect relationship between morphological awareness and word segmentation (**Figure 1**) and proposed the following hypotheses: (1) Intermediate L2 Chinese speakers are sensitive to the compositionality of Chinese compounds (2) Higher scores on Chinese compound awareness will be significantly related to lower error-rate on Chinese word segmentation. (3) Vocabulary knowledge will mediate the association between Chinese compound awareness and word segmentation. (4) Chinese morphological awareness will exert a significant indirect effect on word segmentation through the two-path mediating effect of vocabulary knowledge.



*Figure 1. A path diagram representing the hypothesized mediation model of vocabulary knowledge in the relationship between morphological awareness with word segmentation, with the latent variable as ellipses.*



### **3. Methodology**

#### **3.1 Design**

This study has a battery of tasks targeting speakers' different linguistic abilities, including morphological knowledge of Chinese compounding structure, word segmentation ability, and vocabulary size. All the tasks were carried out online and the data was analyzed through regression models.

#### **3.2 Participants**

This study was approved by the Office of Human Research Ethics at the University of North Carolina, Chapel Hill (Study#20-2800) The participants were recruited from students who have been taking Chinese courses at two universities in the United States. They have been learning Chinese for at least two years and are able to read short passages. Their language proficiency levels range from intermediate-low to intermediate-high. Participants received 10 dollars and optional free Chinese-speaking tutoring as compensation. A total of 45 students (34 male participants and 11 female participants) have participated in this study and 6 of them were removed from the final analysis because they didn't follow the instructions to complete the task (e.g., didn't insert the word boundary in the word segmentation task) or their scores were beyond two standard deviations away from the mean. The average age of the participants is 24.5 years old (standard deviation = 12.18 years). Online consent was obtained from the embedded consent form in the online survey. All the participants are native English speakers and did not report any significant language disorders.

### 3.3 Instruments

#### 3.3.1 Morphological awareness task

The current study intends to explore whether L2 Chinese learners are sensitive to the existence of the compound head which will in turn influence the compositionality in terms of semantic meanings. Given the potential participants' language proficiency, I adopt the word structure analogy task from Zhang et al. (2007). This task assessed the ability to differentiate between semantically compositional words and non-compositional compounds. In each question, the participants will see a word on the first line followed by two other words below. One of these two words has a similar structure to the word above and the participants' task was to decide which word it is. For example:

(3)

Target word	Option 1	Option2
外套	(a) 喜欢	(b) 冰箱
Outside-jacket	Like-Like	Ice-Box
'Overcoat'	'Like'	'Refrigerator'
(compositional)	(non-compositional)	(compositional)

In this example, the target word 外套 (wai4tao4) is compositional as the first character 外(wai4) is modifying the second character 套 (tao4), which is also the head of this compound, and therefore, the meaning of this whole compound is composed by adding the meanings of these two characters. The correct answer should be (b) 冰箱 (bing1xiang1) because the first character 冰(bing1) is also modifying the compound head and the holistic

meaning of this compound is the combination of the meanings of these two characters.

Option (a), however, is different: both 喜 (xi3) and 欢 (huan1) express the same meaning of “like” (in a dictionary) and these two characters are never used independently in formal modern Chinese. Therefore, this compound is morphologically non-compositional — the two characters are spelled separately (and may be taught separately), but they do not correspond to separate morphemes because they always co-occur and are associated with the same meaning. Thus, morphologically, there only one disyllable morpheme 喜欢 (xi3huan1) which means “like”. In this sense, words like “like” are not real compounds at all. They may be called orthographic compounds, perhaps. Some of them derive from historical compounds that used to be compositional but are synchronically best analyzed as mono-morphemic. If the subjects are successful in this task, this would show their ability to pay attention to morphological, not just orthographic structure.

To avoid potentially confounding effects of vocabulary size, all test words were selected from a popular beginner-level Chinese learning textbook that is widely used in the United States.

