Research Article

Typicality Effect and Category Structure in Spanish–English Bilingual Children and Adults

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Purpose: The study examines the typicality effect in Spanish–English bilingual children and adults in their 2 languages.

Method: Two studies were conducted using a category-generation task to compare the typical items generated by children with those generated by adults. Children in the 1st study differed orthogonally with respect to age (older, younger) and language use (higher Spanish use, higher English use). In the 2nd study, the older and younger children were matched with adults on their current Spanish use to delineate the influence of test language and age.

Results: Children with higher English use generated more typical items, and these occurred earlier in their word lists in English than in Spanish. Participants at all levels

of Spanish experience generated fewer typical items in Spanish than in English. Thus, there was less convergence of items considered typical among participants in Spanish. Older and younger children did not differ in the number of typical items generated. However, when participants were matched for language use, older children produced typical items earlier in their word lists than did younger children.

Conclusion: This study demonstrates the influence of language use and test language in generation of typical items in bilingual children.

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Young children learn common words from what they hear in their environment (Tardif et al., 2008). These typical words are derived from semantic categories and perceived as good representations of the category (e.g., *dog* for the category “animals”; Rosch, 1975). Children enrich their vocabulary by gradually adding items that are less typical (e.g., *bat* for the category “animals”). Bilingual children by necessity add vocabulary items in each of their languages, but this process has not been systematically studied. Category generation is an efficient way to qualitatively assess lexical-semantic knowledge in children and adults. Categorization facilitates vocabulary organization and growth (Gopnik & Meltzoff, 1992). This task can be used to evaluate an individual’s ability to generate words belonging to a specific semantic category (e.g., animals) within a specified amount of time (usually 60 s; Nelson & Nelson, 1990). By evaluating the number and types of items generated under each category, an examiner can gain insight into the structure and organization of vocabulary. Performance on such tasks reflects the categorization process

and helps researchers understand the structure of semantic categories as well as the role of typicality in vocabulary learning. By extending this task to bilingual people, it is possible to further examine the influence of language exposure and culture on category structure and typicality.

Semantic-Category Structure

The organization of semantic knowledge can be visualized in vertical and horizontal components (Rosch, 1978). Vertical components involve hierarchically organized taxonomic levels including superordinate (e.g., vehicle), basic (e.g., car), and subordinate (e.g., sports car). Horizontal components of categorization involve meaning relationships within categories (e.g., car, truck, bus, cart). In development, children initially categorize objects on the basis of thematic relations rather than taxonomically (Nelson & Nelson, 1990). These thematic relations, or *slot-filler categories*, are script-based and are formed on the basis of children’s real-world experience. Younger children use their day-to-day experiences to categorize their knowledge about the world. These experiences are typically situation-specific, and children learn vocabulary that aligns with these situations, or scripts. Examples of slot-filler categories might include “toys at home” and “toys at school.” As children gain more experience and acquire more vocabulary, they shift to more efficient adultlike taxonomic categorization. Taxonomic

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categorization allows for the formation of larger item sets on the basis of conceptual similarity rather than experience—for example, “toys.”

The shift from slot-filler to taxonomic categorization has been studied in both monolingual and bilingual children. In monolingual English-speaking children, it is noted that this shift generally occurs by about age 8 years (Nelson & Nelson, 1990). In bilingual children, this shift occurs earlier, at around age 6.5 years as evidenced in Spanish–English bilingual children (Peña, Bedore, & Zlatić-Giunta, 2002) and 6 years in Mandarin–English bilingual children (Sheng & Lam, 2015). In contrast to monolingual children, bilingual children add new words across both of their languages, and this increased number of words may drive them to adopt more efficient taxonomic-organization strategies at an early age.

The internal structure of a semantic category includes a prototype at the core, which is the most central item representing the category. The prototype itself may be an idealized or abstract representation of the category (e.g., *dog* is a more prototypical or ideal representation than *bat* for the category “animals”; Keller, 1982; Rosch, 1973). Category members vary with respect to the number of attributes they share with the prototype (Rosch & Mervis, 1975). The greater the similarity to the prototype, the more typical a member is with respect to the category. Semantic categories are viewed as having a graded structure, with some members considered very good examples or typical instances of the category (e.g., *robin* as a typical member of the category “birds”) and others being considered less representative exemplars (e.g., *penguin* as an atypical member of the category “birds”). This typicality gradient among the category members forms the horizontal component of the category structure. The prototypes in the adult category structure are more similar to typical than atypical members, and they are accessed and processed relatively easily and more frequently than atypical members (Rosch, 1978). This *typicality effect* helps us to understand category structure and whether individuals are using effective strategies to organize members of the category. Examining the developmental progression of typicality in both slot-filler and taxonomic conditions further helps us gain an understanding of whether children are adopting adultlike strategies to organize category members in these two conditions.

