

An exploratory study of predictors of vocabulary knowledge of Vietnamese preschool-age children in a city

Huong-Giang Thi Hoang^{1,3}, Kristof Baten¹, Ludovic De Cuyper^{1,2}, Tat-Thang Hoang³ and Miriam Taverniers¹

¹Universiteit Gent | ²Vrije Universiteit Brussel | ³Hue University

Abstract This study explores the effects of child-external and child-internal factors on vocabulary skills of Vietnamese pre-schoolers. Thirty-nine Vietnamese children (54–77 months) were tested on vocabulary and cognition skills. Their parents completed a questionnaire on background information. Correlation and regression analyses were performed to explore the contribution of multiple factors to the variability in vocabulary skills. Results showed that the effects of multiple factors varied across modality and domain. Productive vocabulary was individually sensitive to more factors than receptive vocabulary; and phonologically-based vocabulary was more sensitive than semantically-based vocabulary. The strongest predictor of receptive vocabulary, productive vocabulary, semantically-based vocabulary and phonologically-based vocabulary was child intelligence, child pre-schooling length, household income and child age, respectively. The findings seem to support the multidimensional views of language with evidence that different domains or modalities of vocabulary skills respond to the effects of multiple factors differently; and components of verbal ability should be examined separately.

Keywords predictors, vocabulary knowledge, receptive vocabulary, productive vocabulary, pre-schoolers, Vietnamese children

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Corresponding author

Huong-Giang Thi Hoang, Giang.Hoang@UGent.be;
hthuonggiang@gmail.com

Author contributions

Huong-Giang Thi Hoang, project administration, funding acquisition^{1,2}, conceptualization, methodology, software, validation, investigation, formal analysis, resources, data curation, visualization, writing – original draft and editing; Kristof Baten, supervision, methodology, writing-review and editing; Ludovic De Cuyper, software, statistical analysis, writing-review and editing; Tat-Thang Hoang, methodology, investigation, and data curation; Miriam Taverniers, supervision, funding acquisition^{1,2}, methodology, writing-review and editing

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There is no supporting information.

1 Introduction

The past decades have witnessed a rapidly growing interest in individual differences in young children's vocabulary development. Also, research has identified both child-external and child-internal factors as sources for these differences (e.g., Bates et al., 1995; Ebert et al., 2013; Hoff, 2006, 2013; Shore, 1994; Stokes & Klee, 2009). External factors includes family, socioeconomic status (SES)- and school-related characteristics (e.g., Ebert et al., 2013; Hoff, 2006; Lohndorf et al., 2017). Internal factors are biological characteristics and cognitive abilities (e.g., Archibald & Gathercole, 2006b; Newbury et al., 2015, 2016; Stokes et al., 2017). They are often reported as significant predictors of the development and the course of vocabulary knowledge in early childhood (e.g., Ebert et al., 2013; Hoff, 2006, 2013; Lohndorf et al., 2017; Stokes & Klee, 2009). This body of research mainly examines one aspect of lexical knowledge such as either receptive vocabulary (Ebert et al., 2013; Hoff, 2013; Teepe et al., 2017) or productive vocabulary (Hoff, 2013; Stokes & Klee, 2009; Umek et al., 2017). Also, these studies extensively explore Western languages and child samples. It is, thus, difficult and unwarranted to draw generalizations about young children's vocabulary development to other settings such as Asian contexts (Hoff & Tian, 2005; Zhang et al., 2008). Armed with this purpose, the present study investigates the sources of variability in lexical knowledge of preschool-aged children in a Vietnamese urban context.

Recently, the assumption of the dimensionality of children's vocabulary development has been increasingly explored in language research (Anthony et al., 2014; Justice et al., 2015; Lonigan & Milburn, 2017; Vermeer, 2001). Two language models have been proposed, namely, unidimensional and multidimensional views (Henriksen, 1999; Meara, 1996; Nation, 1990; Read, 2000; Vermeer, 2001), also called "global trait model" and "separate trait model" (Nizonkiza & Van den Berg, 2015, p. 46), respectively. The former considers one's lexical knowledge as a combination of various dimensions, and multiple aspects of the lexicon to characterize vocabulary competence as a whole (Nation, 1990; Read, 2000). The latter suggests that the components of vocabulary knowledge should be separate because each lexical constituent is a separate model (Henriksen, 1999; Meara, 1996; Vermeer, 2001). Research on these models is scarce but few have reported the relative dimensionality of children's vocabulary knowledge (Justice et al., 2015; Lonigan & Milburn, 2017; Vermeer, 2001).

Numerous studies have explored the impact of child-internal and child-external factors on early vocabulary development; but the majority of them assessed either child-internal or child-external factors influencing vocabulary skills. Little research investigates both internal and external factors simultaneously (Ebert et al., 2013; Hoff, 2006, 2013; Stokes et al., 2017). Few attempts have been made to understand the interaction between multiple child and environmental factors in predicting vocabulary outcomes (see Ebert et al., 2013; Stokes & Klee, 2009; Teepe et al., 2017; Umek et al., 2017). These attempts explore the

predictors of vocabulary knowledge across various modalities (i.e. receptive, productive vocabulary) in preschool-age children.

Regarding *receptive vocabulary*, two studies investigated the simultaneous effects of both internal and external factors on preschool-age children's vocabulary knowledge in Germany (Ebert et al., 2013) and the Netherlands (Teepe et al., 2017). The former study explored child characteristics, preschool characteristics and family background jointly. Findings suggested that working memory, preschool experience, preschool class size, and literacy activities in the home were significant predictors of German receptive vocabulary. Among these factors, working memory was the strongest predictor of vocabulary knowledge (Ebert et al., 2013). In the second study, significant predictors of Dutch receptive vocabulary in pre-schoolers consisted of child age, executive functioning, social functioning and family context (i.e. linguistic diversity and maternal education). The strongest predictor of Dutch receptive vocabulary measure was executive functioning of which components were "working memory, response inhibition and attention shifting" (Teepe et al., 2017, p. 2). Both studies employed the Peabody Vocabulary Picture Test to measure receptive vocabulary. They put forward the assumption that the receptive knowledge of Western-language vocabulary is determined by executive functioning (Teepe et al., 2017), especially working memory (Ebert et al., 2013).