Before the formal task, participants were presented with two example items provided with correct responses. After that, they were asked to finish four practice questions with feedback after they made the choice. The model answer and feedback didn’t directly tell participants to focus on each test word’s structure. Also, we assumed that participants should use their own understanding of the word structures to make the judgment.

For each kind of two-character word (compositional or non-compositional), there are 5 items and therefore, this task has 10 items in total. They were randomly placed in the survey and the position of each option was also arranged carefully to avoid the sequence

effects (i.e., the position of the correct option is equally distributed). Participants received one credit for each time they chose an answer and therefore, the highest score was 10.

### 3.3.2 Word segmentation task

The word segmentation task was designed to test if L2 Chinese speakers could mark the correct word boundary when the meaning of the target word chain was ambiguous. All the reading materials were adapted from the same textbook and the average character number in each sentence is 13. Participants were asked to mark every word boundary when reading sentences with unlimited time. A total of ten groups of sentences were presented to the participants.

For each trial, I have set up a target word chain that can be separated in two different ways according to the contextual information. For instance:

(5) Target character chain: 音乐会

(5.a) 高文觉得听音乐会让大家高兴。

高文 觉得 /听 音乐 /会/ 让 大家 都 高兴。

Gaowen think listen music would make everyone all happy

‘Gaowen thinks **listening to music would** make everyone feel happy.’

(5.b) 费先生知道音乐会在哪里举办。

费先生 知道 /音乐会 / 在 哪里 举办。

Mr.Fei know concert at where hold

‘Mr. Fei knows where the **concert** is.

As the example shows, although the character chain is the same in these two sentences, the word boundary is different because the last character has its own meaning

when it acts as an auxiliary, and given the contextual information in (5.a), it needs to stand alone.

Therefore, in order to mark the accurate and correct word boundary, the participant not only needs to know the meaning of each separate character but also needs to be aware of the compound structure and its combined meaning. In other words, if the participants can differentiate the function and meaning of the same character in different character chains, then I can assume that they have developed the awareness of Chinese words' internal structure.

The grading for the word segmentation task was carried out as follows. All the incorrect word boundaries within the target word chain were labeled and counted. Therefore, individual participants' word segmentation accuracy was determined by their word segmentation error number: the lower the error number, the higher the word segmentation accuracy.

### **3.3.3 Vocabulary size task (VST)**

Developing morphological awareness requires a good command of vocabulary knowledge and earlier studies have found a strong relationship between rates of growth in morphological awareness and vocabulary knowledge (Kiffer & Lesaux, 2012; Zhang, 2002; Zhang & Koda, 2012). Therefore, the vocabulary size test is needed to assess participants' breadth of vocabulary knowledge, which can also to some extent reflect their language proficiency. The Vocabulary Size Test (VST) comprises numerous multiple-choice items. The participants are supposed to have a clear understanding of the meaning of the vocabulary as many options in the questions share part of the same meaning. The targeted words in this study were chosen from the target word chain in the morphological awareness task. For

example, for the target word chain 音乐会 (yin1yue4hui4), I asked the participants if they knew the meaning of 会 (hui4, would) , 音乐 (yin1yue4, music) and 音乐会 (yin1yue4hui4, concert). And their responses were a crucial part for us to interpret their performance in the word segmentation task. For example, if the participant only knows the holistic meaning of the character chain and the meaning of a certain character, and they also successfully mark the word boundary within this word chain, then it is reasonable to infer that the participant is aware that this character chain can be decomposed in a specific context.

This study was composed of 36 Chinese words and the participants were required to choose the correct English translation. For instance, the word 音乐(yinyue4, music) was presented to the participants and they needed to choose the most appropriate English meaning from the three options:

- A. music      B. concert      C. musician

### **3.3.4 Data collection and data analysis**

All the above-mentioned tasks were implemented in Qualtrics and the logistic regression and mediation model were performed with SPSS 16.0 with the assistance of Odum Institute at UNC, Chapel Hill.

