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Category-Generation Performance in Mandarin-English Bilingual Children

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Category-Generation Performance in Mandarin-English Bilingual Children

by

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Dedication

This thesis is dedicated to my fellow classmates and the faculty in the Communication Sciences and Disorders graduate program at University of Texas in Austin. I would also like to dedicate this thesis to my family. Thank you for all the supports and encouragement the last two years!

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I would like to thank all individuals who participated in this project and helped the data collection, including all graduate students and undergraduate students who spent their time testing participants and data entry and coding. I would like to express my gratitude to Li Sheng for her consistent support and guidance to deepen my overall understanding of bilingualism and academic writing. I would also like to thank Elizabeth Peña to review my thesis and provide valuable comments. Finally, I express my gratitude to my family and my friends who supported me throughout this process.

Abstract

Category-Generation Performance in Mandarin-English Bilingual Children

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Research has shown that children categorize words in terms of taxonomic and slot-filler strategies. Monolingual children were thought to shift from a slot-filler to taxonomic strategy between the age of five and eight. The aim of this study is to analyze the way Mandarin-English bilingual children organize their lexical-semantic system through the use of a category-generation task that investigate taxonomic and slot-filler organizational strategies in each language. There were 53 Mandarin-English bilingual participants (between 4 and 7 years of age) included in this study. Participants were asked to name as many items as they could think of in slot-filler and taxonomic conditions in English and Mandarin. The results indicate greater performance in English than Mandarin in children who were five years or older. Four-year-old bilingual children produced comparable number of items in both slot-fill and taxonomic condition, but the five-, six-, and seven-year-old bilingual children showed greater performance in the taxonomic condition. Children performed better for the animal than the clothes category, and better for the clothes than the food category. These findings, while largely consistent with

existing literature, suggest that the slot-filler to taxonomic shift may take place at an earlier age compared to monolingual children.

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INTRODUCTION

According to McCardle & Leung (2006), there are increasing numbers of bilingual students in U.S. schools, leading to a need for enhanced understanding of bilingual language development for both educators and special education personnel who work with culturally and linguistically diverse populations. According to 2010 American Community Survey data, 44% of the population in California indicated that they spoke a language other than English at home. The number was also high for states such as New Mexico (37%), Texas (35%), New York, and New Jersey (30%). One aspect of language that is particularly important for academic success is vocabulary. In order to meet the demands of the academic classroom, children need to possess deep understanding of word meanings and sophisticated networks of semantic knowledge, which enable them to generate specific word definitions, use words in appropriate and diverse contexts, and continue to expand their lexicon (Sheng, Bedore, Peña, & Fiestas, 2013). Bilingual children are faced with a more challenging task because they are learning two sets of vocabulary items and the semantic network characteristics of two language systems. Existing research on bilingual vocabulary development has largely focused on vocabulary breadth (e.g., Patterson, 1998; Pearson, 1998; Pearson, Fernández, & Oller, 1993; Sheng, Lu, & Kan, 2011) and lexical processing (e.g. Kohnert, Bates, & Hernández, 1999; Kohnert, 2002) and only a handful of studies have examined vocabulary depth and qualitative changes in bilingual children's semantic organization (Pena, Bedore, & Zlatic-Giunta, 2002; Sheng, McGregor, & Marian 2006).

This study aims to further our understanding of the development of the semantic organization principles of the lexicon of young Mandarin-English bilingual children. Specifically, we used the category generation task as developed by Nelson and Nelson

(1990) and administered it in both languages of the Mandarin-English bilingual children. As such, we were able to compare the performance between our cohort of bilingual children and the monolingual (Nelson & Nelson, 1990) and bilingual children (Pena et al., 2002) included in previous studies. These comparisons will allow us to reveal patterns of semantic development that are universal across different language groups as well as unique patterns that may be attributed to bilingual experience or exposure to particular languages.

The following sections begin with a review of semantic category development in monolingual populations. This review is followed by a description of semantic category development in bilingual populations and a review of recent studies on vocabulary growth in Mandarin-English bilingual children.

SEMANTIC CATEGORY DEVELOPMENT IN MONOLINGUAL CHILDREN

Rosch, Mervis, Gray, Johnson, and Boyes-Braem (1976) claimed that noun categories are based on three levels including: basic, subordinate, and superordinate. Young children first learn basic level vocabulary (e.g. car, dog), and then subordinate (e.g. taxi, collie) and superordinate words (e.g. vehicle, animal) at older ages. Superordinate categories are considered to be different from basic-level categories in terms of the number and type of their common attributes (Rosch, 1975). For instances, the category furniture is considered to be harder for children to learn than the category chair, because certain common attributes of chair can be used for the establishment of the concept, such as perceptual characteristics like the shape of chair. By contrast, items that belong to the furniture category do not necessarily share the same shape.

A great deal of research suggests that children retrieve categorical items and organize perceptual characteristics in terms of their world experiences. Among different

kinds of strategies, the slot-filler category is defined as grouping words based on experience and specific functions (Peña et al., 2002). Slot-fillers, also termed event schemas or scripts, were believed to be organized according to a common function bound by a particular event (Nelson & Nelson, 1990). For example, children would consider pancake, waffles, and cereal as items that belong to the slot-filler category of foods that I eat for breakfast. According to Cree and McRae (2003), slot-fillers might also play an important role in the construction of both non-living and living concepts. On the other hand, taxonomic organization refers to the grouping of objects in terms of similar functions that cut across various events or scripts (Peña et al., 2002). For example, once children have learned several slot fillers for related to the theme of eating (e.g., breakfast, lunch, snack time), they may formulate a broader taxonomic category of food. Taxonomic categories are thought to be related to a hierarchical system of categories in terms of inclusion relations (Berger & Aguerra, 2010).

