Lower-Elementary Level School Pupils' Developmental Trajectories of Chinese Verbal Vocabulary Knowledge and Influential Factors

Cheng Yahua & Wu Xinchun & Liu Hongyun & Li Hong*

Abstract: 149 elementary school pupils were selected as the subjects for this study, to whom five tracking assessments of their verbal vocabulary knowledge were given over a period of three years. In addition, a latent variable growth model was adopted to explore grades 1-3 elementary school pupil's developmental trajectory for verbal Chinese vocabulary knowledge. The phonological awareness, homomorphic morpheme awareness, compound morpheme awareness and family socioeconomic status (SES) on the students' verbal vocabulary knowledge were also investigated. The findings are: 1, grades 1-3 elementary school pupils verbal Chinese vocabulary knowledge developmental trajectory shows a curvilinear form, of which linear development is trended in the first two years, and as of the third year the developmental rate doubles the previous two years, whereas individual differences are remarkable in both the initial level and the growth rate; 2, awareness of phonetics, homomorphic morphemes and complex morphemes as well as the family socioeconomic status can be referred to for a positive forecast of the students' initial level of verbal vocabulary knowledge; 3, only the awareness of homomorphic morphemes and the family socioeconomic status can be applied to a positive prediction of the students' verbal vocabulary knowledge growth rate..

Keywords: verbal vocabulary knowledge; developmental trajectory; latent variable growth modeling; family socioeconomic status; morphological awareness

* Cheng Yahua, lecturer, Department of Psychology/Research Institute of College of Teacher Education, Ningbo University.
Wu Xinchun, professor, Research Center of Children's Reading and Learning, Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University.
Liu Hongyun, professor, Research Center of Children's Reading and Learning, Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University.
Li Hong, associate professor, Research Center of Children's Reading and Learning, Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University.

* Foundation item: A research project No. 17NDJC120YB of philosophy and social sciences under the planning of Zhejiang province; a Youth Fund research project No. 16YJC190002 of humanities and social sciences under the planning of the Ministry of Education; a key research project No. 13&ZD188 of the of the National Social Science Fund of China.

1. Research questions

Verbal vocabulary knowledge encompasses the morphology (form), phonetics (sound), and semantics (meaning) of Chinese vocabulary and other related linguistic knowledge and is a key indication of the language development of children. Based on a review of relevant research findings, the enrichment level of verbal vocabulary can be employed as a predictive assessment of the pupils' cognitive competence and their prospective learning performance and reading proficiency.① Seen from the children's language development stages, particularly of their reading skills, the lower-elementary stage is critical for pupils learning to read. The pupils' verbal vocabulary knowledge may exert significant effects on their development of word literacy, fluency in functional communication and reading comprehension.② Therefore, access to the lower-elementary verbal vocabulary knowledge developmental trajectory and its influential factors may have theoretical and practical implications to facilitate the pupils' acquisition of verbal vocabulary knowledge.

The changes and influential mechanisms in verbal vocabulary knowledge development draw researchers' extensive attention. Some scholars have conducted studies of verbal vocabulary knowledge development of children, for instance, one study of 130 preschoolers, from junior, middle, and up to senior kindergarten levels, found that the preschoolers' verbal vocabulary knowledge increases markedly with age.③ Another study indicates that grade-1 elementary school pupils' verbal vocabulary knowledge, through two tests at an interval of six months, tends to progress significantly.④ A study with a group of grades 1, 3 and 5 elementary school pupils as subjects also discovered that their verbal vocabulary knowledge, through two tests at an interval of one year, demonstrates a trend of noticeable increases.⑤ Such findings manifest clearly that in a short term, children's verbal vocabulary knowledge sees a considerable rise. For this study, newly enrolled grade-1 pupils were selected as subjects, whose verbal vocabulary knowledge developmental trajectory was investigated over three consecutive years. Moreover, previous studies were mainly concerned with the influential factors of vocabulary knowledge levels⑥, with very few focusing on the influence of the vocabulary knowledge developmental rate.

Some researchers hold that assessments of children's performance of their language competence shall not only be based on the children's language level at a particular time but also should include their language skills developmental rate in the assessment system⑦. The children's verbal vocabulary knowledge developmental rate is conducive to knowing their verbal vocabulary developmental potential. With regard to teaching practice, this may help identify the children at a lower developmental rate and it would be possible for the teacher to take intervention measures to speed up their vocabulary development. Then, will such factors as phonological awareness, morphological awareness, and family socioeconomic status, which have proved to affect

① Wright & Cervetti, 2017.
② Song et al., 2015
③ Li, Rao et al, 2016.
④ Cheng, Li et al, 2017.
⑤ Zhao, Cheng, et al, 2016
⑥ Li Hong et al.
⑦ McMaster, Fuchs, Fuchs & Compton, 2005

the children's verbal vocabulary developmental level, also affect their verbal vocabulary developmental rate. This is the second question that this study attempts to answer. Therefore, from the first test of tracking in this study, data of phonological awareness, morphological awareness, family socioeconomic status and other variables was collected, to explore their predictive roles in the children's verbal vocabulary knowledge developmental level and rate in latent variable growth modeling.

It was our hope that this study would also provide some evidence regarding the ideographic Chinese script learning for the differences and similarities of the children's vocabulary knowledge development models in a diversified language system. Based on a study with 45 out of 360 Swedish children at a high risk of dyslexia, , and 89 children as a control group, followed by a three-year tracking investigation, some researchers determined that the gaps between the two groups were enlarged in terms of vocabulary knowledge development with the Matthew effect.① Cain and Oakhill identified out a group of 21 reading comprehension elites and another group of 21 reading comprehension stragglers from 102 eight-year-old English children, with three-year follow-up tracking, and noted that the differences were amplified in vocabulary knowledge development, but there was no similar phenomenon in word reading skills.② As a typical non-phonetic script, Chinese lacks a systematic and explicit rule for phonetic-to-morphological conversion. Only through in-depth exploration can such questions as which trajectories children's Chinese vocabulary knowledge development follows, and what connections exist between the initial and later development rates, be better answered in reference to theories on the language development laws.