Concerning *productive vocabulary*, two attempts explored the concurrent effects of child and environmental factors on vocabulary size of very young children in England (Stokes & Klee, 2009) and Slovenia (Umek et al., 2017). The first study examined the role of various factors, specifically, socio-cognitive, social-familial and geographical factors in English-speaking toddlers' vocabulary knowledge. Results revealed that working memory, age and gender were significant predictors of English vocabulary knowledge. Among these factors, working memory was the strongest predictor (Stokes & Klee, 2009). The second investigation included child age, child gender, parental education and shared reading activities in the home into its multifactorial model of vocabulary knowledge in Slovenian toddlers. Findings indicated that early vocabulary was significantly predicted by age and the frequency of shared reading, with age being the strongest predictor (Umek et al., 2017). These studies employed MacArthur-Bates Communicative Development Inventories to estimate productive vocabulary. They highlight that the productive knowledge of Western-language vocabulary is most strongly predicted by cognitive measures, and particularly child age (Stokes & Klee, 2009; Umek et al., 2017). When working memory is added to the multifactorial model, it becomes the strongest predictor (Stokes & Klee, 2009).

Although the existing literature on children's vocabulary knowledge as a function of multiple factors focuses mostly on Western societies, few attempts have been made regarding *Asian contexts* (Tardif et al., 2009; Zhang et al., 2008). These attempts explored the coexistent impact of several internal and external factors on *productive vocabulary* in preschool-age children. Zhang and colleagues (2008) investigated the impact of child

age, gender, SES (i.e. family income, paternal education and occupation) and caregivers' teaching practices on early vocabulary skill. Findings showed that significant predictors of Mandarin vocabulary knowledge in Chinese pre-schoolers were age, gender, paternal educational level and caregivers' teaching practices. Among these factors, child age was the strongest predictor. The second study explored child age, gender, parental education and location concurrently (Tardif et al., 2009). The results on monolingual child speakers, of Cantonese and Mandarin languages in Hong Kong and Beijing respectively, indicated that all four factors significantly predicted Cantonese and Mandarin vocabulary knowledge. The strongest predictor of productive vocabulary in these two Asian contexts was child age (Tardif et al., 2009). These findings appear to confirm the hypothesis that cognitive factors, especially age, are the strongest predictors of productive vocabulary in early childhood. However, these studies did not include other cognitive measures than age; therefore, the effect of cognitive factors such as working memory in Asian children's vocabulary skills is still unconfirmed.

Apparently, there is still limited knowledge of the multifactorial model of vocabulary development in early childhood. Investigations into these factorial effects on early vocabulary skills from multidimensional views, especially in non-Western contexts are necessary for a better understanding of the universality and the variability of internal and external factors in vocabulary learning. The present study is the first, to our knowledge, to explore the simultaneous effects of child-external and child-internal factors on different modalities and domains of vocabulary knowledge in preschool-age children in an understudied Asian context. The study aims to answer to what extent child-internal and child-external factors conjointly contribute to Vietnamese preschool-age children's vocabulary knowledge across two modalities (receptive, productive) and two domains (semantic, phonological); and to which factor is the strongest predictor of these modalities and domains of Vietnamese vocabulary knowledge. No prior hypothesis about the relative contribution of predictors, and the relative importance of internal or external predictors are formulated for measures of two modalities and two domains of Vietnamese pre-schoolers' vocabulary knowledge. This decision is important in this exploratory study as no research, to our knowledge, has previously examined the child's general intelligence together with other child and environmental characteristics (Stokes et al., 2017). Also, the multifactorial effects on early vocabulary ability have not been investigated from multidimensional views, with an inclusion of both modality and domain of vocabulary knowledge, before (Anthony et al., 2014).

2 Method

2.1 Participants

Participants were 39 monolingual, Vietnamese-speaking children aged 54–77 months ($M = 68$, $SD = 5.5$) with no physical or mental disability as declared by parents. All children had the same ethnicity (i.e., Kinh people) and resided in the city centre of Thua Thien Hue province in Central Vietnam. They attended 12 kindergartens in the city-centre neighbourhoods. The parents and children volunteered to participate in the study after the parents read the study's flyer. A total of 19 children were girls (49%); 20 were boys (51%). 26 children were first-born (67%); 13 were second-born (33%). Six children had no sibling (15%); 30 had one sibling (77%); three had two siblings (8%); two children (one boy, one girl) were a twin sibling pair. All children had one parent as a main caregiver, that was the mother (97%) or the father (3%). A total of seven had fathers with a postgraduate degree (18%); 19 had fathers with a graduate degree (49%); six had fathers with short-cycle tertiary education (15%); and seven had fathers with lower or upper secondary education (18%). Fourteen children had mothers with a postgraduate degree (36%); 19 had mothers with a graduate degree (49%); four had mothers with short-cycle tertiary education (10%), and two had mothers with upper secondary education (5%).

2.2 Materials and procedures

Vocabulary tests were used to measure Vietnamese vocabulary knowledge. Vocabulary knowledge was operationalised along two modalities (i.e. receptive, productive), and two domains (i.e. semantic, phonemic) as shown in Figure 1. Two modalities were measured with two vocabulary tests; two domains were measured with two subtests of the second vocabulary test; the tests were administered in accordance with standard procedures. Children were individually tested in a quiet room using child-friendly visual materials (i.e. picture books and toys). Before the actual testing, a warming-up session was conducted to make sure that children understood the task requirements.