In order to understand the process of language learning, Nelson and Nelson (1990) proposed a category-generation task for the evaluation of monolingual children's semantic organization. All participants included in this study were from a lower to lower-middle-class urban school. The participants were divided into three groups by ages and school experience. One group of kindergarten children (Mean age = 5;4) did not have prior preschool experience, while the other group of kindergarten children was (Mean age = 5;6) reported to have previously attended day-care centers, nursery school, or Head Start programs. The third group were second graders (Mean age=8;1). The participants were tested to evaluate the effects of different task conditions, age levels, and prior preschool experience on category generation performance.

In the slot-filler task condition, the children were asked to name as many items in a narrow event-based category (e.g., foods they eat for breakfast) as they could think of.

In the taxonomic task condition, they were asked to name as many items in a broad superordinate category (e.g., all the foods) as they could think of. The results revealed that kindergarteners produced more items in the slot-filler than the taxonomic condition, whereas second graders produced more items in the taxonomic condition than in the slot-filler condition. Second graders and kindergarteners with preschool experience generated more items overall than the kindergarteners who had not attended school. Children generated more items in foods category compared to the animal and clothing categories. The authors argued that there was a shift from slot-filler organization to taxonomic organization in vocabulary grouping between the ages of five and eight. Nelson and Nelson (1990) claimed that children started to use taxonomic categorization skills as they gained experience from diverse circumstances as they grow older. Although the study revealed a shift from slot-filler to taxonomic organization within the window of five to eight years age range, it is unclear whether or not there is a more specific age at which most children will show this developmental shift. It is also unclear how universal this shift is across different language and cultural groups.

Yu and Nelson (1993) conducted a study to evaluate the generalizability of the slot-filler to taxonomic shift phenomenon with monolingual native Korean-speaking children. Using the category generation task by Nelson and Nelson (1990), the authors recruited five-and eight-year-old Korean-speaking children from a preschool and a public school. The children were asked to produce category items under either slot-filler or taxonomic instructions. Replicating Nelson and Nelson (1990), the result showed that five-year-old monolingual Korean children produced more items in the slot-filler condition than the taxonomic condition, while eight-year-old children generated more items in the taxonomic compared to slot-filler condition. Again this result was consistent with the view of a developmental shift from slot-filler to taxonomic organization of

children's semantic knowledge. However, this study showed that Korean-speaking children generated fewer clothing items compared to the English-speaking children in Nelson and Nelson (1990). According to the authors, this was possibly due to restrictive clothing variances in Korea than in the U.S. For example, "nightclothes" is the only word used in Korean representing many US English words such as "pajamas", "nightgown", and "bathrobe." Furthermore, the clothing category in Korea also does not include shoes, sneakers, or boots. This finding shows a difference in how categories are constructed across cultures. In other words, the boundary line of categories might be drawn differently (Choi & Bowerman, 1991).

In terms of the age of onset of slot-filler category organization, typically developing children are thought to possess the ability to create conceptual representational systems based on different scripts or events by the age of two (Hudson & Nelson, 1983). According to Berger & Aguerra (2010), typically developing children tended to use strategic processes at the age of six. At age six, slot-filler is considered a primary strategy for contextual/contiguity structure and equivalence relations such as specific event or script. On the other hand, according to Berger & Aguerra (2010), children learned how to use taxonomic organization at the ages of three to four. Children at the age of six produced more taxonomic responses compared to children at age four (Berger & Aguerra, 2010). By the age of seven or eight years, children began to use taxonomic categories to organize their vocabularies (Nelson & Nelson, 1990). In other words, younger monolingual children before the age of six tended to understand more event-based structure and slot-filler categories than wider superordinate categories such as taxonomic categories (Berger & Aguerra,2010); while older monolingual children started to incorporate taxonomic category skills after the age around seven.

SEMANTIC CATEGORY DEVELOPMENT IN BILINGUAL CHILDREN

Peña et al. (2002) conducted a study to evaluate English-Spanish bilingual children's uses of taxonomic versus slot-filler strategies in a category generation task. This study included forty-four bilingual speakers aged four to seven. Children were divided into two age groups: younger (Mean age = 5;1) and older (Mean age =6;5). The authors used Nelson and Nelson's category generation task (1990) to evaluate bilingual children's semantic categorization. For example, trained bilingual graduate students asked the children "Tell me all the foods you know", which was considered an English taxonomic category, and "Tell me all the foods you can eat for lunch", which was referred to as an English slot-filler category.