In studies of vocabulary knowledge, exploration of the influential factors for vocabulary knowledge development may be conductive to deeper access through the mechanism of vocabulary knowledge development. Studies find that metalinguistic awareness of phonetics and morphemes, forms key cognitive factors contributing to vocabulary knowledge development.③ Other studies have concluded that phonological awareness can be a key predictive indicator for children's vocabulary knowledge development and can shed light on the significance of the awareness in vocabulary knowledge development.④ In one study of the interconnection between phonological awareness and vocabulary knowledge, with a group of grade 2 elementary pupils in China (Beijing and Hong Kong), South Korea, and the United States, it was found that the interconnection is close and has a cross-linguistic universality.⑤ Some researchers tracked 74 preschool children at two given points of time. After controlling the autoregressive effects of rapid naming, morpheme awareness and vocabulary knowledge, phonological awareness can still account for 7% of the vocabulary knowledge variables.⑥ For Chinese children, morphological awareness may affect the vocabulary knowledge level, but whether morphological awareness also enables positive prediction of the initial knowledge development level needs further research. However, with

① Kempe, Eriksson–Gustavsson & Samuelsson, 2011
② Cain & Oakhill, 2011
③ McBride–Chang et al., 2005; Zhao et al., 2016.
④ McBride–Chang et al., 2005; Li et al., 2011.
⑤ McBride–Chang et al., 2005
⑥ Dong et al, 2014

children's buildup of reading and writing experience as well as their overall language proficiency, the morphological awareness's effect on vocabulary knowledge may also change correspondingly. After the preschoolers' progress to elementary education, when Chinese phonetics is taught, their morphological awareness can be developed rapidly up to a relatively stable level,[①] and their vocabulary knowledge is in a state of continuous growth. As a result, whether morphological awareness can predict children's vocabulary knowledge developmental rate is not clear cut.

As the only ideogram still in use in the world, Chinese has a systematic and transparent correspondence between its written symbols (Chinese characters) and morphemes.Therefore, morphological awareness is believed to play a distinctive role in children's Chinese vocabulary development with supportive evidence from a great number of empirical studies.[②] Morphological awareness refers to children's recognition of morphemes, the smallest semantic unit of the language, and their language operational ability.[③] Homomorphic and compound morphological awareness is found to be closely related to Chinese morphological awareness.[④] Homomorphic morphological awareness facilitates children's consideration of contextual clues for distinction of multiple morphological meanings,[⑤] whereas compound morphological awareness means children's awareness of morphological combination rules for compound vocabulary, which is conducive to children's analysis of morphological structures and rational conjecture of lexical meanings.[⑥]

Previous studies investigated the effect of morphological awareness on the vocabulary knowledge development level. The researchers then found that children with greater morphological awareness are usually more proficient in vocabulary knowledge. According to some studies, the upper-elementary schoolers in grades 5-6 with developmental dyslexia tend to be insufficient in their competence of homomorphic morpheme distinction.[⑦] One study, with 154 9-year-old Chinese Hong Kong children as test takers, discovered, despite restriction of the maternal education level and phonological awareness, compound morpheme awareness still has unique interpretation coincidence for verbal vocabulary.[⑧] However, no study has been conducted on how such morpheme awareness affects the vocabulary knowledge development rate. Our study explored the roles of both homomorphic and compound morpheme awareness in children's vocabulary development. In reference to previous studies, we hypothesized that both homomorphic and compound morpheme awareness can be referred to for positive predictions of the children's initial vocabulary level. Seen from the significance of the morpheme awareness for children's Chinese vocabulary and reading skill development,[⑨] we can also anticipate that homomorphic and compound morpheme awareness may play a positive role in children's vocabulary knowledge development.

In addition to the cognitive factor, researchers

① Shu, Peng, & McBride-Chang, 2008.
② Cheng, Li &Wu, 2015; Dong et al., 2014; Li et al., 2011
③ Zou & Shu, 2013
④ Cheng et al., 2015; Zhao, 2016
⑤ Zhao et al., 2016
⑥ Cheng et al., 2015
⑦ Shu, McBride-Chang, Wu & Liu, 2006
⑧ Liu, McBride-Chang, Wong, Shu &Wong, 2013
⑨ Pan et al., 2016

are also very much concerned with the family socioeconomic status (SES), a contextual factor. In view of the eco-system theory, individual development is conducted in a system. The closer a system's connection with an individual, the greater the individual influence will be on the system. Other studies find that SES may affect children' vocabulary knowledge development.① Seen from the family investment model,② the higher the child's SES, the better the social resources and the better the family environment. For example, the number of books is more, the reading time is more sufficient, and the language exchange opportunities with parents are more abundant, thereby promoting the benign development of its cognitive and social skills.③ According to one tracking study with a family over three generations, the educational investment and parent-and-child communication for children in the second family generation hinges on the SES of the parents in the first generation, and thus the first-generation parents' SES may influence the second-generation children's educational level. When the children in the second generation grow into parents themselves, their educational level may also continue influencing the next (the third) generation, particularly on the children' vocabulary development level.④ Based on review and analysis of the available literature, this study takes account of the contextual variable, exploring its effect on the children's vocabulary development level and the rate, and concludes that SES may be applied for positive prediction of the initial level and the development rate of children's vocabulary knowledge.

Though there were studies of relevant variable effects on the verbal vocabulary knowledge of children in particular age brackets, no systematic investigation has been carried out to explore their effects on the knowledge development rate, nor has a tracking paradigm been practiced for a systematic survey of the verbal vocabulary developmental trajectories of children at elementary school ages. Therefore, with some newly enrolled grade 1 elementary schoolers as subjects, this study conducted five tracking tests over three years adopting a latent variable growth model to study the children's verbal vocabulary knowledge developmental trajectories. Moreover, we also attempted to explore the phonological, homomorphic and compound awareness as well as their effects on the initial level and developmental rate of the children's vocabulary knowledge. Apart from an in-depth exploration of the children's unique Chinese vocabulary knowledge developmental laws, the study also intended to offer some reference for future language teaching practice.

2. Methodology

2.1 Test takers for this study

This study originated from a tracking study of children's Chinese language skills. Five tests were given to 149 grade 1 pupils, 69 being girl students, from two primary schools in Linfen city of Shanxi province. The first test (T1) was scheduled in the autumn semester of the candidates at the average age of 75.78 ± 3.75 months, while the four later tests were set respectively in the spring semester of grade 1 (T2), the autumn semester of grade 2 (T3), the spring semester of grade 2 (T4), and the autumn

① Fernald, Marchman & Weisleder, 2013.
② Conger & Donnellan, 2007.
③ Gu, Liu, Xia, 2017
④ Sohr–Preston et al., 2013

semester of grade 3, each at an interval of 6 months. Consequently, 3, 19 and 2 candidates were absent for T2, T3 and T5, respectively.