Rating scales have been used with adults and children to determine typicality of category members. There are, however, concerns about the appropriateness and reliability of rating scales for understanding typicality in children (Maridaki-Kassotaki, 1997). An alternative measure of typicality is production frequency, which measures the relative frequency with which participants produce an exemplar in response to a category name (Chang, 1986). For instance, in a category-generation task the production frequency of the item *dog* for the category “animal” can be calculated as the number of participants who produced it as compared to other items. Because prototypes are more similar to typical members than atypical ones (Keller, 1982; Rosch, 1975), participants tend to produce typical members more frequently and earlier in their responses than atypical ones. Despite the

differences in the two methods, there is consistent overlap in the items considered typical that are obtained using rating scales and using production frequency (Nelson & Nelson, 1990).

Development of the Typicality Effect

The development of categorization skills in children plays a vital role in acquisition and storage of the vocabulary that is necessary for effective language use. One of the organizational principles of categories is the typicality of category members with respect to the category prototype. Typicality effects have been extensively studied in monolingual English-speaking children and adults. Differences between child and adult typicality have been demonstrated across a number of paradigms, such as category inclusion (Carson & Abrahamson, 1976), typicality rating (Bjorklund, Thompson, & Ornstein, 1983), priming (Duncan & Kellas, 1978; Keller, 1982), and category verification (Jerger & Damian, 2005). These studies were cross-sectional and carried out with monolingual English-speaking children and adults residing in the United States. In category-inclusion and category-verification tasks, older children and adults have demonstrated comparable typicality effects (Carson & Abrahamson, 1976) and the contrast with adults was more pronounced in children in their preschool and early years (Jerger & Damian, 2005). This is consistent with findings from priming tasks, where children categorize typical and atypical members with category names as primes; younger children have been shown to lack preferential processing for typical items—in distinction to their older counterparts—in that their response times did not improve for typical members (Duncan & Kellas, 1978). With respect to typicality ratings, older children’s ratings are more comparable to those of adults than those of younger children, and correlations with adults’ ratings increases significantly with increase in age (Bjorklund et al., 1983). Together, results suggest that there are developmental changes in the internal category structure and that the typicality effect gradually converges to adultlike as the children mature.

In contrast, other studies have demonstrated very similar typicality effects for children and adults. Anglin (1977) studied children ranging in age from 2 years 10 months to 6 years 6 months for classification of category exemplars from three semantic categories: “animals,” “food,” and “clothing.” The exemplars varied with respect to their typicality, from “central” (typical) to “peripheral” (atypical) instances of the category. The resulting typicality effect was significant: Children made significantly fewer errors in central instances compared with peripheral ones. Anglin thus claimed that typicality is a very basic principle mastered by children at a very young age. Posnansky and Neumann (1976) studied children at ages 7 years 11 months, 8 years 11 months, 10 years 11 months, and 12 years 7 months, using a set of stick figures as artificial categories. All four groups of children recognized typical patterns more accurately than atypical ones, and the recognition rates were the same as those of adults. When experience with category exemplars was controlled for among adults and children, there was no difference by typicality effect.

Influence of Culture and Bilingualism on the Category Structure

Although the tendency to categorize concepts in our environment is shared across languages and cultures, category membership itself may vary (Kövecses, 2006). Internal category structure is influenced greatly by the items considered prototypical by the language users who share similar experiences and culture, which may in turn affect prototypicality ratings. For instance, dates are not considered a prototypical fruit in the United States or the United Kingdom, whereas in Tunisia or other North African countries, they may be considered highly prototypical (Croft & Cruse, 2004). Thus, a potential factor that might determine typicality is the cultural familiarity with category exemplars, given that the representation of categories jointly involves both cognitive and cultural aspects (Kövecses, 2006; Ochs, 1988). As a result, typicality gradients cannot be generalized across cultural groups. Cross-cultural differences can be attributed to some extent to the familiarity of exemplars in that culture. Another example comes from Schwanenflugel and Rey (1986), who studied Spanish- and English-speaking monolingual adults from different cultures residing in the United States. In their study, the mean typicality rating by English-speaking adults for the fruit *raspberry* was 5.38 on a scale of 1 to 7, indicating it as more typical, but the Spanish-speaking adults rated its typicality as 3.74, indicating it as less typical. With the aim of delineating the influence of cultural familiarity on typicality in children's category structure, Lin, Schwanenflugel, and Wisenbaker (1990) compared typicality ratings in monolingual children and adults who were living in the United States with those living in China. Along with developmental changes in the typicality ratings of children, there were differences in the exemplars reported to be typical for each category by the two cultural groups. Children's typicality ratings for category items correlated with cultural familiarity ratings of the respective adults. The authors concluded that the exemplars considered prototypical for a particular category vary, at least partially, as a function of cultural familiarity.