The findings of this study indicated that the younger Spanish-English bilingual children generated approximately equal number of items in the slot-filler and taxonomic conditions, but the older bilingual children tended to produce more items in the taxonomic than slot-filler condition. When viewed together with Nelson and Nelson (1990)’s results, these two previous studies indicated that the monolingual five-year-olds (Mean age =5;5) showed a clear slot-filler advantage over taxonomic organization, the bilingual five-year-olds (Mean age = 5;1) showed equal performance in slot-filler and taxonomic conditions, the bilingual six-year-olds (Mean age = 6;5) were beginning to show a taxonomic advantage, whereas the monolingual eight-year-olds (Mean age = 8;2) were demonstrating a clear taxonomic advantage. These patterns suggest that bilingual children may have shifted from slot-filler to taxonomic organization at an earlier age. Peña et al. (2002) suggested two potential reasons why bilingual children might have shown an early shift from slot-filler to taxonomic organization. First, bilingual children may have to learn a larger set of words because they need to acquire words in two different languages. This could have put more pressure on the system to better organize

vocabulary items, therefore leading to more mature semantic organization. Second, through immersing in two cultures, bilingual children may have been exposed to a larger number of events and scripts that could facilitate generation of more items in the taxonomic condition. Similarly, Gonzalez (1994) and Vermeer (2001) have both argued that semantic representations in bilingual children were affected by the individuals' unique culture background and language usage patterns.

In Nelson's previous studies, the monolingual children demonstrated a taxonomic bias at eight years of age. However, Nelson's studies did not include any six and seven-year-olds. Had they included younger monolinguals, they might have found a taxonomic bias at those younger ages. Peña et al. (2002) included four- to seven-year-old Spanish-English bilingual children but the children were divided into two age levels instead of a more finer-grained year-by-year division. In the current study, we also included bilingual children between four and seven years of age, but we divided the children into four different age bands. This would allow us to provide a more complete picture of the development shift from slot-filler to taxonomic organization during the preschool to early elementary age period. In addition we sampled a different bilingual group, namely, children who speak Mandarin and English. This will allow us to see if the bilingual advantage as suggested by Peña et al. (2002) can be generalized to bilingual children who speak a first language other than Spanish.

VOCABULARY GROWTH PATTERNS IN MANDARIN-ENGLISH BILINGUAL CHILDREN IN THE U.S.

To date, only a handful of studies have been conducted on lexical-semantic development of Mandarin-English bilingual children in the United States. Sheng, Lu, and Kan (2011) conducted a cross-sectional study to evaluate Mandarin-English bilingual children's lexical performance in a picture identification task and a picture naming task.

There were thirty-five participants between ages three and eight years who resided in Austin, Texas. Mandarin was considered as a minority language that was used mostly at home and received little support outside of home setting. Almost all the participants' parents reported speaking only Mandarin or using a mixture of both Mandarin and English to their children. Despite considerable exposure to Mandarin, the children showed significant differences in English lexical comprehension and production between the younger (three- to five-year old) and older (six- to eight-year-old) age groups but small growth or even stagnation in Mandarin vocabulary task performance. It is possible that the Mandarin-English speaking children ceased to expand new Mandarin vocabulary during preschool years, which was different from the results from Spanish-English and Welsh-English bilingual children (e.g., Cobo-Lewis, Pearson, Eilers, & Umbel, 2002; Gathercole & Thomas, 2009).

Another study done by Sheng (2013) also revealed the early stagnation of Mandarin vocabulary in Mandarin-English bilingual children. The longitudinal study included twenty-seven participants to evaluate the results of picture identification and picture naming tasks. The interval between two the time points was 15.7 months. The results revealed greater gains in younger children (Mean age = 4;0) than in older children (Mean age = 6;10) in English lexical semantic skills, but no significant gains in Mandarin in both groups of children. Together, these two studies with Mandarin-English bilingual children (Sheng et al., 2011; Sheng, 2013) indicated that children who grew up in an English-dominant environment with minimal support for their first language outside of the home settings demonstrated fast and continuous growth in English vocabulary but little changes in Mandarin vocabulary as early as the preschool years.

Besides the amount of vocabulary in the bilingual children's two languages, semantic organization and categorization skills are also a significant part of children's

language development. Further evaluations of category structures in Mandarin-English bilingual children would potentially help us understand language and vocabulary development in children immersed in different languages and cultures.

THE CURRENT STUDY

The aim of this study is to analyze the way Mandarin-English bilingual children organize their lexical-semantic system through the use of a category-generation task that investigate taxonomic and slot-filler organizational strategies in each language. There are three main questions that are explored in this study. First, we focus on between-language differences in the taxonomic condition of the category generation task to examine growth in children's L1 and L2 across different ages. Second, the differences between English taxonomic and English slot-filler category generations are analyzed in an attempt to pinpoint the age at which the slot-filler to taxonomic shift takes place in the current sample of bilingual children. Finally, children's knowledge for the English taxonomic categories of animals, clothes, and foods are evaluated to investigate potential developmental differences across several categories that are familiar to young children.

With respect to between-language differences in children's L1 and L2, in light of previous studies on Mandarin-English bilingual children's lexical development (Sheng et al., 2011; Sheng, 2013), we predict that bilingual children would show stronger performance in English than in Mandarin and this pattern will be particularly true for children who have begun systematic exposure to English. Regarding differences between English taxonomic and slot filler conditions, given that Peña et al. (2002) found equivalent performance between slot-filler and taxonomic conditions in the five-year-old and a clear taxonomic preference in the six-year-old Spanish-English bilinguals, it is predicted that the current sample of Mandarin-English bilingual children would show a

similar timeline for the slot-filler to taxonomic shift. Regarding comparison of categories, Nelson and Nelson (1990) found stronger performance for the food category than the animal and clothing categories in English monolinguals, but Peña et al. (2002) found stronger performance for the animal category than the food and clothing categories in both languages of the Spanish-English bilinguals. Therefore we expect to see differences across various categories, however, it is unclear which category, between food and animal, would be the most advanced in development.