2.2 Study instruments

2.2.1 Vocabulary knowledge

All the five tests adopted the assignment of word definitions to investigate the children's verbal vocabulary knowledge. The five tests on the vocabulary knowledge were identical with the specific form of the interlocutor's presenting of double-character phrases for the children testers' definitions.[①] A total of 32 projects were arranged in an easy-to-difficult sequence, and the outcome of any candidate who gave five consecutive wrong answers, or left five questions blank, was deemed as invalid. Two test graders worked independently to score 0, 1 or 2. The consistencies among the graders for their five times of scoring ranged from 0.93, 0.94, 0.94, 0.95, to 0.94, whereas the internal consistency coefficients α for the tests were 0.74, 0.78, 0.87, 0.7, and 0.82, respectively.

2.2.2 Phonological awareness

T1 was administered through the assignment of phoneme deletion, to test the children's phonological awareness, particularly in the form of the interlocutor's oral presenting of a syllable that required the test takers to tell the syllable left after deletion of a designated phoneme.[②] For instance, one shall say which sound was left after deletion of /u/ of the phonetic transcription /zhua1/. The answer was /zha1/. A total of 12 projects, including 4 phonemes in the front, middle and rear were deleted. 1 point was scored for each correct answer. The internal consistency coefficient α was 0.88 for the tests.

2.2.3 Homomorphic morpheme awareness

T1 was administered through the assignment of homomorphic morpheme production, in which the interlocutor orally presented double-character phrases, designated a morpheme as the target one, like '花' in the phrase '花朵' (Chinese character and phrase meaning a general floral designation and a specific flower respectively), and asked the children to make two more phrases, of which the meaning of one target morpheme was identical to the original one, though the other one may be different, like '鲜花' and '花钱' (fresh flower and expending money).[③] A total of 12 projects were implemented, and 2 points were scored for each. The internal consistency coefficient α was 0.69 for the tests.

2.2.4 Compound morpheme awareness

T1 was administered through the assignment of compound phrase production, in which the interlocutor asked each child tester one question and the test takers responded creatively with a new phrase, for instance, '纸篮' (paper basket) is a '篮子' (basket) woven with '纸' (paper).[④] A total of 20 projects were involved, in an easy-to-difficult sequence, and the outcome of any candidate who gave five consecutive wrong answers, or left the five questions blank, was deemed as invalid. Two graders might, depending on a child tester's extraction of key morphemes as well as the accuracy and conciseness of their vocabulary structure, score 0, 1, 2, and 3 points, at a consistency of 0.98. The internal consistency coefficient α was 0.83 for the tests.

2.2.5 Family socioeconomic status (SES)

On the basis of relevant studies,[⑤] a questionnaire

① Shu et al., 2006.
② Shu et al., 2006
③ Li, et al., 2011
④ Cheng et al., 2017
⑤ Shi & Shen, 2007

was designed. As T1 was administered, the pupil candidates' parents were asked to fill out the family questionnaire informing their occupations, educational levels, and incomes. Their occupations were coded into corresponding rankings, and 1 up to 5 points were scored for the rankings. Their educational levels were in the sequences of elementary, junior high school, senior high school, technical secondary school, junior college, undergraduate, master, and PhD, which were scored 1 to 8 points when coded. The monthly income levels were arranged in the sequences of below 1,000, 1,001 - 2,000, 2,001 - 4,000, 4,001 - 6,000, 6,001 - 8,000, 8,001 - 10,000, and above 10,000, which were scored 1 - 7 points when coded. In the end, summation of the values of occupational rankings, educational levels, and income levels were referred to as the SES indicators.

2.3 Procedures

All the tests were administered by trained interlocutors. The family questionnaires were filled out by the children testers' parents at home, and the rest of the tests were administered to individuals. The procedures of the five tests were completely identical. Upon the first test, some individual tests were completed twice (one test in one day) within a week to avoid inclusion of other factors, but the other four tests were done one time. During the tests a break between sections was scheduled to avoid the children testers' over-fatigue. Individual tests were administered in a quiet room, on a one-to-one basis, with an interlocutor and a test candidate, each within a time frame of 45 minutes.

3. Findings

For this study, the churn rate of test takers was 16%, which, based on an analysis of the chi-square test and the student's test, indicated that there existed neither remarkable differences nor structural loss among the 125 (n = 125) participants and 24 (n=24) for follow-up studies in the gender ratio ($\chi 2(1)=0.25$, $p=0.62$), ages ($t(147)=0.35$, $p=0.73$) and the first test of vocabulary knowledge ($t(147)=-1.79$, $p=0.08$), compound morpheme awareness ($t(147)=-1.89$, $p=0.06$), homomorphic morpheme awareness ($t(147)=0.08$, $p=0.92$), phonological awareness ($t(147)=0.71$, $p=0.48$), and SES ($t(147)=-0.67$, $p=0.51$). In the analysis of the statistic figures, the missing value of the tracking data was allowed, and a maximum likelihood model was used for estimation.

3.1 Descriptive statistical results

Table 1 lists the average value, standard deviation and relevant matrix of variables. From T1 to T5, the children testers' vocabulary knowledge took on a trend of gradual growth. Their performance of vocabulary knowledge indicated an intermediate level of stability at coefficients ranging from 0.50 to 0.71. A marked moderate and positive correlation existed amid SES, phonological awareness, homomorphic and compound morpheme awareness. Five tests of vocabulary knowledge at related coefficients ranged from 0.20 to 0.49.