Receptive modality of Vietnamese vocabulary knowledge was examined by means of a Vietnamese translation of the Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007) by the first author. An array of four images, which was printed in full colour, was simultaneously presented to children, together with a word spoken by the researcher. Then, the children were asked to point out the image that matched the spoken word. Given the selected age range of four to six years, the children all started with set four and stopped when making eight errors or more within a set. All of them stopped before reaching set twelve. Raw scores were reported.

Productive modality of Vietnamese vocabulary knowledge was measured using the Verbal Fluency test (Lezak et al., 2004) adapted for use with Vietnamese children by the first author. This test had two subtasks, namely Semantic Fluency and Phonemic Fluency.

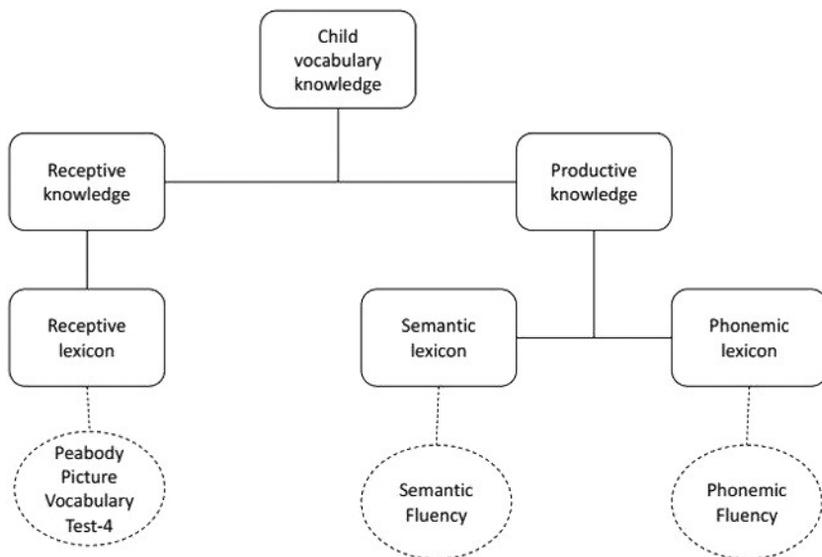


Figure 1 The multidimensional model of children's vocabulary knowledge

The former was used as measurement of semantic domain of Vietnamese vocabulary knowledge, while the latter was employed to quantify phonemic domain. The Semantic Fluency task included three semantic categories: animals (Kempler et al., 1998), fruits and vegetables (Sauz on et al., 2004), and food-drinks (Shao et al., 2014). The Phonemic Fluency task consisted of two phonemes [b] and [d], which are the two most frequent phonemes in Vietnamese based on a Vietnamese corpus for young children (Tran, 2011). These phonemes correspond with two alphabetical letters B and D in Vietnamese orthography. The Verbal Fluency task was presented as a game to stimulate the child's interest and participation (following Snyder & Munakata, 2010). Children were asked to say as many items as possible in 60 seconds for each semantic category and each letter. One point was given for a correct exemplar or word in each subtest. Both general category (e.g. *bird, fish* when producing animals; *đi (to go), đẹp (beautiful)* when producing [d]) and a specific exemplar (e.g. *shrimp, squid* when producing animals; *đứng (to stand), đi bộ (to walk)* when producing [d]) were given one point. From this we calculated three vocabulary measures: a total score, which included raw scores of semantic and phonemic sections, measuring productive modality; and two scores, which were the scores for semantic domain and phonemic domain, respectively.

Cognitive tests were employed to measure working memory and intelligence. In particular, the child's nonverbal short-term memory was measured with the Corsi's Block-Tapping Task (Corsi, 1972) in both forward condition (see Kessels et al., 2000 for description) and backward condition (see Kessels et al., 2008 for details). The total score

was a combination of maximum scores for forward and backward condition. The child's nonverbal intelligence was measured using a Vietnamese version of Raven's Coloured Progressive Matrices (Đỗ & Lưu, 1992; Raven, 1956). Raw scores were reported with one point for each correct answer.

All vocabulary and cognitive tests were operationalised with standard procedures. For vocabulary and intelligence tests, two examples were demonstrated in the trial phase to make sure that the children understood the requirements. For the memory test, the testing phase started only when the children repeated given examples correctly twice in a row. Given a small portion of the children were under five years old in the current study, the raw scores of the assessments were used instead of the standardised scores.

Parental questionnaires were used to collect data for several internal factors and all external factors. An informed consent form and two questionnaires were given to the parents when they brought the children to the testing room. The parents completed these forms while the children were performed the test battery. One part of the questionnaire was based on the Multilingual Assessment Instrument for Narratives study (Gagarina et al., 2012) while the rest adopted the household questionnaire of the Young Lives study (Boyden, 2012). The first questionnaire addressed child characteristics. It yielded three internal predictors, namely, the child's age (in months), gender (male, female), and age of starting preschooling (in months). The second one focused on environmental characteristics including household demographics and preschool characteristics. It yielded a number of external predictors. Specifically, family-related variables included measures of the child's birth order, sibling number, relationship of main caregiver to the child, current and past number of family members, family SES and home investment. The currency of Vietnam (VND) was used to calculate continuous family-SES or home-investment measures (1euro = 26,000–27,000VND). Measures of family SES were paternal and maternal education (total years of formal education), paternal and maternal occupation (following Hollingshead, 2011), current and past family income (a continuous six-level scale with an interval of 4,999,999VND), and poverty status (family's registration for a governmental program of hunger elimination and poverty decrease). The indicators of home investment were household basic budget (poor, nearly poor, non-poor) and family wealth (in VND). Preschool-related variables comprised of measures of children's schooling experience (in months) and preschools' types (state-run, private).