METHODOLOGY

PARTICIPANTS

Fifty-five children (26 females) participated in this study (mean age=6.07, SD=10.7), including two children with specific language disorders (SLI) and fifty-three typically developing children. The participants' ages ranged from 4 years and 2 months to 7 years and 7 months. The two children with SLI were excluded from the study because the focus of the study is on typical lexical development. All participants were Mandarin-English bilingual speakers living in Austin, Texas who were immersed in a bilingual environment. They were recruited by referrals from other research studies conducted by Language Learning and Bilingualism Laboratory at the Department of Communication Sciences and Disorders at the University of Texas at Austin. Informed consent and parent questionnaire were acquired from each participant's parent. The questionnaires included a survey regarding children's language proficiency in the domains of vocabulary, grammar, sentence length, production, and listening comprehension using a five point scale (0= low proficiency, 5= high proficiency). Ratings of proficiency in English as well as Mandarin were obtained. Children's hourly language usage on a typical weekday and a typical weekend were used to evaluate the exposure to each language in terms of speaking and listening frequency.

Maternal education was obtained by self-report. The mean length of maternal education was 19.21years (ranging from 15 to 25 years). Table 1 shows the summary of participant information. As seen in Table 1, the children were grouped into four age bands, with more children falling into the five- and six-year-old age bands than the four- and seven-year-old age bands.

Group	Numbers	Mean age (month)	Gender	Maternal education	Englsih use	English rating	Mandarin rating
4 years old	7	54.89	4F; 3M	18.1 (2.9)	0.5 (0.2)	3.8 (0.6)	4.0 (0.7)
5 years old	16	66.00	10F; 6M	19.8 (3.1)	0.6 (0.2)	3.9 (0.7)	4.0 (0.5)
6 years old	22	78.18	9F; 13M	19.5 (2.6)	0.7 (0.1)	4.5 (0.4)	4.0 (0.5)
7 years old	8	87.63	3F; 5M	17.4 (2.6)	0.6 (0.1)	4.5 (0.4)	3.7 (1.0)

Table 1: Participant Information

CATEGORY GENERATION TASKS

This study was derived from a larger study focusing on the development of semantic and grammatical skills in Mandarin-English bilingual children in a bilingual environment. The original study included diverse semantic tasks such as category generation, compound analogy, derivative form, contrast association, category association, repeated words association, picture naming, and picture identification. The category-generation tasks used in this research were based on Peña et al.'s tasks (2002) which evaluate knowledge of semantic categories among Spanish-English bilingual children. The tasks were divided into two conditions: the taxonomic category condition assesses knowledge of broad semantic categories such as foods, clothes and animals; the slot-filler condition assesses knowledge of relatively narrow, event-based categories such as zoo versus farm animals, and warm-weather versus cold-weather clothing. All together, there were six English tasks including three taxonomic generation tasks (i.e., animals, foods, clothes) and three slot-filler tasks (i.e., farm animals, zoo animals, circus animals). In Mandarin, two tasks were administered, one targeting taxonomic category (i.e., animals), the other targeting slot-filler category (i.e., cold-weather clothes).

PROCEDURE

Data collection began after Institutional Review Board (IRB) granted approval. Examiners were trained bilingual graduate or undergraduate students in the field of speech-language pathology. Examiners administered the tests individually to tested children. The tasks were conducted in participants' homes or in a bilingual laboratory at University of Texas at Austin. Parent questionnaires and consent were given before or after the administration of the tasks. Children were tested in Mandarin and English on two separate days with language of first session counterbalanced across children. Testing was conducted by native speakers of each language or a highly proficient bilingual. For the taxonomic category generation tasks, the examiner provided verbal prompts such as "Tell me all the foods you know," “Tell me all the animals you can think of” and “Tell me all the clothes you can think of”. Similarly, for the Mandarin taxonomic task, the prompt was “”告訴我你知道的所有動物的名字” [“Tell me all the animals you can think of”]. For the slot-filler tasks, the examiner gave the following verbal prompts: "Tell me all the zoo animals you can think of," “Tell me all the farm animals you can think of” and Tell me all the circus animals you can think of.” For the Mandarin slot-filler task, the prompt was "告訴我天氣冷的時候我們該穿什麼" ["Tell me all the clothes that we can wear when it is cold"]. During administration of the tasks, examiner provided generic feedback such as "You are doing a good job" or "You are working hard". The participants were not given any correct answers to the questions, but minimal prompts such as "And...?" or "And what else?" were provided if the participant paused for a long time after the initial prompt was given. The tasks were not timed and each child was allowed as much time as they needed until the child indicated they could no longer provide any new items.