3.2 Children's vocabulary knowledge developmental trajectories: unconditional modeling

To plot the vocabulary knowledge developmental trajectories, a linear, unconditional latent variable growth model and a quadratic nonlinear growth model could be structured respectively. The intercept α and the gradient β were two parameters necessary for estimation of the linear, non-conditional latent variable growth modeling, in which the intercept stood for the initial level of the vocabulary knowledge developmental trajectories with all the modeling factor load set at 1, whereas the gradient represented the vocabulary knowledge trajectory rate at an equal interval for the study-purposed tests at the set factor loads of 0, 1, 2, 3, and 4. The equation of the first level model was

VOCit=αi+βiλt+ζit, of which VOCit stood for the value of a child's (i) vocabulary knowledge by the time spent; αi, the estimated average value of the child's (i) vocabulary knowledge by calculation of the intercept level at T1 for this study; βi, the average variable value of the vocabulary knowledge during the five tests for the study; λt, the value of time; and ζit, the residual error of the child at the time (t). The second level equation is αi=μα+ζαi;βi=μβ+ζβi, in which, μα and μβ referred to the average value of the intercept and the gradient; and ζαi and ζβ, the residual errors of the child's intercept and gradient. Based on the linear growth modeling, one quadratic term was added to constitute a non-linear growth model with the respective factor loads of 0, 1, 4, 9, and 16.

The fit index of two unconditional models was shown in table 2 (lines 1-2), which indicated that both the linear and quadratic nonlinear models were well fitted, and that such models did not apply to the vocabulary knowledge developmental trajectories. To explore the vocabulary developmental trajectories, an undefined curve model estimation was adopted,[①] by which, the gradient at the first time point was set at 0; the second; at 1; and the free estimation of the gradient for the later three was shown in the simulative fit index table 2 (Line 3). Seen from the index, such models complied with a desirable data fitting, the five times of gradient factor loads being at 0, 1, 2.54, 3.23, and 5.78.

Table 1 Average value, standard deviation and related matrix of variables

Variables	M	SD	1	2	3	4	5	6	7	8	9
1.T1_Vocabulary knowledge	8.62	5.13	1								
2.T2_Vocabulary knowledge	10.69	5.74	0.71***	1							
3.T3_Vocabulary knowledge	13.51	6.36	0.64***	0.67***	1						
4.T4_Vocabulary knowledge	14.81	6.39	0.55***	0.50***	0.62***	1					
5.T5_Vocabulary knowledge	19.86	6.62	0.58***	0.59***	0.66***	0.68***	1				
Family SES	18.31	6.30	0.46***	0.45***	0.45***	0.43***	0.47***	1			
7.T1_Phonological awareness	6.05	3.83	0.29***	0.25**	0.20*	0.32***	0.28**	0.17*	1		
8.T1_Homomorp−hic morpheme awareness	5.88	3.03	0.47***	0.41***	0.36***	0.39***	0.49***	0.25**	0.27**	1	
9.T1_Compound morpheme awareness	9.57	8.96	0.42***	0.40***	0.47***	0.33***	0.39***	0.39***	0.14	0.44***	1

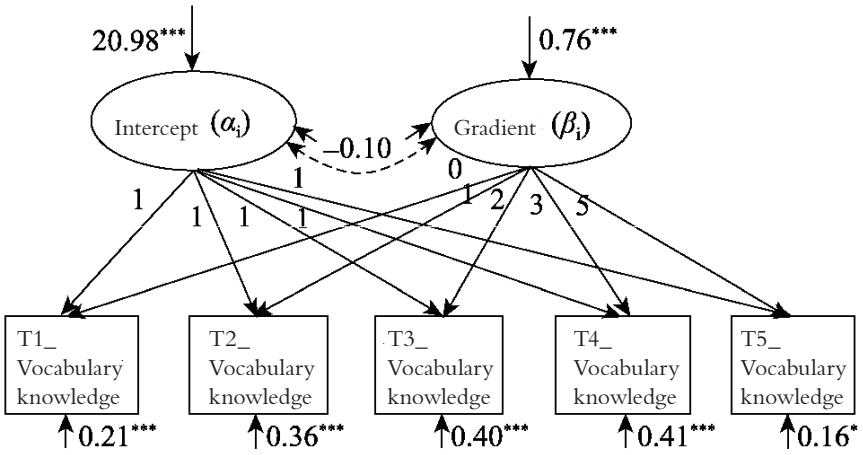
Note: ***p<0.001;**p<0.01;*p<0.05, the same hereinafter

Table 2 The latent variable growth model fitting indices of nonlinear and undefined curve and defined slope factor loads

Models	χ2	df	p	RMSEA	SRMR	CFI	TLI
Linear unconditional model	36.99	10	0.00	0.14	0.07	0.93	0.93
Quadratic nonlinear unconditional model	21.37	6	0.00	0.13	0.04	0.96	0.93
Undefined curve model	8.42	7	0.29	0.04	0.04	0.99	0.99
Defined gradient factor load model	13.19	10	0.21	0.05	0.03	0.99	0.99

① Liu & Zhang, 2005

Figure 1 The unconditional latent variable growth model of the children's vocabulary knowledge



It was difficult to explain the value of estimation simply on the basis of an undefined curve model alone. Therefore, generally in line with the gradient factor loads estimated by the model, researchers deduced whether the model-based estimation of gradient factor loads conformed to some explicable developmental trajectories, worked out the gradient factor load value, and then attached a psychological implication to the undefined curve model. Seen from the gradient factor load by the undefined curve model, with the five-test factors set at 0, 1, 2, 3, and 5, in reference to the defined gradient factor load model, an estimation was made for the model fitting indices in Table 2 (Line 4), which indicated good model-to-data fittings (See figure 1 for the finalized model).

The statistical outcome of the models was shown in Table 3. The model intercept, i.e. the vocabulary knowledge level of the newly enrolled elementary students, was 8.59, markedly greater than 0 ($p<0.001$); there was significant growth during the five tests (M=2.27, SE=0.10, $p<0.001$); seen from the factor loads, the growth was nonlinear in general, with four times of linear growth and one time of accelerated growth (T5) at rates double the previous.[①] In addition, the variation of the intercept ($\sigma 2=20.98$, $p<0.001$) and that of the gradient ($\sigma 2=0.76$, $p<0.001$) were obviously greater than 0, which indicated there were evident individual differences in the initial level of the children's vocabulary knowledge and the knowledge developmental rate. Eventually, it was found that there was no obvious relativity between the intercept and the gradient ($r=0.10$, $p=0.45$), which indicated clearly that there existed no marked relevance between the growth rate of the children's vocabulary knowledge and the initial level.