2.3 Statistical analysis

Information, which was collected from the parental questionnaire, showed certain homogeneity in the sample. Main caregivers of children in this study were all parents. The main caregiver's years of education reflected parental education years. Additionally, all households in the city centre's neighbourhoods were non-poor. This resulted in an exclu-

sion of these variables from analysis. Complete data were available on four dependent variables and 19 independent variables. Four outcome variables were scores of PPVT, Verbal Fluency, Semantic Verbal Fluency, and Phonemic Verbal Fluency. Independent variables included indicators of chronological age, pre-schooling-entry age, general intelligence, short-term memory, child gender, child's birth order to the mother, total number of siblings, number of older siblings, number of younger siblings, household size, past household size, paternal education years, maternal education years, paternal occupation level, maternal occupational level, household income, past household income, household basic budget, household wealth, child's length of pre-schooling, school's type and quality.

Analytical procedure started with a performance of descriptive statistics for all dependent and independent variables, followed by univariate analyses of covariance of 19 independent variables and four vocabulary scores. Child age as a factor was not partialled out from vocabulary test scores in this study's analyses given a small age range (four to six) in this sample. To avoid overlapping covariance of age and cognitive factors on vocabulary outcomes, age was partialled out from the intelligence and short-term memory test scores, using three simple regression models (following Sun et al., 2018). Then, regression analyses were performed to identify the contribution of statistically significant predictors to the variability in two vocabulary modalities and domains (following Stokes & Klee, 2009; Sun et al., 2018).

3 Results

3.1 Descriptive statistics

Table 1 presents means, standard deviations and ranges for the vocabulary ability, and continuous and ordinal child-internal and child-external variables. Figure 1 to Figure 5 show the distribution amongst values of categorical variables. Variability was more substantial in the PPVT and Verbal Fluency scores with a range of 66 and 49 points respectively, than in Semantic and Phonemic Fluency scores with 37 and 21 points respectively. Variability was larger in PPVT scores ($M = 76.74$, $SD = 20.30$) than in Verbal Fluency scores ($M = 35.03$, $SD = 12.35$). Variability in Semantic Fluency scores ($M = 26.49$, $SD = 8.60$) was also larger than Phonemic Fluency scores ($M = 8.54$, $SD = 5.83$). Additionally, considerable variability was found in the measures of nonverbal intelligence, short-term memory, household wealth and preschooling experience.

Table 1 Descriptive statistics for continuous measures (N = 39)

Measure	M	SD	Min	Max
<i>Vocabulary scores</i>				
PPVT	76.7	20.3	45	111
Verbal Fluency	35	12.3	11	60
Semantic Fluency	26.5	8.6	8	45
Phonemic Fluency	8.5	5.8	0	21
<i>Child-internal predictor</i>				
Age	68	5.5	54	77
Age of starting preschooling	22.2	7.6	8	36
Intelligence	17.6	5.8	7	30
Memory	33.0	17.5	9	88
<i>Child-external predictor</i>				
Sibling number	0.9	0.5	0	2
Older-sibling number	0.4	0.5	0	2
Younger-sibling number	0.6	0.6	0	2
Household size	4.7	1.2	3	8
Past household size	4.1	1.2	3	8
Father's education years	15.4	2.4	9	22
Mother's education years	16.3	1.7	11	18
Father's occupation	6.5	2.0	3	9
Mother's occupation	7.1	1.6	4	9
Household income	3.6	1.1	2	6
Past household income	2.9	0.8	1	5
Household wealth	362128205.1	447916702.8	76200000	2154200000
Schooling experience	45.9	9.5	27	64

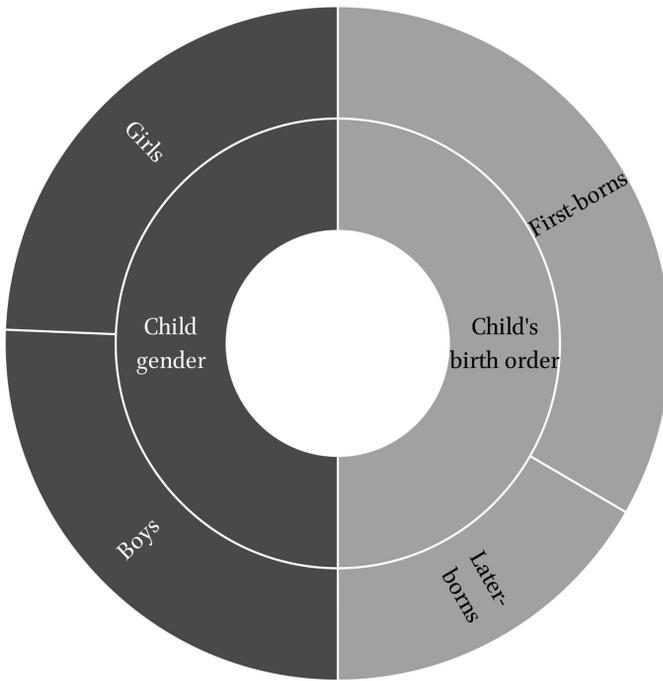


Figure 2 Values in percentage of variables of child's age and birth order. The proportion of girls and boys was nearly equal in this sample. The number of first-born children was larger than that of later-born children. This difference indicated that most of city-centre children were the first-born child of the mother.