SCORING AND ANALYSIS

The number of correctly generated items was tallied for each individual task. For the English task, each answer was compared to a list of acceptable answers developed by Peña et al. as part of the Bilingual English Spanish Assessment (BESA) protocol. Self-repetitions were not counted, as well as any answers that were not on the list. For the English tasks, no incidences of code-switched responses were observed in any of the typically developing bilingual children. One child with SLI produced many responses in Mandarin on the English tasks but as stated earlier, the two children with SLI were not included in the analyses because the study's focus was on typical development. Recall that in English there were a total of six tasks, three in the taxonomic condition (all animals, all clothes, all food) and three in the slot filler condition (zoo, farm, and circus animals). The circus animal task was not included in the final analyses because children generated very few items for this task. Therefore, for the English slot-filler condition, we averaged children's scores over the zoo and farm animal tasks.

To score the Mandarin tasks, the author of this thesis and the faculty supervisor went over children's answers and reached agreement on the scores. Code-switched responses were observed in 13 out of the 53 children. In total there were 418 responses produced, 43 of which were code-switched responses (10.3% of the overall responses). Among these 43, 42 represented correct answers in the other language. These code-switched responses (from Mandarin to English) were counted as incorrect. Only two category generation tasks were administered in Mandarin (all animals, cold-weather clothes). Because the cold-weather clothes task did not have a corresponding English equivalent, we did not include this task in subsequent analyses.

The results of category-generation tasks were scored in terms of the number of items that the participant produced according to the stimulus questions (e.g., animals, zoo

animals, etc.). English and Mandarin taxonomic category generation scores were derived from the response of "Tell me all the animals you can think of." The comparisons of individual English taxonomic category such as animals, clothes, foods were conducted by means of a one-way ANOVA. In addition, English slot-filler category generation scores were calculated with the responses to the stimulus questions, "Tell me all the zoo animals you can think of." And “Tell me all the farm animals you can think of.”

Inappropriate responses such as repetition of all or part of the question, unintelligible words or phrases, and items not related to the category were eliminated from the adequate items that the participant produced. The participant's response for each stimulus question was recorded by the examiner and audio recorded for further examination after the tasks.

RESULTS

ENGLISH AND MANDARIN TAXONOMIC CATEGORY GENERATION

Children's scores were put into a two-way Analysis of Variance (ANOVA) with age (4-, 5-, 6-, and 7-year-old) as the between-subject variable and languages (English and Mandarin) as the within-subject variable. There were main effects of age [$F(3,49)=7.73$, $P< .001$, $\eta_p^2= .32$] and language [$F(1,49)=6.21$, $p= .016$, $\eta_p^2= .11$]. Tukey Post hoc test with Unequal N indicated that when the two languages were combined, children aged 7 generated more taxonomic category items than children aged 4 ($P= .002$), and children aged 6 also generated more taxonomic items than children aged 4 ($p= .0045$). The other pairwise comparisons did not reach significance. The language effect was due to a higher number of items generated in English than in Mandarin. These patterns are illustrated in Figure 1. As seen in Figure 1, although the interaction between age and language was not significant ($p= .43$), the four-year-olds produced a comparable number of items in their two languages, whereas in the older groups, there was a trend for children to produce more items in English than in Mandarin.

		English			Mandarin
Group	n	Animal	Clothing	Food	Animal
4-year-olds					
Taxonomic	7	3.1(3.7)	2.7 (3.3)	3.6 (3.6)	3.4 (1.9)
Slot-filler	7	4.3 (1.9)	n/a	n/a	n/a
5-year-olds					
Taxonomic	16	8.0 (3.9)	5.7 (2.8)	6.9 (3.8)	6.4 (4.5)
Slot-filler	16	5.3 (1.4)	n/a	n/a	n/a
6-year-olds					
Taxonomic	22	10.6 (4.0)	6.2 (2.2)	8.5 (5.1)	7.9 (4.5)
Slot-filler	22	6.4 (2.4)	n/a	n/a	n/a
7-year-olds					
Taxonomic	8	11.8 (3.3)	6.1 (2.6)	9.9 (4.3)	7.9 (4.6)
Slot-filler	8	7.4 (2.0)	n/a	n/a	n/a
Mean Taxonomic	53	9.0 (4.6)	5.6 (2.8)	7.6 (4.7)	6.9 (4.4)
Mean Slot-filler	53	5.9 (2.2)	n/a	n/a	n/a

Table 2: Mean Number of Items Produced by Age Group, Condition, and Category

To examine the between-language relationship of taxonomic category generation, a correlation was conducted between children's Mandarin and English scores on the "all animals" task, there was a significant but modest correlation between the two scores, r= .34, p= .01, r^2= .12. Children who were able to generate more animal names in English also tend to produce more animal names in Mandarin.