Languages differ in the nature of mapping of conceptual meanings onto words, which may further contribute to the differences in category structure. For instance, Malt, Sloman, Gennari, Shi, and Wang (1999) studied naming of exemplars from the category "household containers" (e.g., jars, bottles, cans) in English, Chinese, and Spanish and found substantial differences in the items named across languages. Similar results were reported by Ameel, Storms, Malt, and Sloman (2005) for Dutch and French speakers.

In the case of bilingual language development, children are exposed to varying degrees of each language associated with each culture. Similar to monolingual children from different cultural backgrounds, there may be differences in the category structure across bilingual children's languages. Peña et al. (2002) have reported that bilingual children generate different typical items in Spanish and English for the same category, and that the frequency of generation of prototypical items in each language appears to result from

the emphasis each item receives in its respective language environment.

Because bilingual people have to organize and categorize words in both of their languages, the linguistic distinctions between their two languages may further have effects on category structure. Ameel, Malt, Storms, and Van Assche (2009) studied typicality ratings by Dutch–French bilingual people in each of their languages and compared those with the ratings obtained from Dutch and French monolingual participants. The typical exemplars for bilingual people in their two languages were more similar to each other than to the exemplars for monolingual people. Thus, the category structure and typicality may be influenced by experience with two languages.

Bilingual language development presents unique conditions to allow further study of category structure and typicality in children and their convergence with bilingual adults' category structure. The present study aimed at examining the typicality effect and semantic-category structures of Spanish–English bilingual younger and older children using a category-generation task. Because categories in a slot-filler condition are more constrained, we predicted that children would generate more typical items for these categories than in the more open taxonomic condition. For the slot-filler condition, children may converge on a small set of highly typical items, and there would be little if any difference in typicality across age groups. But for the taxonomic condition, there might be greater variability on which items are considered typical due to broader categories resulting in less agreement. We explored the following three main (and two subsidiary) questions in two analyses:

1. Are there age-related differences in the generation of typical exemplars between younger and older children in their two languages?
2. What are the influences of language exposure and use on typicality in bilingual people?
 - 2a. Does the amount of language exposure and use have an effect on the generation of typical exemplars in older and younger children?
 - 2b. What are the differences and/or similarities in the typicality effect across Spanish and English?
3. Does the generation of typical exemplars vary for taxonomic and slot-filler conditions and across semantic categories in both languages?

Method

Study 1

Participants

The children included in the present study were a part of a larger study ($N = 280$) of semantic and morpho-syntactic development in Spanish–English bilingual children. Sixty children ages 7–9;11 (years;months; see Table 1) who varied in their exposure to Spanish and English from

Table 1. Participant details of Study 1.

Characteristics	Y-HSU (<i>n</i> = 15)	Y-HEU (<i>n</i> = 15)	O-HSU (<i>n</i> = 15)	O-HEU (<i>n</i> = 15)	Adults (<i>n</i> = 20)
Mean (<i>SD</i>) age (years)	7.82 (0.27)	7.89 (0.41)	9.18 (0.52)	9.36 (0.49)	21.35 (2.18)
Mean (<i>SD</i>) current English use (%)	33(8.50)	68 (7.80)	31 (10.70)	69 (8.70)	72(14.00)
Breakdown of bilingualism types	13-SEQ, 2-SIM	5-SEQ, 10-SIM	11-SEQ, 4-SIM	10-SEQ, 5-SIM	12-SEQ, 8-SIM
Mean (<i>SD</i>) age of English onset (years)	3.87 (1.64)	2.27 (1.95)	4.20 (1.57)	4.00 (2.42)	4.05 (2.01)
Mean (<i>SD</i>) English exposure (years)	3.89 (1.79)	5.60 (2.10)	5.13 (1.30)	5.38 (2.32)	19.00 (3.71)
Breakdown of SES status ^a	14 low, 1 middle	10 low, 5 middle	14 low, 1 middle	14 low, 1 middle	—
Mean (<i>SD</i>) education ^b (years)	—	—	—	—	16.23 (1.52)
Mean (<i>SD</i>) English proficiency ^c	3.58 (1.08)	4.44 (0.68)	3.47 (1.16)	4.41 (0.57)	4.89 (0.18)
Mean (<i>SD</i>) Spanish proficiency ^c	4.72 (0.44)	2.31 (1.82)	4.80 (0.21)	3.51 (1.83)	4.16 (0.50)
Mean (<i>SD</i>) language use in education (%)					
English	37.00 (14.35)	77.00 (36.72)	28.00 (24.25)	74.00 (21.03)	48.00 (36.63)
Spanish	34.00 (19.75)	4.40(4.44)	38.00 (26.08)	3.50 (13.35)	3.30 (10.25)
Both	29.00 (19.37)	18.60 (16.00)	34.00 (25.25)	22.50 (22.08)	48.70 (35.00)

Note. Y-HSU = younger–higher Spanish use; Y-HEU = younger–higher English use; O-HSU = older–higher Spanish use; O-HEU = older–higher English use; SEQ = sequentially bilingual (exposure to English at age 3 years or older); SIM = simultaneously bilingual (exposure to English before age 3 years).