## 4. Results

### 4.1 Descriptive statistics

Table 2 presents means, standard deviations (SD), skewness, kurtosis of all measures used in this study. The scores of the morphological awareness task and vocabulary size task represent the number of correct responses that the participants got in these two tasks and the score of the word segmentation task represents the number of errors they made in this task. The score range in each task is relatively large given the SD and skewness, which to some extent reflects the diverse language proficiency levels among the participants.

*Table 2. Descriptive statistics of all measure*

Variable	Range	Mean	SD	Skewness	Kurtosis
Morphological awareness task	1-7	4.41	1.46	0.03	-0.28
Word segmentation task	3-11	6.67	1.85	0.13	-0.12
Vocabulary size task	26-36	31.85	2.29	-0.70	0.62

### 4.2 Sensitivity to the compositionality of Chinese compounds

To affirm the first research hypothesis that the intermediate L2 Chinese speakers are sensitive to the compositionality of Chinese compounds, I conducted a logistic regression with no predictors and just the intercept in the model to test the research hypothesis that the mean score of the morphological awareness task is above chance. Given the current results of this model (Mean = 4.41,  $\beta = -0.076$ ,  $p = 0.4856 > 0.05$ ), I failed to find support for my research hypothesis. In other words, the results are consistent with the scenario when

participants were choosing the answers randomly. The performance in the morphological awareness task, therefore, cannot provide evidence for the first research hypothesis — that is, the L2 intermediate speakers are sensitive to the compositionality of Chinese compounds.

### 4.3 Mediation model

To start to test the mediation model, the first step was to examine the direct path coefficient from morphological awareness to word segmentation without the mediator (i.e., the morphological awareness is the independent variable, and the word segmentation is the dependent variable). Table 3 reports the four regression analyses which were part of the mediation model. In the partially mediated model (**Figure 2**), the vocabulary size test serves as the mediator and there is a direct path from the morphological awareness and word segmentation was tested (i.e., morphological awareness and vocabulary knowledge are independent variables, word segmentation is the dependent variable. First the direct path of morphological awareness on word segmentation was tested and the results of the linear regression showed that the direct path is not significant ( $\beta = -0.036, p = 0.83 > 0.05$ ). Then the simple effects of morphological awareness on vocabulary size test and vocabulary size test on word segmentation were tested. The path coefficient from morphological awareness to vocabulary size is non-significant ( $\beta = -0.067, p = 0.685 > 0.01$ ) and the path coefficient from vocabulary size to word segmentation is still not significant ( $\beta = -0.239, p > 0.01$ ), which demonstrates that there is no mediation effect of vocabulary size. Lastly, the partial path coefficient from morphological awareness to word segmentation ( $\beta = -0.052, p = 0.752 > 0.01$ ) is non-significant. To conclude, the results of the mediation model analysis suggest that although I found an expected inverse direct relationship between proportion of correct