3.3 The conditional models for prediction of the initial vocabulary knowledge level and the knowledge growth rate

Considering such predictive variables for

Table 3 Analytical outcome of the unconditional latent variable growth model for children's vocabulary knowledge

Parameters		Fixed effect	Stochastic effect
	Coefficient	Standard error (SE)	Mean variance ($\sigma 2$)
Intercept	8.59***	0.41	20.98***
Gradient	2.27***	0.10	0.76***

① Liu Hongyun, Zhang Lei, 2005

constitution of the conditional growth model, including children's phonological awareness, homomorphic and compound morpheme awareness and SES, the researchers explored whether such variables were causal factors contributing to the individual differences in the initial level of vocabulary knowledge and the knowledge growth rate. These conditional models (See figure 2) were well fitted with the data: $\chi 2(22)=26.95$, $p=0.21$, CFI=0.99, TLI=0.98, RMSEA=0.04, SRMR=0.03. The products showed that in the estimation of the vocabulary knowledge growth model intercept, SES ($\beta=0.35$, $p<0.001$), phonological awareness ($\beta=0.15$, $p<0.05$), homomorphic morpheme awareness ($\beta=0.28$, $p<0.001$), and compound morpheme ($\beta=0.20$, $p<0.05$) all played dramatically positive and predictive roles. With regard to the prediction of the gradient for the vocabulary knowledge growth model, marked positive and predictive roles were demonstrated in SES ($\beta=0.26$, $p<0.05$) and homomorphic morpheme awareness ($\beta=0.30$, $p<0.01$), but no explicit predictive roles were played in phonological awareness and compound morpheme awareness.

4. Discussion

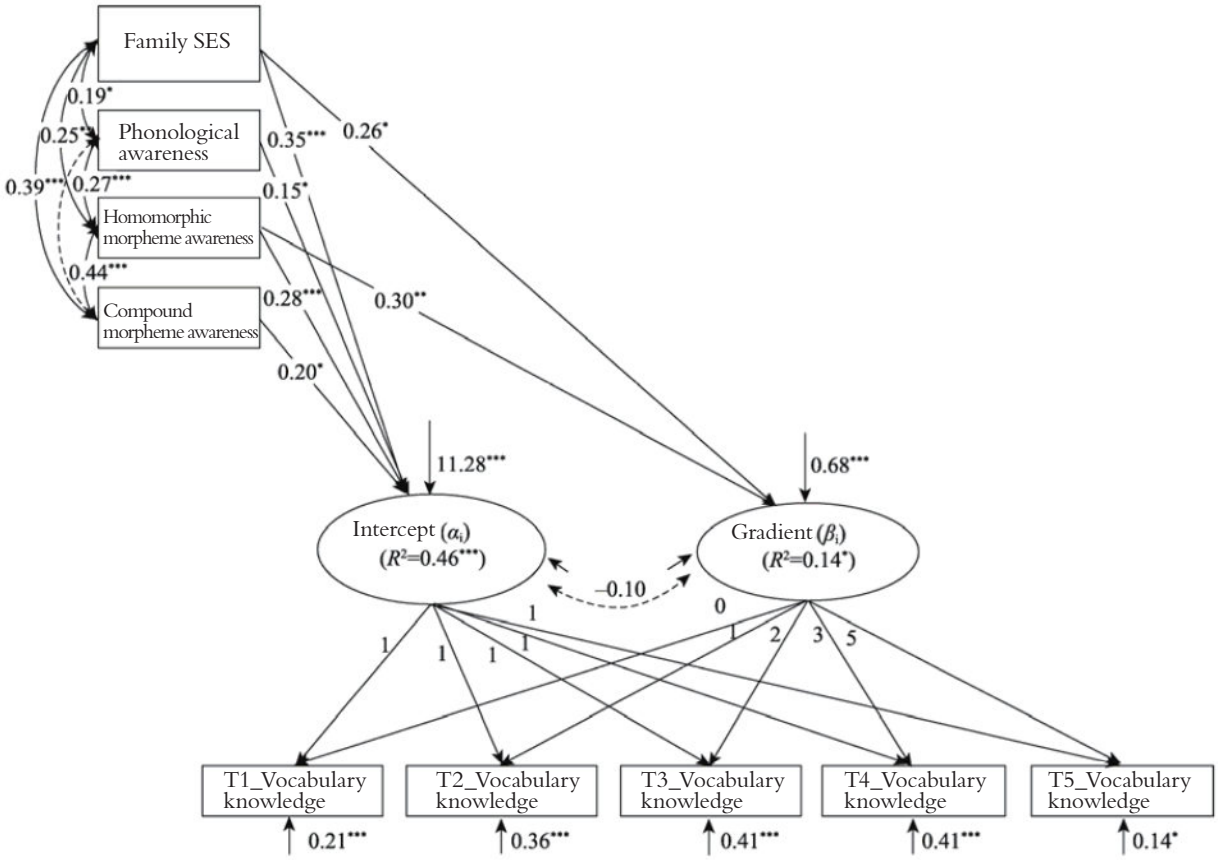
4.1 The developmental trajectories of the elementary pupils' vocabulary knowledge

The results of this study of the children subjects' marked growth during their elementary learning of Chinese verbal vocabulary knowledge is found consistent with the findings of previous studies[①]. In the stage from grades 1 to 2, the children enjoy rapid, linear development in the knowledge; as of grade 3, greater developmental rates are achieved, which shows that grade 3 may be a critical stage for the children's vocabulary knowledge development. It was also found that there is no remarkable relevance between the initial knowledge level (intercept) and the developmental rate (gradient), i.e. the lower-elementary schoolers' verbal vocabulary knowledge development takes on a model with differential steadiness.

The developmental trend of the vocabulary knowledge is mainly attributable to the following three factors: 1, relevance to the children's reception of formal teaching of vocabulary knowledge as part of the language acquisition contents based on the multi-factor model for the vocabulary knowledge; meanwhile, it results from the children's learning of reading and writing skills. Prior to their access to formal pedagogy, the children gain their vocabulary knowledge mainly by means of interaction. After that, through practice of reading and writing, the children integrate their previous vocabulary knowledge and the meanings of the new words they have learned. Whenever a new word is acquired, a solitary nodal point is added in its lexical system with updated semantic connections to the established system, and thus their comprehension of original vocabulary can be deepened. 2, relevance to increased semantic communication. The children's chances to interact with their teachers and peers are multiplied after they are admitted to an elementary school, a key venue of formal learning. Through such bilateral exchanges with their teachers or peers, either by teacher-to-student or student-to-student interaction, the children's comprehension of the vocabulary can be interpreted and clarified. 3, relevance to the children's cognitive and language development in this stage[②] found that, through their studies of children's vocabulary knowledge, the children's phonological awareness and morpheme

① Zhao et al., 2016; Song et al., 2015
② Song et al.2015

Figure 2 The effect of family SES, phonological awareness, homomorphic and compound morpheme awareness on their vocabulary knowledge developmental trajectories



awareness in this stage may be strikingly developed. Their phonological awareness and morpheme awareness can be protective factors that enable the children at a lower vocabulary proficiency level to develop their vocabulary knowledge level.