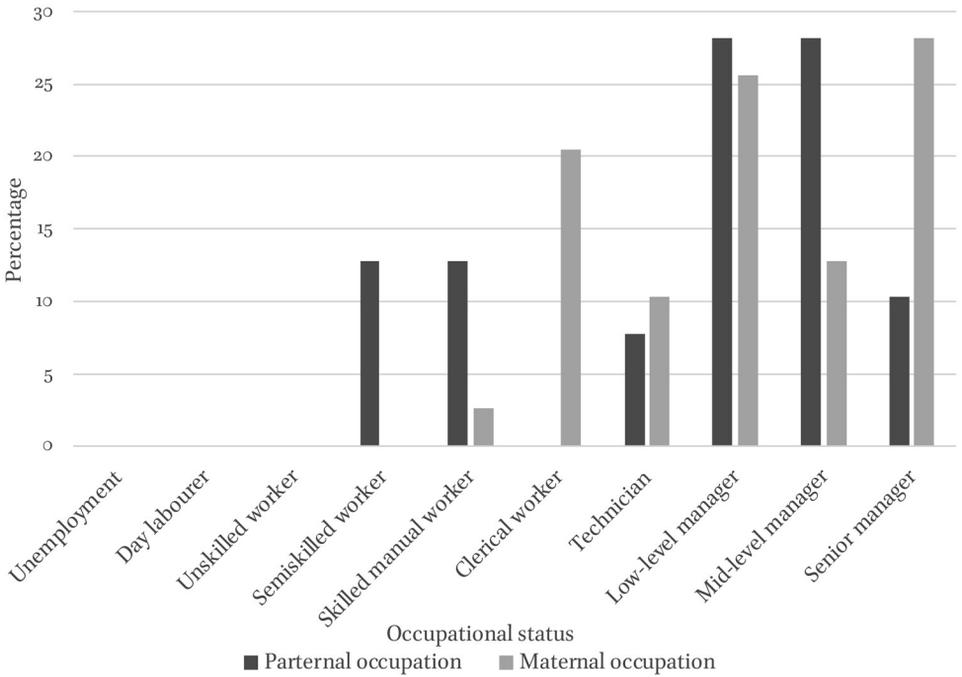


Figure 3 Values in percentage of variables of paternal and maternal occupation. Both indicators of parental occupation showed a skewness towards high occupational status. The majority of parents in this sample had high-rank and high-paid occupations including technician, low-level to senior manager.

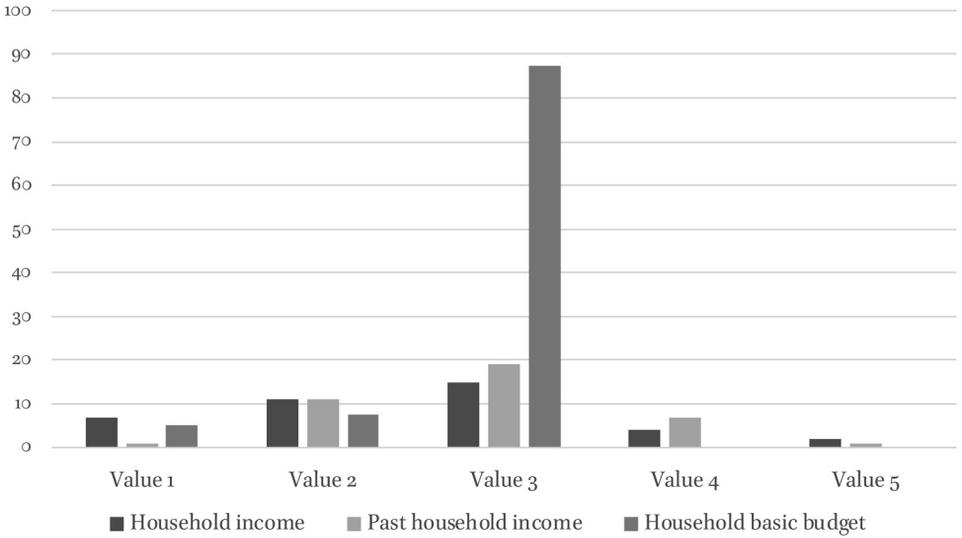


Figure 4 Values in percentage of variables of households' current income, past income and basic budget. Two income variables followed the following value scale in Vietnamese dollars: 1 = 1–4,999,999; 2 = 5,000,000–9,999,999; 3 = 10,000,000–14,999,999; 4 = 15,000,000–19,999,999; 5 = 20,000,000–24,999,999. The income variables showed that a large number of households in this sample were middle-class. The measure of household basic budget had the following values: Households without a basic budget (1), with a small basic budget (2) or a big basic budget (3). This variable showed a skewness towards households with a big basic budget for an emergency.

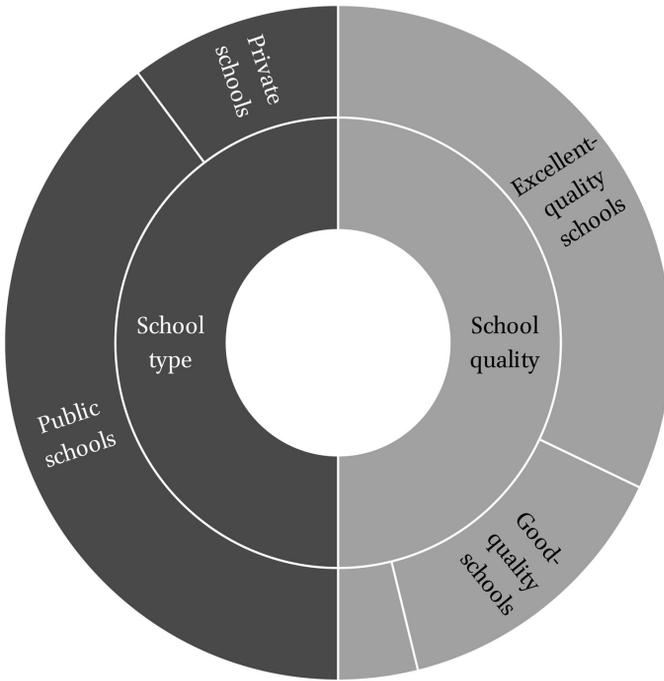


Figure 5 Values in percentage of variables of school's type and quality. The majority of children in this sample attended state-run schools. A large number of children went to schools with excellent quality that assessed by the government; and a lesser number attended preschools with good quality.

3.2 Bivariate analyses

In order to examine the effects of independent variables on four vocabulary scores, multiple bivariate analyses of variance were conducted. The *t*-tests showed that four vocabulary scores did not significantly differ as a function of child gender, birth order to the mother, and school type. Kruskal-Wallis tests indicated that there was no significant difference between the three groups for households' basic budget and schools' quality, and between multiple groups for paternal and maternal occupational status, in all vocabulary scores at the .050 level.