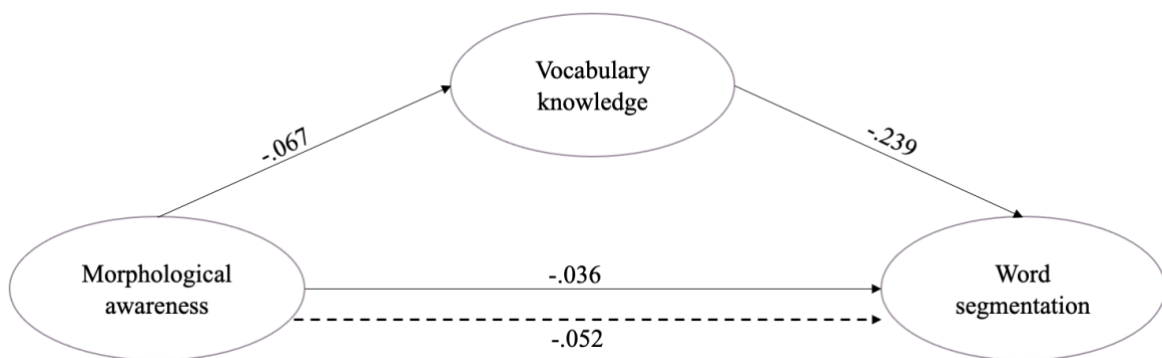


responses in the morphological awareness and number of errors in the word segmentation task, the former cannot strongly predict participant’s performance in word segmentation. This is perhaps not surprising given that we found no effect of morphological awareness in the first place. In addition, vocabulary knowledge didn’t mediate the association between Chinese morphological awareness and word segmentation. Chinese morphological awareness also didn’t exert a significant indirect effect on word segmentation through the two-path mediating effect of vocabulary knowledge.

**Table 3. Path estimates in predicting Chinese word segmentation**

<i>Parameter</i>	<i>Estimate</i>	<i>StdErr</i>	<i>tValue</i>	<i>Probt</i>
MA → WS (Total)	-0.036	0.209	-1.11	0.831
MA → VST	-0.067	0.346	1.37	0.685
VST → WS	-0.239	0.089	-2.92	0.149
MA → WS(Partial)	-0.052	0.195	-0.55	0.752

*MA = Morphological awareness; WS = word segmentation; VST = vocabulary size test*



**Figure 2. Standardized parameter estimates of the effects of morphological awareness on word segmentation mediated by vocabulary knowledge with the dashed line representing the partial path coefficients.**

Additional analysis was also conducted to test whether significant results may emerge for more advance learners (**Table 4** and **Table 5**). All participants were separated into two groups given their language learning length: Participants who have learned English for more than two years were classified as the intermediate-higher group (N =15) and participants who have learned English less than or equal to two years were classified as the intermediate-lower group (N=24). The same mediation model was also implemented to test the path coefficients between Chinese morphological awareness, vocabulary knowledge, and word segmentation. The results are listed in the following two figures.

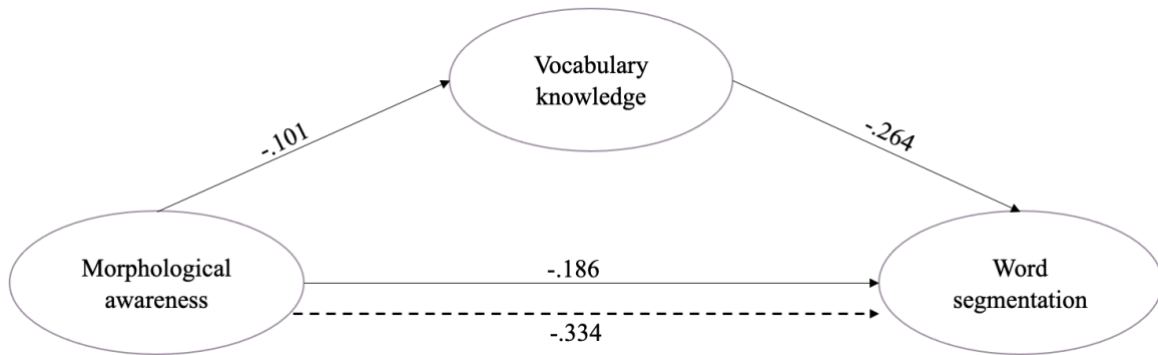
**Table 5. Path estimates in predicting Chinese word segmentation in intermediate-higher group**

<i>Parameter</i>	<i>Estimate</i>	<i>StdErr</i>	<i>tValue</i>	<i>Probt</i>
MA → WS (Total)	-0.184	0.346	0.90	0.393
MA → VST	-0.101	0.331	-0.19	0.855
VST → WS	-0.264	0.312	2.06	0.078
MA → WS(Partial)	-0.334	0.292	1.20	0.267