Seen from the developmental perspective, grade 3 may be a critical period for elementary schoolers' vocabulary knowledge development[①]. In view of the theory on reading skill developmental stage[②], the children in different stages of schooling may be confronted with differentiated reading development assignments. In around grade 3, however, the children can move from the stage of "learning to read" to that of "learning from reading," with a gradually increased contribution to speech comprehension from readings. Some studies with some children sitting for the tests as subjects, found that speech comprehension's contribution to reading was 11% for grade 2 students and could rise to 31% by the time they reached grade 4[③]. Unlike the early knowledge of vocabulary that just rests on the shallow level of basic semantics, for children in grade 3, in-depth interpretation competence for verbal vocabulary, the context of the words in

① Song et al., 2015
② Chall, 1996
③ Joshi, Tao, Aaron, & Quiroz, 2012

use, the semantic knowledge online, among some others, may be gradually deepened, which reflects the process of children's continuous understanding of the connections between new knowledge and that already learned[①]. Therefore, regarding the developmental view, there is an upgrade potential for children's verbal vocabulary knowledge. However, due to the limit of the tracking times, it would be difficult to draw more accurate developmental trajectories for the children's vocabulary knowledge after grade 3.

Verbal vocabulary knowledge is deemed as the individual learner's language learning competence for later sustainable development in life[②]. The children, whose initial level is already considerably high, may still have broad room for development. So studies of alphabetic writing show that the children at low or high initial verbal vocabulary levels may enlarge their later gaps in the vocabulary knowledge development. It is noteworthy that, like the children's age brackets concerned by some institutes of alphabetic writing studies, this study also pays close attention to the lower-elementary school children. A possible interpretation for developmental model differences lies in the characteristics of the writing system of a language that may affect the developmental trajectories of vocabulary knowledge.[③] Compared with the Chinese language, children, whose mother tongue follows the alphabetic system, may acquire the word-decoding skills[④] in relatively shorter duration, their independent reading may be started at an earlier stage and thus they also tend to develop higher initial vocabulary knowledge at a faster pace. By contrast, Chinese children, despite also having a fast buildup of verbal vocabulary in the same ages, owing to main efforts on literary[⑤], generally demonstrate much less quantities of independent reading without the trend of gap widening though there may be a constant discrepancy among the children in terms of their initial level.

4.2 Correlation of the pronunciation, homomorphic morpheme, compound morpheme awareness and family SES with the initial verbal vocabulary level

This study found that the phonological awareness may contribute to variations in the initial verbal vocabulary levels, which is consistent with the findings of previous studies[⑥]. In view of the hypothesis on long-term phonetic knowledge[⑦], vocabulary knowledge learning depends on activation of or accessibility to the long-term memory for phonological representation. In the vocabulary knowledge learning process, lexical meanings are acquired through phonological activation and bonding. Children with stronger phonological awareness also tend to perform better in segmentation and operation of continuous sound flow in speech, and behave more sensibly in phonetic clues to verbal vocabulary learning, which may foster their vocabulary learning and upgrading of their vocabulary knowledge proficiency[⑧].

Some studies discovered that, following the control of the ages, phonological awareness and rapid naming, homomorphic morpheme awareness still contributes specially 5% to the verbal

① Paris, 2005
② Paris, 2005
③ Pfost, Hattie, Dörfler, & Artelt, 2014
④ Moll et al., 2014
⑤ Shu, Chen, Anderson,Wu, & Xuan, 2003
⑥ McBride–Chang et al., 2005; Li et al., 2011
⑦ Bowey, 2001
⑧ Li et al., 2011

vocabulary knowledge[①]. The results of these studies also indicate that the homomorphic morpheme awareness plays a prominent predictive role in the progression of verbal vocabulary knowledge. For Chinese vocabulary, superficially, all the word structures appear the same. As a matter of fact, the Chinese morphemes bear no external structural clues but pure representational meanings, that is, almost every Chinese character may convey an independent morpheme meaning[②] . Referring to the hypothesis of the vocabulary-based core semantic representation[③], multiple-semantic representation of homomorphic morphemes may produce greater semantic activation. Therefore, children better aware of homomorphic morphemes may not just focus on a particular homomorphic morpheme implication but rather may have more extensive semantic comprehension of a single word. They are more likely to be able to distinguish the possible meanings of the same Chinese character in several different phrases, express the meanings promptly in a certain context, and thus effectively facilitate their vocabulary knowledge development.

Consistent with the findings of other studies[④], for this study, the compound morpheme awareness is also strikingly conducive to forecast the initial verbal vocabulary knowledge level. Related studies display that decomposability is a key mechanism of morpheme processing and the morpheme and entire word representation coexist in Chinese verbal vocabulary processing[⑤]. It has been found that children with adequate development of compound morpheme awareness may, more deliberately, have access to every morpheme in the vocabulary, and analyze the morpheme structures of complex vocabulary with two or more morphemes. By full use of clues, they may also learn new words, infer rationally the word implications, and comprehend fully the lexical meanings[⑥].

A previous study of kindergarten children's vocabulary knowledge shows that those with higher SES tend to be more proficient in their verbal vocabulary level[⑦]. This study also found children with higher SES may also develop higher initial verbal vocabulary knowledge than their peers with lower SES. Usually, households with higher SES may own greater volumes of readings, and a high correlation exists between the household quantity of readings and the children's reading competence[⑧]. On the other side, the parents with higher SES may keep reading stories to their children, share picture books with their own children, and have more meaningful exchanges with them among other activities involved, which facilitates the children's acquisition of vocabulary knowledge.