Non-parametric Spearman's correlations were conducted to document significant associations between other independent variables and four vocabulary scores at the .050 level. The correlations among measures are reported in Table 2. The Verbal Fluency and Phonemic Fluency scores were both positively correlated with children's age and pre-schooling experience. Although the age range of the children in this study was restricted, simple regression analysis indicated that age significantly accounted for 19.5% and 23.6% of the variance in these two vocabulary scores ($F(1, 37) = 8.99, p = .005$;

Table 2 Non-parametric correlations for vocabulary variables

Variable	PPVT	Verbal Fluency	Semantic Fluency	Phonemic Fluency
1. PPVT				
2. Verbal Fluency	.54***			
3. Semantic Fluency	.54***	.91***		
4. Phonemic Fluency	.37*	.77***	.44**	
5. Age	.19	.42**	.23	.52**
6. Age of starting pre-schooling	-.11	-.22	-.14	-.27
7. Intelligence	.44*	.39*	.28	.42**
8. Memory	.32*	.29	.24	.30
9. Sibling number	.24	.15	.09	.21
10. Older-sibling number	.04	-.20	-.18	-.10
11. Younger-sibling number	.14	.33*	.27	.27
12. Household size	.23	.19	.20	.12
13. Past household size	-.10	-.00	-.06	.10
14. Father's education years	.05	.00	.07	-.09
15. Mother's education years	.09	.01	.18	-.20
16. Father's occupation	.14	-.09	.01	-.17
17. Mother's occupation	.07	-.00	.08	-.06
18. Household income	.36*	.36*	.33*	.28
19. Past household income	.19	.12	.12	.15
20. Household wealth	.38*	.20	.15	.23
21. Schooling experience	.28	.46**	.29	.52**

Note. * $p < .050$; ** $p < .010$; *** $p < .001$

$F(1, 37) = 11.43, p = .002$; respectively). The PPVT, Verbal Fluency and Phonemic Fluency were all positively correlated with the nonverbal intelligence scores. Only PPVT scores were positively correlated with the nonverbal memory scores and household wealth. Only Verbal Fluency scores were positively correlated with the number of younger siblings. Lastly, the PPVT, Verbal Fluency and Semantic Fluency were all positively correlated with households' current average income. Overall, the predictors that were significantly correlated with at least one of four vocabulary variables are child age, child intelligence, child memory, younger sibling number, household income, household wealth, and child pre-schooling experience.

The correlations between predictor variables were checked in order to avoid multicollinearity problems. A high correlation was found between child age and pre-schooling length ($r(39) = .60$). However, these variables measured two different concepts, specif-

ically, time-related factor (Sun et al., 2018) or cognitive maturity (Paradis, 2011), and quantity or length of education in childhood (Ebert et al., 2013; Sun et al., 2018), respectively. Therefore, they were both selected for the final multivariate regression.

3.3 Regression analyses

Given our small sample size (39 participants), it was not recommended to include all seven factors that were statistically significantly correlated with one or more measures of vocabulary knowledge. With this sample size, four factors would be included into the main regression model. Two initial multivariate regressions were applied for four vocabulary scores to find out four candidate predictors for the final multivariate regression. A first backward regression with only child-external factors (i.e. child age, standardised residuals of intelligence and memory scores as independent variables) was conducted. For PPVT scores, the resulting model retained nonverbal intelligence as the internal predictor accounting most of the total variance in vocabulary scores ($R^2 = .18$, $F(1, 37) = 8.32$, $p = .007$). For Verbal Fluency scores, age and nonverbal intelligence were retained in the final model ($R^2 = .26$, $F(2, 36) = 6.44$, $p = .004$). For Semantic Fluency and Phonemic Fluency scores, the resulting model retained age as the strongest internal predictor ($R^2 = .09$, $F(1, 37) = 3.80$, $p = .059$; $R^2 = .24$, $F(1, 37) = 11.43$, $p = .002$; respectively). According to these results, internal predictors that were selected for the final regression were child age and nonverbal intelligence.

A second backward regression was performed with only child-external factors (i.e. the number of younger siblings, household income, household wealth, and child pre-schooling length) as independent variables. The resulting model retained household income as the external predictor accounting most of the total variance in PPVT and Semantic Fluency scores ($R^2 = .10$, $F(1, 37) = 4.02$, $p = .052$; $R^2 = .12$, $F(1, 37) = 4.96$, $p = .032$; respectively). For Verbal Fluency scores, household income and child pre-schooling experience were retained in the final model ($R^2 = .27$, $F(2, 36) = 6.64$, $p = .004$). For Phonemic Fluency scores, the final model retained children's pre-schooling length as the strongest external predictor ($R^2 = .23$, $F(1, 37) = 10.72$, $p = .002$). Consequently, external predictors that were selected for the final regression were household income and child pre-schooling experience.

A final regression entered child age, child nonverbal intelligence, household income and child pre-schooling experience for every vocabulary variable, using the backward method. The full model significantly accounted for 24.6%, 32.6%, and 32.7% of the variance in PPVT, Verbal Fluency, and Phonemic Fluency scores ($F(4, 34) = 2.77$, $p = .043$; $F(4, 34) = 4.12$, $p = .008$; $F(4, 34) = 4.14$, $p = .008$) respectively, at the .05 level. The full model significantly accounted for 20.3% of the variance in Semantic Fluency scores at the .10 level ($F(4, 34) = 2.17$, $p = .094$). The final model explained 18.4%, 26.9%, 11.8%, and 23.6% of the variance in PPVT, Verbal Fluency, Semantic Fluency, and Phonemic Fluency scores ($F(1, 37) = 8.32$, $p = .007$; $F(2, 36) = 6.64$, $p = .004$; $F(1, 37) = 4.96$, $p = .032$; $F(1, 37)$