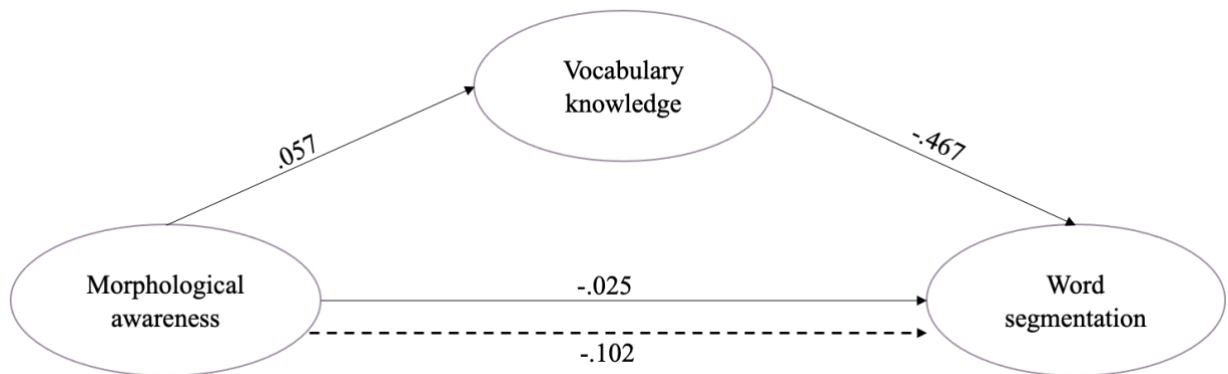
**Table 4. Path estimates in predicting Chinese word segmentation in intermediate-lower group**

<i>Parameter</i>	<i>Estimate</i>	<i>StdErr</i>	<i>tValue</i>	<i>Probt</i>
MA → WS (Total)	-0.250	0.384	-1.78	0.119
MA → VST	0.057	0.842	1.38	0.210
VST → WS	-0.467	0.173	-0.99	0.362
MA → WS(Partial)	-0.125	0.434	-1.12	0.307

As it showed in the following two figures, none of the path coefficients were significant in these two subgroups, which is consistent with the overall analysis. One particular point is that the correlation between morphological awareness and vocabulary knowledge is positive in group 2 in which participants have learned Chinese for more than two years, which is compatible with previous research that emphasizing the positive effects of morphological awareness on vocabulary knowledge



**Figure 3. Standardized parameter estimates of the effects of morphological awareness on word segmentation mediated by vocabulary knowledge with the dashed line representing the partial path coefficients (participants' year of learning  $\leq 2$ )**



**Figure 4. Standardized parameter estimates of the effects of morphological awareness on word segmentation mediated by vocabulary knowledge with the dashed line representing the partial path coefficients (participants' year of learning  $> 2$ )**

## 5. Discussion

The present study intended to explore the influence of Chinese morphological awareness on word segmentation and the potential mediation effects of vocabulary knowledge among adult L2 Chinese speakers. The overall conclusion is that I cannot find evidence to prove learners were sensitive to the internal morphological structure of Chinese compounds and this (lack of) sensitivity was also not significantly related to the performance in the word segmentation task. Additionally, no mediation effects of vocabulary knowledge were found.

The first research hypothesis addressed whether L2 intermediate Chinese learners are sensitive to the semantic compositionality of Chinese compounds. The difficulty level of the morphological awareness task might be one possible reason accounting for the current result that the participants' correctness rate is not above chance. During the task, participants were not given direct instruction on how to understand the “similar structure”. Instead, they were only offered two examples without explicit explanations. Although I provided four practice questions (Mean =3.00) before the formal trial, it was still quite possible that they didn't fully understand the task. The original task was intended to test the conscious awareness of Chinese compounds' semantic compositionality, but I didn't explicitly tell the participants what makes the two options different. There are many ways in which one may interpret this task, and the participants may not have paid conscious attention to the the knowledge of morphological structure or the knowledge of semantic compositionality to analyze the test

items. For future research, I could try to explain the task more explicitly. It is also necessary to set up a post-experiment interview to talk with the participants so that I will be able to know more about how they make their decisions, which will be a valuable resource for subsequent analysis.