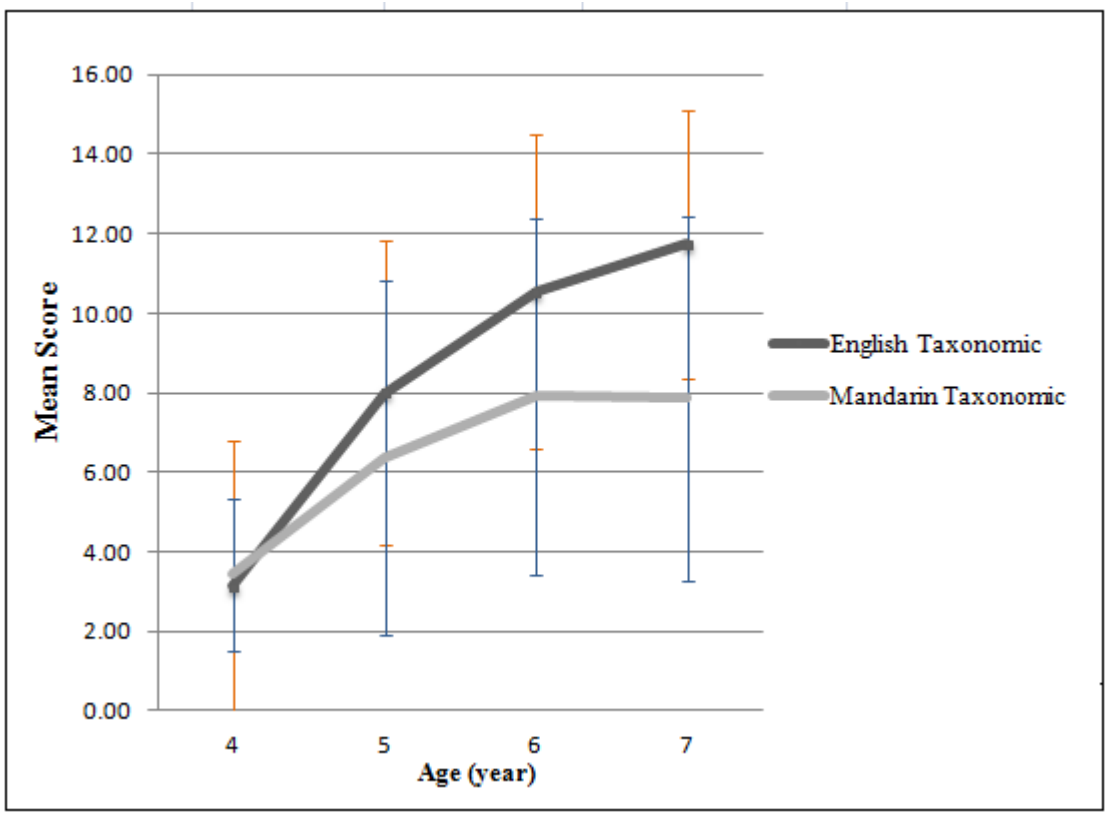

Figure 1: Interaction for Age and Language

ENGLISH TAXONOMIC AND SLOT-FILLER CONDITIONS

A two-way ANOVA was also used for evaluating the interaction between age (4-, 5-, 6-, and 7-year-old) and condition (taxonomic and slot-filler categories). In this analysis we used scores from the English "all animals" task to represent the taxonomic condition and the average scores from the English "farm animals" and "zoo animals" tasks to represent the slot-filler condition. Age was considered the between-subject variable and condition the within-subject variable. The results revealed that there were main effects of age [$F(3,49)=9.08$, $p< .001$, $\eta_p^2= .36$] and condition [$F(1, 49)=22.18$, $p< .001$, $\eta_p^2= .31$]. The results of Tukey Post hoc test with Unequal N demonstrated that

when the two conditions were combined, children aged 7 and 6 both generated more items than children aged 4 (p= .0043; p= .0004). The main effect of condition was attributed to a higher number of items generated in the taxonomic than in slot-filler conditions. There was also a significant interaction effect for Age × condition [F(3, 49)=4.50, P= .007, η_p^2= .22]. Children aged 4 generated comparable numbers of both taxonomic and slot-filler items (p= .99), but children aged 5, 6 and 7 generated more taxonomic items than slot-filler items (p= .05, p< .001, p= .02). These patterns are illustrated in Figure 2.