Table 3 Backward regression results for vocabulary measures

Vocabulary skill	Model		B	SE	Beta	t	Sig.	95%	Cls	Part
PPVT	Full model	(Constant)	50.00	39.48		1.27	.214	-30.23	130.24	
		Age	-0.11	0.72	-0.03	-0.15	.883	-1.58	1.36	.02
		Intelligence	8.80	3.89	0.36	2.26	.030	0.90	16.71	.34
		Income	3.74	3.05	0.20	1.23	.229	-2.46	9.94	.18
		Pre-schooling	0.33	0.41	0.16	0.82	.419	-0.49	1.16	.12
	Final model	(Constant)	70.16	3.75		18.71	.000	62.56	77.76	
		Intelligence	10.61	3.68	0.43	2.88	.007	3.15	18.06	.43
Verbal Fluency	Full model	(Constant)	-27.06	22.69		-1.19	.241	-73.18	19.06	
		Age	0.58	0.42	0.26	1.39	.174	-0.27	1.42	.20
		Intelligence	2.67	2.24	0.18	1.20	.240	-1.87	7.22	.17
		Income	2.33	1.75	0.20	1.33	.193	-1.24	5.89	.19
		Pre-schooling	0.28	0.23	0.22	1.20	.237	-0.19	0.76	.17
	Final model	(Constant)	0.72	9.63		0.07	.941	-18.81	20.24	
		Income	3.30	1.68	0.29	1.97	.056	-0.10	6.70	.28
		Pre-schooling	0.49	0.19	0.38	2.62	.013	0.11	0.87	.37
Semantic Fluency	Full model	(Constant)	-3.46	17.19		-0.20	.842	-38.41	31.48	
		Age	0.24	0.32	0.15	0.76	.456	-0.40	0.88	.12
		Intelligence	1.45	1.69	0.14	0.86	.398	-1.99	4.89	.13
		Income	1.90	1.33	0.24	1.43	.161	-0.80	4.60	.22
		Pre-schooling	0.13	0.18	0.15	0.75	.456	-0.23	0.49	.12
	Final model	(Constant)	16.65	4.61		3.61	.001	7.32	25.99	
		Income	2.76	1.24	0.34	2.23	.032	0.25	5.27	.34
Phonemic Fluency	Full model	(Constant)	-23.60	10.71		-2.20	.034	-45.36	-1.83	
		Age	0.34	0.20	0.32	1.73	.092	-0.06	0.74	.24
		Intelligence	1.22	1.06	0.17	1.16	.255	-0.92	3.37	.16
		Income	0.43	0.83	0.08	0.51	.611	-1.26	2.11	.07
		Pre-schooling	0.15	0.11	0.24	1.34	.190	-0.08	0.37	.19
	Final model	(Constant)	-26.72	10.46		-2.55	.015	-47.92	-5.53	
		Age	0.52	0.15	0.49	3.38	.002	0.21	0.83	.49

= 11.43, $p = .002$) respectively, significantly at the .05 level. The resulting model retained child nonverbal intelligence, household income and child age as the strongest predictor of PPVT, Semantic Fluency and Phonemic Fluency scores, respectively. For Verbal Fluency scores, household income and child pre-schooling experience were retained in the final model; and child pre-schooling length had the larger standardised beta coefficient and semi-partial correlation ($\beta = .38$, *semi-partial* $r = .37$). The results are presented in Table 3.

4 Discussion

With the purpose of examining the multifactorial model of vocabulary knowledge in monolingual preschool-age children from a multidimensional approach to language development in a Vietnamese urban context, this study has found interesting results. The best fitting models of the four Vietnamese vocabulary skills contain different significant predictors. The child's nonverbal intelligence and pre-schooling experience were the strongest predictor of receptive and productive modalities of vocabulary knowledge, respectively. The household's monthly average income at present (the testing time) and the child's chronological age were the strongest predictor of semantic and phonological domains of vocabulary knowledge, respectively. These models accounted for 18.4%, 11.8%, and 23.6% of total variance in receptive modality, semantic domain and phonological domain of vocabulary size, respectively. Together with household income, child exposure to pre-schooling accounted for 26.9% of total variance in productive modality of vocabulary size.

The findings of the present study contribute to existing discussion on children's language development, which has been dominated by the body of research on Western contexts, with empirical evidence for a different language and culture. First, substantial variability in Vietnamese vocabulary modalities and domains in urban monolingual kindergarteners supports previous reports of variability in early language development (see Hoff, 2013, pp. 148–153). Also, our results supports early findings that “comprehension precedes production and comprehension vocabularies are larger than productive vocabularies” (see Hoff, 2013, p. 147). Furthermore, our findings seem to support outcomes that semantic knowledge is larger than phonological knowledge in early language development (Anthony et al., 2014).

Regarding *external factors*, the child's birth order to the mother, older siblings (Hoff-Ginsberg, 1998; Hoff, 2006), and parents' education levels as SES indicators (Hoff, 2006, 2013; Tardif et al., 2009; Zhang et al., 2008), which have been identified as good predictors previously, were not significant in our study. A possible explanation for this might be related to demographic characteristics of the current sample of children in this study. Their parents' education level and occupational status were skewed towards higher achievement. Confirming previous findings in Stokes and Klee (2009), our dataset may suggest that individual differences in vocabulary knowledge as a function of several familial and parental characteristics (e.g., birth order, siblings, parents' educational level and occupational status) are likely to decline until insignificance when the parents achieve generally higher education and occupation levels (e.g., higher than high school and skilled workers, respectively). However, few previous studies found that parents' educational level and occupational status as middle or upper-middle SES indicators were significantly predictive of pre-schoolers' vocabulary knowledge (e.g., Bornstein et al., 1998). This inconsistency may be due to methods of data collection across studies (Stokes & Klee, 2009). Bornstein and colleagues (1998) collected child spontaneous speech to

measure vocabulary knowledge; meanwhile, we, Stokes and Klee (2009) use vocabulary tests and checklists, respectively. These inconsistent findings further may suggest that the predictive role of parents' education and occupation levels in middle or upper-middle SES samples may be determined by study settings. Specifically, their impact may not be found in instructional settings; whereas it is possibly documented in naturalistic settings.