The following research hypotheses further asked whether morphological awareness has a strong effect on word segmentation either directly, or indirectly via vocabulary knowledge. Based on the results of the mediation model, the general results demonstrate that there is no significant causal relationship between Chinese morphological awareness and word segmentation neither directly nor indirectly. This was not surprising given that the performance on morphological awareness was at chance. Also, I didn't find evidence to support that vocabulary knowledge was the mediator between Chinese morphological awareness and word segmentation. It is noticeable that although some participants got the correct answer in the vocabulary size task (i.e., they chose the correct meaning for the target words in the word segmentation task), they still didn't mark the correct boundary in the word segmentation task. For example, although they chose the correct meaning for 音乐 (yin1yue4, music) and 会 (hui1, would), they still didn't insert the required word boundary between these two words given the contextual information. Nevertheless, given the current task design, I cannot determine whether participants who made such choices lacked understanding of the whole sentence or whether they believed the meaning of the multi-character combination (i.e., 音乐会 (yin1yue4hui4, concert) is compatible with the contextual information. In fact, since participants' performance in the morphological awareness task was random (given the first logistic regression model), their responses naturally become less reliable for the subsequent data analysis, but I still decided to finish the

designed analysis. The current results, therefore, to some extent reflect their random choices in the morphological awareness task again. The only surprising result in the current mediation model is that Chinese morphological awareness and vocabulary size is also non-significantly correlated as lots of previous studies have established the important role of vocabulary knowledge in Chinese word learning, meaning inferring and morphological awareness (Zhang, 2002; Zhang & Koda, 2012). One possible reason is that the current study implemented a different morphological awareness task compared to the previous studies which were mainly focusing on the difference between inflectional and derivational structures or the way to construct a new compound. The current morphological awareness task emphasized the semantic compositionality of the Chinese compounds. Particularly, I selected non-compositional words like 聰明 (cong1ming2, clever-clever, clever) in which the two individual characters' meanings are the same and they were never used separately without losing the meaning in this compound. To our knowledge, no relevant studies have used a similar design to test speakers' morphological awareness and therefore, the current morphological awareness task can be regarded as a different attempt, but it requires further modification to ensure its validity.

What's more, another potential factor that can account for the current results is the relationship between word segmentation and reading comprehension. Although word segmentation has been identified as one crucial procedure during Chinese reading, its relationship with general reading comprehension has not been verified yet. And the theoretical support for the indirect relationship between Chinese morphological awareness and word segmentation derives from the findings of previous studies focusing on the relationship between morphological awareness and reading comprehension as most of them

have reported both direct and indirect contribution of morphological awareness to reading comprehension.

For future research, I will try to test the difficulty level of the morphological awareness task among L1 Chinese speakers to make sure the task instruction is clear and easy to understand. If the L1 speakers find anything ambiguous, I will be able to adjust the design before moving on to testing L2 learners.

## APPENDIX 1: MORPHOLOGICAL AWARENESS TASK

Training		
Target word	Option 1	Option 2
聪明 Clever-Clear ‘Clever’ (non-compositional)	旁边 Aside-Side ‘Aside’ (non-compositional)	毛衣 Wool-Cloth ‘Sweater’ (compositional)
清楚 Clear-Clear ‘Clear’ (compositional)	喜欢 Like-Like ‘Like’ (non-compositional)	冰箱 Ice-Box ‘Refrigerator’ (compositional)
外套 Outside-jacket ‘Overcoat’ (compositional)	希望 Hope-Hope ‘Hope’ (non-compositional)	书架 Book-Shelf ‘Bookshelf’ (compositional)
整理 To mend-To handle ‘To arrange’ (non-compositional)	检查 To check- To check ‘To check’ (non-compositional)	地图 Ground-Picture ‘Map’ (compositional)
Formal test		
Target word	Option 1	Option 2
车站 Bus-Station ‘Bus station’ (compositional)	书店 Book-Store ‘Bookstore’ (compositional)	安静 Quiet-Quiet ‘Quiet’ (non-compositional)
医院 Medical-Yard ‘Hospital’ (compositional)	商人 Business-Man ‘Businessman’ (compositional)	合适 Fit-Fit ‘Appropriate’ (non-compositional)
牛肉 Oxen Meet ‘Beef’ (compositional)	药店 Drug-Store ‘Drug store’ (compositional)	希望 Hope-Hope ‘Hope’ (non-compositional)
水平 River-Flat ‘Horizontal’ (non-compositional)	城市 City-City ‘City’ (non-compositional)	冰茶 Ice-Tea ‘Iced Tea’ (compositional)
平常 Normal-Normal ‘Normal’ (compositional)	地图 Ground-Picture ‘Map’ (compositional)	清楚 Clear-Clear ‘Clear’ (compositional)