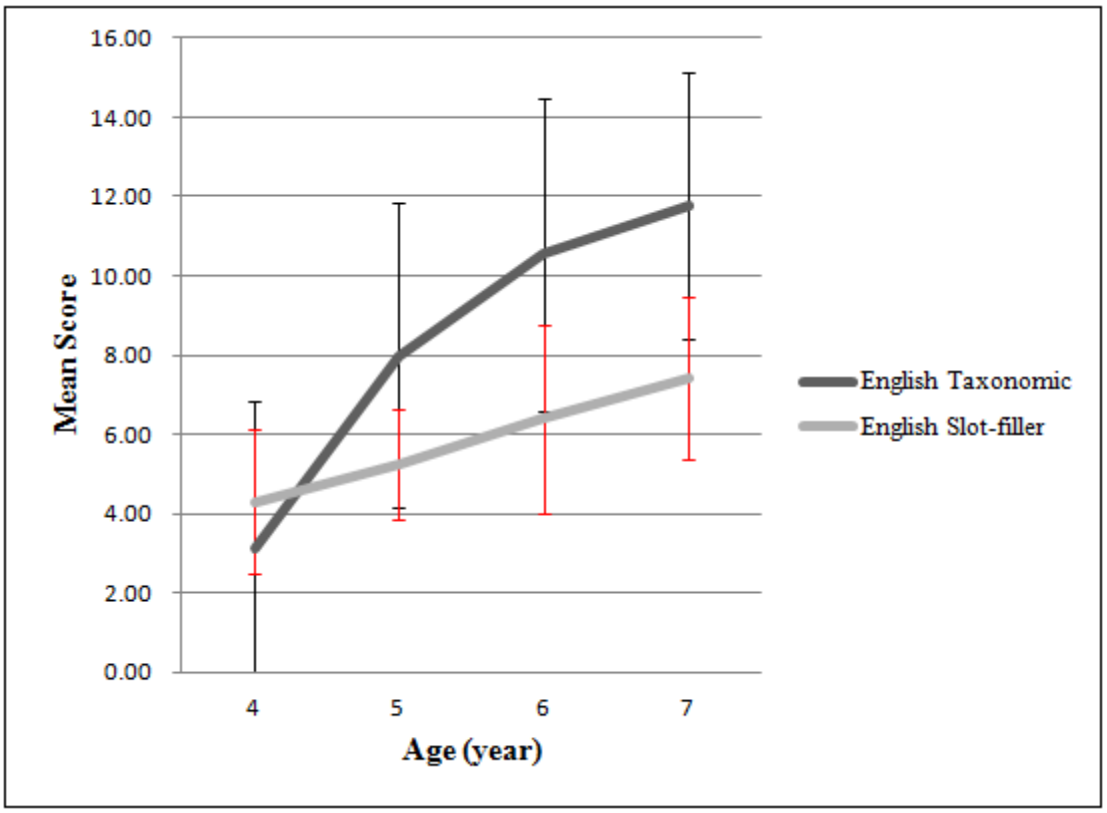

Figure 2: Interaction for Age and Scope

ENGLISH TAXONOMIC ORGANIZATION ACROSS THREE COMMON CATEGORIES

Children's scores on three different taxonomic categories were obtained from the questions "Tell me all the animals you can think of", "Tell me all the foods you can think of", and "Tell me all the clothes you can think of." The numbers of items children produced were put into repeated measure ANOVA to compare knowledge across the three categories. In this analysis, age was not included as an independent variable. The main effect of category was significant [$F(2, 104)=17.70$, $P<0.001$, $\eta p2=0.25$]. Bonferroni posthoc tests indicated that children generated more animal items than clothes items ($P<0.001$), and more food items than clothes items ($P=0.002$). Children produced more animal items than food items but this difference did not reach significance ($p=0.057$).

DISCUSSION

This study aimed to evaluate qualitative and quantitative changes in Mandarin-English bilingual children's use of taxonomic and slot-filler categorization strategies. Specifically, we aimed to address three questions that respectively examine the effects of language, age, and semantic categories on children's performance. The next sections of the discussion will address each question in turn.

COMPARING ENGLISH AND MANDARIN TAXONOMIC ORGANIZATION

This analysis yielded a main effect of age and a main effect of language. The older children, particularly the six- and seven-year-olds, produced more correct answers than the four-year-olds. When age groups were collapsed, children did better in English than Mandarin. Although the age by language interaction was not significant due to large individual variability (see Figure 1 for error bars depicting Confidence Interval), the four-year-olds appeared to perform comparably in Mandarin and English whereas the older groups began to show increased gap between the two languages with English leading Mandarin. As seen in Table 2, between the four- (M = 3.1) and five-year-old (M = 8) groups, there was a very large difference in the number of English items. This upward trend continued in the six- (M = 10.6) and seven-year-old (M= 11.8) groups, but the difference was much reduced. We also saw a large difference in Mandarin performance between the four- (M=3.4) and five-year-old (M=6.4) groups with the means almost doubled, and another increase of 1.5 items between five- and six-year-old groups, indicating sizable but more limited growth in Mandarin skills over the preschool years. However, the six- and seven-year-olds produced identical numbers of items (M=7.9) in Mandarin. These findings suggest that as formal English exposure accumulates, the home language begin to lose ground. These results are consistent with previous of

Mandarin-English bilingual children using tasks such as picture identification and picture naming (Sheng, 2013; Sheng et al., 2011).

According to Wong-Fillmore (1991), parents from Chinese immigrant families reported concerns about how to improve or even maintain Mandarin as bilingual children were exposed to English from educational programs. Needs for academic success and peer interactions demand more use of the majority language in the educational system, thus resulting in the probable neglect of home language. Furthermore, as the majority language is widely used in the society except home environment, children might deliberately choose to improve the majority language and avoid using the home language.

Nevertheless, sizable differences were noted in the Mandarin performance of the four-, five-, and six-year-old groups. Additionally there was a significant correlation between Mandarin and English category generation performance, indicating that children who were able to generate more animal names in Mandarin also tended to produce more animal names in English. This positive relationship between L1 and L2 lexical-semantic skills has also been documented in previous studies (Sheng, 2013; Sheng et al., 2011). Together, these suggest that L1 and L2 semantic learning is not subtractive, but that children could use semantic conceptual knowledge in one language to bootstrap the same kind of learning in the other language. Therefore, the unbalanced language skills between English and Mandarin when children grow older cannot be attributed to the negative subtractive effects from English. As a matter of fact, as the learner gain higher proficiency in the second language, a direct link between the second language and concepts might be found without the participation of the first language. (Kroll & Stewart, 1994; Kroll, Van Hell, Tokowicz, & Green, 2010). In other words, bilingual children might first learn vocabularies in second language through mapping the new words onto their first language vocabulary. However, as they grow older, the link between the second

language and central concept becomes stronger. The direct link between first language and second language might thus become weaker because of the shift of individual features to overall integration of various vocabularies that rely mainly on concepts.