Household income as dollar-based measure of SES (Hoff, 2006, 2013; Lohndorf et al., 2017) was found to be a significant predictor of Vietnamese productive vocabulary and to be the strongest predictor of semantic domain of Vietnamese vocabularies in this dataset. Vietnamese preschool-age children from higher-income families showed more advantages in productive vocabulary skill, especially semantic knowledge, than peers from lower-income families. Our findings may propose that dollar-based measures of SES such as household income or wealth may predict variability in productive vocabulary skills better than parental measures of SES (e.g. parental education and occupation) in middle or upper-middle SES samples, especially with instructional settings.

Contrary to other studies (Ebert et al., 2013; Hoff, 2006; Lohndorf et al., 2017; Marjanovič-Umek, Peklaj et al., 2008; Marjanovič-Umek, Socan et al., 2008) that reported the non-predictive role of pre-schooling characteristics in vocabulary development, we found the child's pre-schooling experience to be the strongest predictor of Vietnamese productive vocabulary in urban kindergarteners. This study supports findings reported in earlier work that "attending a preschool has a positive effect on children's vocabulary" (Van Druten-Frietman et al., 2015, p. 98). This inconsistency in findings may suggest that unlike many Western contexts, early education in the Vietnamese context provides cognitive-language stimulation (see Boyd & Dang, 2017; Hien, 2018) to the development of child language production.

Concerning *internal factors*, our finding supports findings of previous studies, which reported the significantly predictive role of child age in early vocabulary development (Teepe et al., 2017; Van Druten-Frietman et al., 2015), especially productive vocabulary skill even in a narrow age range (Stokes & Klee, 2009; Tardif et al., 2009; Umek et al., 2017; Zhang et al., 2008). Our findings show that child age was the strongest predictor of phonological knowledge of Vietnamese productive vocabulary in urban pre-schoolers. This finding may confirm the role of child age in early vocabulary development but its effects on modalities or domains of vocabulary knowledge seem to be a culture-related difference.

In contrast to earlier findings, however, no evidence of the predictive role of child gender (Hoff, 2013; Stokes & Klee, 2009; Zhang et al., 2008) and working memory (Ebert et al., 2013; Gathercole et al., 1992; Hoff, 2013; Stokes et al., 2017; Teepe et al., 2017) in early vocabulary development across modalities and domains was detected in this exploratory study. Regarding the gender effect, our dataset supports findings that the impact of child gender is small and often undetectable in studies with small samples (Hoff, 2013, p. 153). We further propose that the sex difference in early vocabulary development may be dependent of cultural discrepancy (see Ebert et al., 2013; Hoff, 2006; Teepe et al., 2017).

Concerning the neglectable effect of memory in Vietnamese pre-schoolers' vocabulary skills, we advance two explanations. First, we may support findings (Archibald & Gathercole, 2006a, 2006b) that the visuospatial memory ability insignificantly correlates with vocabulary skills in preschool years when the age effect is partialled out from cognitive measures. Second, we seem to fill in gaps in previous research (Ebert et al., 2013; Stokes et al., 2017; Stokes & Klee, 2009) that the memory impact on early vocabulary development may become neglectable when working memory and general intelligence are examined simultaneously.

Moreover, we found the child's general intelligence to be the strongest predictor of Vietnamese pre-schoolers' receptive vocabulary skill. The finding supports the significant role of general intelligence in pre-schoolers' language development (Bornstein et al., 2016; Marjanovič-Umek, Peklaj et al., 2008; Pan et al., 2016), specifically receptive vocabulary (Gathercole et al., 1992; Niklas & Schneider, 2015). We suggest that general intelligence is not only important to the diagnosis of language skills of typically developing children and children with intellectual disabilities or specific language impairment (Hoff, 2008, 2013; Pan et al., 2016) but also essential to the enhancement of receptive vocabulary skill in early childhood.

Respecting the dimensionality of language development, our findings support the multidimensional views of language development (Fenson et al., 1994; Karmiloff-Smith, 1998; Lonigan & Milburn, 2017), extending specifically to the lexical-semantic system in early childhood. In contrast to earlier proposal by which language competence is unidimensional at younger grades (Tomblin & Zhang, 2006), we found evidence for the existence of dimensionality of vocabulary development across modalities and domains in the examination of multifactorial effects on early vocabulary development. The findings suggest that the significance and magnitude of effects of external and internal factors on early vocabulary development may be a function of the dimensionality of this language subsystem. Also, they are seemingly dependent of cultural differences.

This study has several limitations. First, conclusions about causality could not be generated given the cross-sectional design. Second, some hypotheses on the significant role of factors (e.g. child gender, parental education) could not be tested given the small sample. Consequently, the effects of some factors, which are shown small in previous research, were not found in this exploratory study. Follow-up research should recruit a large sample of Vietnamese children to test the existing hypotheses. Also, future research could adopt a longitudinal design to explore developmental trajectories over time. Finally, measures of verbal cognitive ability (e.g. phonological working memory; Ebert et al., 2013; Stokes et al., 2017), other child characteristics (e.g. social functioning; Teepe et al., 2017) and school-related characteristics (Ebert et al., 2013) should also be taken into consideration. These supplementary records would enhance our knowledge of the bioecological models (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006; Vélez-Agosto et al., 2017) of early language development across cultures.

In conclusion, the effects of internal and external factors on Vietnamese pre-schoolers' vocabulary knowledge are modality-and-domain-sensitive and relatively context-or-culture-specific. It is suggested that multidimensional models of child vocabulary development are crucial to profound understanding of individual differences in early vocabulary competence, especially in children from Asian contexts or developing countries. This profound knowledge, in turn, enables better prediction of language stimulation, differences and difficulties that children are likely to experience. The knowledge, then, contributes to children's later catch-up.

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