身体 Body-Body ‘Body’ (non-compositional )	白菜 White-Vegetable ‘Cabbage’ (compositional)	朋友 Friend-Friend ‘Friend’ (compositional)
饭卡 Meal-Card ‘Meal Card’ (compositional)	铅笔 Lead-Pencil ‘Pencil’ (compositional)	容易 Easy- Easy ‘Easy’ (non-compositional)
整理 To mend-To handle ‘To arrange’ (non-compositional )	饭馆 Food-Building ‘Restaurant’ (compositional)	打扫 To beat – To sweep ‘Sweep’ (non-compositional )
干净 Tide-Clean ‘Neat’ (non-compositional )	书桌 Book-Desk ‘Desk’ (compositional)	方便 Easy-Easy ‘Easy’ (non-compositional )

## APPENDIX 2: WORD SEGMENTATION TASK

### 1. Target character chain: 新手机

- 1) 小白买了新手机用来练习口语。

小白 买了 新 /手 机/ 用 来 练 习 口 语。

Xiaobai buy-PST new hand-machine used to practice spoken language  
'phone'

'Xiaobai bought a **new phone** to practice speaking.'

- 2) 高老师告诉我们比赛中新手机会更多。

高老师 告诉 我们 比赛 中 /新 手 / 机 会 更 多。

Ms.Gao tell us game in new-hand opportunity more  
'beginners'

'Ms. Gao told us that **beginners** have more **chances** in a game.'

### 2. Target character chain: 电脑中心

- 1) 王朋每天都去电脑中心学习电脑。

王朋 每 天 都 去 /电 脑 中 心/ 学 习 电 脑。

Wang Peng every day all go electricity -brain center study computer  
'computer'

'Wang Peng goes to the **computer center** every day to learn computer.'

- 2) 高文致电脑中心的医生怎样才能治好他爸的病。

高文 致电 / 脑 中 心 / 的 医 生 怎 样 才 能 治 好 他 爸 的 病。

Gaowen call brain center poss doctor how to can heal his father poss disease  
'Gao Wen **calls** the doctor of the **brain center** about how to heal his father.'

### 3. Target character chain: 音乐会

- 1) 高文觉得听音乐会让大家都高兴。

高文 觉得 /听 音 乐 /会/ 让 大 家 都 高 兴。

Gaowen think listen music would make everyone all happy

'Gaowen thinks **listening to music would** make everyone feel happy.'

- 2) 费先生知道音乐会在哪里举办。

费先生 知道 /音 乐 会 / 在 哪 里 举 办。

Mr.Fei know concert at where hold

'Mr.Fei knows where the **concert** is.'

### 4. Target character chain: 有意思

- 1) 王朋觉得这本书很有意思。

王朋 觉得 这 本 书 很 / 有 意 思 /。

Wang Peng think this QUANT book much is-meaning

‘interesting’

‘Wang Peng thinks this book is really **interesting**.’

2) 我妹妹是有意思考这个问题。

我 妹妹 是 / 有意 / 思考 / 这个 问题。  
My sister is is-intention think this question  
‘intentionally’

‘My sister is **intentionally thinking** about this question.’