Another observation is worth noting here. Besides the two participants with SLI excluded at the beginning of the study, all participants responded in the language which the testers used in presenting stimulus questions. In other words, children rarely switched to the other language when performing the task in one language. It is possible that the bilingual children's semantic representation was activated by the language used in stimulus questions, thus leading to the loop of activation in the same language. According to Dalrymple-Alford (1984), as the link of words are stronger in the same language than in different languages, the next semantic concept that would be triggered might be named in the same language instead of in the other language. In other words, as the name of a concept is activated, other names from the same category would be prepared for generation. An alternative explanation might be social experience that the children had when they talked with different people. Children might learn from experience that they need to respond in the language that the communication partners are using when they are not familiar with their partners, because the partners might not understand the other languages that the children use.

SLOT-FILLER AND TAXONOMIC ORGANIZATION IN ENGLISH

Because we divided children into four age groups, we were able to pinpoint the age at which bilingual children might show the slot-filler to taxonomic shift in semantic organization. The results indicated that Mandarin-English bilingual children who were four years of age generated similar numbers of slot-filler and taxonomic category items,

while the five-year-old bilingual children began to show a taxonomic advantage. This taxonomic advantage became more pronounced in the six- and seven-year olds.

Recall that Nelson and Nelson (1990) found a slot-filler advantage over the taxonomic condition in five-year-old monolingual children and a taxonomic advantage over the slot-filler condition in eight-year-old monolingual children, and Peña et al. (2002) found equal performance between slot-filler and taxonomic conditions in five-year-old Spanish-English bilinguals and a clear taxonomic advantage in the six-year-old bilinguals. Our findings suggested that the shift from slot-filler to taxonomic organization may occur at an even earlier age in bilingual children.

Everyday experiences are referred to as the main effective elements that lead to different language performance in category generations. Slot-filler category generation is a semantic strategy that requires the understanding of specific events or scripts in order to categorize words into different layers for future word retrieval or novel word learning. As children become older, they might receive information of a variety of events or scripts that are force them to establish newer or broader concepts for organizing the large amount of words in these events and scripts. This circumstance might lead to the shift from slot-filler strategy to taxonomic strategy in older children. Because bilingual children are immersed in two languages with more vocabularies and culturally unique words, they might need more advanced organizational strategies than monolingual children. The shift from slot-filler strategy to taxonomic strategy might occur earlier in bilingual children because of the constant needs of tackling huge amount of vocabularies compared to children who speak only one language. The capacity of categorize many words based on taxonomic approach assists the bilingual children to arrange vocabularies once they acquire a critical number of items (Peña et al., 2002).

In the present study, the shift from slot-filler to taxonomic strategy occurred earlier in Mandarin-English bilingual children than Spanish-English bilingual children (Peña et al., 2002). This difference may be attributed to the specific languages spoken by the bilinguals, the socioeconomic background of the participants, or methodological differences. Further investigations are needed to replicate the current findings and identify the contributing factors.

ENGLISH TAXONOMIC ORGANIZATION ACROSS THREE COMMON CATEGORIES

Mandarin-English bilingual children in the present study produced more animal items than food items and more food items than clothes items. This result corresponded with the Spanish-English bilingual children study done by Peña et al. (2002), which showed that more items were produced in the animal category compared to food and clothes categories. One of the reasons for this performance advantage for the animal category might be that the animal category is broader than food or clothes categories, especially for young children. Children are introduced to names of zoo, farm, aviary, and aquatic animals from a very young age and many child-centered activities, television programs, and books are designed around the animal themes. In addition, animals may be inherently interesting to children as young children are attracted to objects that are colorful, can move, have eyes, and make sounds (Murphy, 2002). These factors might have motivated children to learn many names for animals.

By contrast, food and clothes are more constrained by certain living styles, weather, location, and culture. For example, children living in tropical areas might not be able to name many winter clothes such as gloves, scarves, etc. Similarly, children might be familiar with the food items common in their own home and culture but unfamiliar

with food items from other households and cultures, thereby limiting the number of responses produced in those categories.

CONCLUSION AND LIMITATION

In conclusion, the current study analyzed category generation performance in Mandarin-English bilingual children. The results showed that four-year-old children were relatively balanced in Mandarin and English but the older groups began to show an English advantage in taxonomic condition. As for the shift from slot-filler to taxonomic organization, children began to show the taxonomic advantage as early as the age of five. Among the items produced in taxonomic condition in English, Mandarin-English bilingual children in the present study produced more animal than food, and more food than clothes items. These findings suggest that both general developmental factors such as age, and individual-specific factors such as bilingual language experience, and experience with one's own culture work together to shape children's semantic skills.

The present study included only one Mandarin task (告訴我你知道的所有動物的名字 ["Tell me all the animals you can think of"]) which limited the kind of comparisons that can be performed against the English tasks. Future research should include more Mandarin tasks in both taxonomic and slot-filler condition in order to further evaluate the shift from slot-filler to taxonomic organization in both languages of the bilinguals. In addition, the present study included unequal numbers of participants in each age group. There were fewer children in the four-and seven-year old groups, which may limit the conclusions made regarding these age levels. Future extension of this study should aim to increase the sample size for these two age groups.

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