4.3 The vocabulary knowledge developmental rate: the roles of homomorphic morpheme awareness and family SES

This study also finds that homomorphic morpheme awareness and family SES can be two marked references for the prediction of children's verbal vocabulary knowledge developmental rate, but there is no indication of the predictive role of phonological and compound morpheme awareness. With regard to phonological awareness, we maintain that such outcomes may be attributable to the fact

① Li et al., 2006
② Shu et al., 2006
③ Borowsky & Masson, 1996
④ Liu et al., 2013; Dong et al., 2014
⑤ Zhou & Marslen–Wilson, 1995
⑥ Cheng et al., 2015
⑦ Fernald et al., 2013
⑧ Shu et al., 2002

that the phonological awareness role is regulated to some extent by the form-to-sound consistency of the language writing system. In contrast to an alphabetic writing system, the pronunciation of the Chinese language features markedly monosyllable vocabulary, with lower form-to-sound consistency. Compared with the continual development of vocabulary knowledge, the development of Chinese phonological awareness became mature earlier.[①] Therefore, the correlation between phonological awareness and vocabulary knowledge may be gradually weakened with advancement of children's ages. For children who are learning Chinese, satisfactory phonological representation competence alone is inadequate for vocabulary acquisition.

Speaking of compound morpheme awareness, the finding and the hypothesis were found to be inconsistent. The study shows children with better compound morpheme awareness may also tend to make more meticulous analysis of morpheme interconnection and vocabulary structures, and thus may demonstrate more sensitivity to key morphemes in verbal vocabulary. Meanwhile, children may learn to interpret unfamiliar vocabulary based on the vocabulary composition rules, which is then conducive to their vocabulary knowledge development.[②] However, though this study intend to identify the effect of compound morpheme awareness on the initial vocabulary knowledge level, there was no discovery of the effect of the compound morpheme awareness on the vocabulary knowledge developmental rate. Such results still need further validation in prospective studies and the causal factors to the outcome to be explored.

There have already been some studies with children suffering from Chinese language developmental dyslexia, who tend to demonstrate homomorphic morpheme awareness defect.[③] According to the results of this study, homomorphic morpheme awareness was found noticeable in prediction of both the children's initial verbal vocabulary level and the vocabulary knowledge developmental rate, which indicates that homomorphic morpheme awareness plays a very important role in children's vocabulary knowledge. To sum up the findings of this study and previous ones, we can infer that homomorphic morpheme awareness can be a predictive factor for children's vocabulary knowledge development. As there contains a large number of polysemic words in Chinese, Chinese word comprehension requires access to both phonological and morpheme information to convey the meaning and achieve the sound and meaning correspondence for ultimate word comprehension.[④] Accordingly, children with more satisfactory homomorphic morpheme awareness may be able to grow aware, in earlier ages than their peers, to distinguish word meanings, identify the contextual clues, tell the multiple meanings of homomorphic morphemes, and avoid any semantic misunderstanding. In other words, the homomorphic morpheme awareness in children may facilitate their deeper word comprehension and ensure their continuous development of vocabulary knowledge.

Seen from the results of this study, SES is prominent in the prediction of the vocabulary knowledge developmental rate, which indicates its unremittingly strong bond with the lower-elementary children's vocabulary knowledge. Such a finding expands the outcomes of previous

① Shu et al., 2008
② Liu et al., 2013
③ Shu et al., 2006
④ Shu et al., 2006

studies,[①] and brings to light the key role of family environment, probably as a protective factor contributing to children's vocabulary knowledge development. The parents with higher SES, on one hand, may render sufficient material support to their children, such as the creation of optimum reading settings at home; on the other, they may also offer their children richer emotional backing, for instance, more parent-to-child communication, or participatory and inspiring readings together with the children.[②] Living in families with optimum reading atmospheres, children tend to be nurtured into more proficient and independent readers, accordingly with increased reading quantities and interests, which then fosters effective development of their vocabulary knowledge. This can be a hint for us that the role of family environment factors may affect the prospective development of the children's vocabulary knowledge.

4.4 Theoretical implications of this study

This study has several key theoretical implications. First, through 5 tracking tests over a period of three years, a systematic investigation was conducted with a group of children to explore their verbal vocabulary knowledge developmental trajectories and reveal their individual differences in the growth rate. The findings from this study show that the study of the developmental trajectories, particularly the developmental rate, has a unique value for understanding children's vocabulary knowledge development. In a prospective assessment of children's speaking skills, it would be necessary to include the children's verbal vocabulary knowledge developmental rates in the assessment system, and provide focused interventions for children with a slower developmental rate. The results of this study may remind parents and educators of additional care to the elementary schoolers in grades 1-3. Second, this study also discloses the roles of homomorphic morpheme awareness and SES on children's verbal vocabulary knowledge developmental rates. Currently, studies of the factors on the verbal vocabulary knowledge mainly focus on prediction of their developmental level, and few studies have been conducted on prediction of the developmental rate. Consequently, the findings from this study, to a certain extent, enrich and expand the achievements of previous studies.

5. Conclusion

In grades 1-3 elementary schoolers' vocabulary knowledge takes on a trend of nonlinear development, in which the first two years sees a linear development and as of the third grade a doubled rate of development. Meanwhile, both the initial level and the developmental rate demonstrate a marked individual difference.

Phonological awareness, homomorphic morpheme awareness, compound morpheme awareness, and family SES are all attributable to positive prediction of the initial vocabulary knowledge level of the newly enrolled elementary school pupils.

Homomorphic morpheme awareness and family SES were found conducive to positive prediction of the grades 1-3 elementary schoolers' vocabulary knowledge developmental rate.

(Translator: Bai Chongshun; Editor: Jia Fengrong, Yan Yuting, Xu Huilan, Xiong Xianwei)

① Fernald et al., 2013
② Conger & Donnellan, 2007; Gu et al., 2017

This paper has been translated and reprinted with the permission of *Acta Psychologica Sinica*, No. 2, 2018.

REFERENCES

Borowsky, R., & Masson, M. (1996). Semantic ambiguity effects in word identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 63–85.

Bowey, J. A. (2001). Nonword repetition and young children's receptive vocabulary: A longitudinal study. *Applied Psycholinguistic*, 22, 441–469.

Cain, K., & Oakhill, J. (2011). Matthew effects in young readers: Reading comprehension and reading experience aid vocabulary development. *Journal of Learning Disabilities*, 44, 431–443.

Chall, J. S. (1996). *Stages of reading development (2nd ed.)*. Fort Worth, TX: Harcourt-Brace.