5. Target character chain: 考上海

1) 高文一直想考上海海洋大学。

高文 一直 想 / 考上 / 海洋 大学。  
GaoWen always wish exam-admit Ocean university  
‘to be admitted’

‘Gao Wen wishes to be **admitted to the Ocean University**.’

2) 李华想考上海的大学。

李华 想 考 / 上海 / 的 大学。  
Lihua wish get into Shanghai POSS University  
‘Li Hua wishes to **get into** the university in **Shanghai**.’

6. Target character chain: 出租房

1) 小白住在学校外面的出租房里。

小白 住 在 学校 外面 的 / 出租 房 / 里。  
Xiaobai live at school outside POSS rental apartment inside  
‘Xiaobai lives in the off-campus **rental apartment**.’

2) 王朋想出租房子给同学。

王朋 想 / 出租 / 房子 / 给 同学。  
WangPeng want rent apartment to classmate  
‘Wang Peng wants to rent apartment to classmates.’

7. Target character chain: 学生餐

1) 中国大学生一般都吃学生餐。

中国 大学生 一般 都 吃 / 学生 餐 /。  
Chinese college student usually all eat student meal  
‘Chinese college students usually buy the **student meal** at school.’

2) 今天晚上学生餐厅有红烧肉。

今天 晚上 / 学生 餐厅 / 有 红烧肉。  
Today night student café has five-spice pork  
‘Tonight, **student café** provides five-spice pork.’

8. Target character chain: 暑期班

1) 这个暑期班上好多同学都去旅游了。

这个 / 暑期 / 班 上 / 好多 同学 都 去 旅游了。

This summer-period class in many classmate all go travel-PST  
'summer vacation time'

'A lot of classmates went to travelling during this **summer vocation.**'

2) 小白问高文他暑期班上了多长时间。

小白 问 高文 他 / 暑期 班 / 上了 多长 时  
间。

Xiaobai asked Gaowen he summer-period school take-PST how long time  
'summer vacation time'

'Xiaobai asked Goa Wen how long he has studied in the **summer school.**'

9. Target character chain: 语言学

1) 语言学专业的学生毕业可以去公司上班。

语言学 / 专业 的 学生 毕业 可以 去 公司 上  
班。

Language-study major poss student graduate could go company work  
'Linguistics'

'**Linguistic** students can go to work at company after graduation.'

2) 我认为语言学习要通过练习。

我 认为 / 语言 / 学习 / 要 通过 练习。

I think language study require by practice

'I think **language learning** requires consistent practices.'

### APPENDIX 3: VOCABULARY SIZE TEST

考	to take an entrance exam for	to copy	to pass an entrance exam
听音乐	play the music	listen to music	play the music
语言	linguistics	linguist	language
老师	teacher	lawyer	doctor
爱好	love	hobby	compassion
学生餐	cafeteria	student government	student meal
语言学	linguistics	to study	language
班上	in the classroom	in the class	in the classroom
出租	rental apartment	to sell	to rent
学生	student	student union	student meal
聪明	mediocre	clever	stupid
思考	to read	to argue	to think
游泳	to swim	to run	to jump
有意思	boring	interesting	intentionally
上	in somewhere	to take off	to attend
运动场地	stadium	playground	transport
音乐会	listen to music	concert	musician
电脑	lightning	brain	computer
法律	court	judge	law
会	would/ will	concert	might/may
饭店	restaurant	bookstore	hotel
暑期	summer class	winter vacation time	summer vacation time
上海	ocean	Shanghai	maritime
新手	telephone	new hand	novice
脑中心	brain center	computer center	center
机会	opportunity	airplane	telephone
餐厅	bar	cafeteria	student meal
考上	to check	to take an entrance exam for	to pass an entrance exam
学习	to study	linguistics	to read
有意	accidentally	intentionally	interesting
中心	brain center	nearby	center

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