Cheng, Y., Li, L., & Wu, X. (2015). The reciprocal relationship between compounding awareness and vocabulary knowledge in Chinese: A latent growth model study. *Frontiers in Psychology*, 6, 440.

Cheng, Y. H., Li, H., Wu, X. C., & Dong, Q. (2017). The reciprocal relationship between Chinese grade one children's morphological awareness and vocabulary: Evidence from a longitudinal study. *Journal of Psychological Science, 40*, 103–109.

Cheng, Y., Zhang, J., Li, H., Wu, X., Liu, H., et al. (2017). Growth of compounding awareness predicts reading comprehension in Young Chinese students: A longitudinal study from Grade 1 to Grade 2. *Reading Research Quarterly*, 52, 91–104.

Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology*, 58, 175–199.

Dong, Q., Li, H., Wu, X. C., Rao, X. W., & Zhu, J. (2014). The roles of morphological awareness, phonological awareness and rapid naming in linguistic skills development of Chinese kindergartener: Evidence from a longitudinal study. *Studies of Psychology and Behavior*, 12, 207–211.

Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science*, 16, 234–248.

Gu, H. L., Liu, J., & Xia, T. S. (2017). Effect of family socioeconomic status on reading autonomy among elementary school students: The mediating effects of parents' encouragement and reading motivation. *Acta Psychologica Sinica*, 49, 1063–1071.

Joshi, R. M., Tao, S., Aaron, P. G., & Quiroz, B. (2012). Cognitive component of componential model of reading applied to different orthographies. *Journal of Learning Disabilities*, 45, 480–486.

Kempe, C., Eriksson-Gustavsson, A., & Samuelsson, S. (2011). Are there any Matthew effects in literacy and cognitive development? *Scandinavian Journal of Educational Research*, 55, 181–196.

Li, H., Rao, X. W., Dong, Q., Zhu, J., & Wu, X. C. (2011). The roles of phonological awareness, morphological awareness, and rapid naming in linguistic skills development of kindergartener. *Psychological Development and Education*, 27, 158–163.

Liu, H. Y., & Zhang, L. (2005). *Longitudinal data analysis methods and its applications*. Beijing: Educational Science Press.

Liu, P. D., McBride-Chang, C., Wong, T. T.-Y., Shu, H., & Wong, A. M.-Y. (2013). Morphological awareness in Chinese: Unique associations of homophone awareness and lexical compounding to word reading and vocabulary knowledge in Chinese children. *Applied Psycholinguistics*, 34, 755–775.

McBride-Chang, C., Cho, J. R., Liu, H., Wagner, R. K., Shu, H., Zhou, A., … Muse, A. (2005). Changing models across cultures: Associations of phonological awareness and morphological structure awareness with vocabulary and word recognition in second graders from Beijing, Hong Kong, Korea, and the United States. *Journal of Experimental Child Psychology*, 92, 140–160.

McMaster, K. L., Fuchs, D., Fuchs, L. S., & Compton, D. L. (2005). Responding to nonresponders: An experimental field trial of identification and intervention methods. Exceptional Children, 71, 445–463.

Moll, K., Ramus, F., Bartling, J., Bruder, J., Kunze, S., Neuhoff, N., … Landerl, K. (2014). Cognitive mechanisms underlying reading and spelling development in five European orthographies. *Learning and Instruction*, 29, 65–77.

Pan, J., Song, S., Su, M., McBride, C., Liu, H., et al. (2016). On the relationship between phonological awareness, morphological

awareness and Chinese literacy skills: Evidence from an 8-year longitudinal study. *Developmental Science*, 19, 982–991.

Paris, S. G. (2005). Reinterpreting the development of reading skills. *Reading Research Quarterly*, 40, 184–202.

Pfost, M., Hattie, J., Dörfler, T., & Artelt, C. (2014). Individual differences in reading development: A review of 25 years of empirical research on Matthew effects in reading. *Review of Educational Research*, 84, 203–244.

Shi, B. G., & Shen, J. L. (2007). The relationships among family SES, intelligence, intrinsic motivation and creativity. *Psychological Development and Education*, 23(1), 30–34.

Shu, H., Chen, X., Anderson, R. C., Wu, N., & Xuan, Y. (2003). Properties of school Chinese: Implications for learning to read. *Child Development*, 74, 27–47.

Shu, H., Li, W. L., Gu, Y. M., Anderson, R., Wu, X. C., Zhang, H. C., & Xuan, Y. (2002). The role of home literacy environment in children's reading development. *Psychological Science*, 25, 136–139.

Shu, H., McBride-Chang, C., Wu, S., & Liu, H. (2006). Understanding Chinese developmental dyslexia: Morphological awareness as a core cognitive construct. *Journal of Educational Psychology*, 98, 122–133.

Shu, H., Peng, H., & McBride-Chang, C. (2008). Phonological awareness in young Chinese children. *Developmental Science*, 11, 171–181.

Sohr-Preston, S. L., Scaramella, L. V., Martin, M. J., Neppl, T. K., Ontai, L., & Conger, R. (2013). Parental socioeconomic status, communication, and children's vocabulary development: A third-generation test of the family investment model. *Child Development*, 84, 1046–1062.

Song, S., Su, M., Kang, C., Liu, H., Zhang, Y., McBride- Chang, C., … Shu, H. (2015). Tracing children's vocabulary development from preschool through the school-age years: An 8-year longitudinal study. *Developmental Science*, 18, 119–131.

Wright, T. S., & Cervetti, G. N. (2017). A systematic review of the research on vocabulary instruction that impacts text comprehension. Reading Research Quarterly, 52, 203–226. Xu, F., Homer, B., & Lee, K. (2002). Development of Chinese children's early word awareness. *Psychological Development and Education*, 18(4), 31–35.

Zhao, Y., Cheng, Y. H., Wu, X. C., & Nguyen, T. P. (2016). The reciprocal relationship between morphological awareness and vocabulary knowledge among Chinese children: A longitudinal study. *Acta Psychologica Sinica*, 48, 1434–1444.

Zhou, X. L., & Marslen-Wilson, W. (1995). Morphological structure in the Chinese mental lexicon. *Language and Cognitive Processes*, 10, 545–600.

Zou, L. J., & Shu, H. (2013). The cognitive and neural mechanisms of morphological processing during word recognition. *Advances in Psychological Science*, 21, 1570–1577.