^aSES for children was calculated based on their lunch program. Children with low SES received free and/or reduced lunch and children with middle SES did not receive free/reduced lunch. ^bThree adults did not report their number of years of education. ^cLanguage proficiency is rated on a 5-point scale; children's ratings were obtained from parents or caregivers.

20% Spanish/80% English to 20% English/80% Spanish were included. They were divided into four groups that differed orthogonally with respect to age (younger and older) and language use (high Spanish use and high English use). The age range of children in the younger group was 7;3 to 8;4 ($M = 7.8$; $SD = 0.34$), and that of children in the older group was 8;7 to 9;11 ($M = 9.27$; $SD = 0.51$).

A detailed interview of parents and caregivers regarding their language history, education, occupation, and children's English and Spanish exposure and use was completed. Parents and/or caregivers provided an account of the children's input and output languages and communication partners for every waking hour during typical weekdays and weekends (Peña, Gutiérrez-Clellen, Iglesias, Goldstein, & Bedore, 2014). Depending on the percentage of English and Spanish use obtained from the interview and age, the children were classified into four groups of 15 each: younger–higher Spanish use (Y-HSU), younger–higher English use (Y-HEU), older–higher Spanish use (O-HSU), and older–higher English use (O-HEU). HEU groups had 56%–86% English use (14%–44% Spanish use), and HSU groups had 56%–92% Spanish use (8%–44% English use). Every child was matched to another pairwise on age within 5 months and inversely with respect to language use within 12%. For instance, a participant in the younger age group with 20% Spanish use was matched with a participant of equivalent age but 20% ($\pm 12\%$) English use.

Younger and older children in the HEU groups differed significantly with respect to age, $t(28) = 11.11$, $p < .001$, $d = 4.06$, but were similar with respect to English language use, $t(28) = 0.35$, $p = .73$. (Effect sizes [Cohen's d] are interpreted on the basis of guidelines by Cohen, 1988, in which 0.2 is small, 0.5 is medium, and 0.8 is large.) Likewise, younger and older children in the HSU groups differed significantly in terms of age, $t(28) = 11.97$, $p < .001$, $d = 4.37$,

and were similar with respect to Spanish use, $t(28) = 0.36$, $p = .72$. Language use differed significantly in the two younger groups, $t(28) = 11.81$, $p < .001$, $d = 4.31$, and the two older groups, $t(28) = 11.97$, $p < .001$, $d = 3.86$. There were no differences for age among the younger group, $t(28) = 0.85$, $p = .41$, or the older group, $t(28) = 0.35$, $p = .73$ (see Sheng, Bedore, Peña, & Fiestas, 2013).

Children in the four groups were determined to have typically developing language ability on the basis of caregiver ratings of their language performance in both of their languages. The 5-point rating scale (1 = *low proficiency*, 5 = *high proficiency*) was used to rate language performance across various domains. The cutoffs for typical language development were derived empirically using discriminant function analysis: 4.5 and above for Spanish and 3.9 and above for English (Peña et al., 2014). On an individual basis, children were considered as having typical language ability if their ratings were above the cutoff in at least one of their languages. Language ability was also confirmed by assessing narrative skills in both languages. Children demonstrated 80% grammaticality or above in storytelling in their stronger language (Gutiérrez-Clellen & Kreiter, 2003). Children lived in central Texas and Colorado, and 55 out of 60 were Hispanic as indicated by their parents on the questionnaire (five parents did not indicate race/ethnicity). All children were exposed to Spanish from birth, but the age of English onset ranged from 0 to 5 years (see Table 1).

In addition to the child participants, there were 20 adult (age: $M = 21.35$, $SD = 2.18$) Spanish–English bilingual participants (see Table 1). All participants were heritage Spanish speakers and reported typical speech and language development. Information about their language history and use was obtained using an extended language-use questionnaire (Kiran, Peña, Bedore, & Sheng, 2010). At the time of testing, their English use ranged from 100% to

42% and their Spanish use from 58% to 0%. All the participants lived in central Texas. Fourteen participants had immigrant parents from Mexico, and one from El Salvador. The remaining five adult participants' parents were from the United States.

The five groups of participants were compared with each other on ratings of English proficiency, Spanish proficiency, and age of English exposure using Welch's *t* tests. The older and younger HSU children did not differ significantly with respect to English proficiency, Spanish proficiency, or age of English exposure. Likewise, the younger and older HEU children did not differ significantly with respect to English proficiency ($t_s < 1$, $p_s > .05$)—however, they differed significantly with respect to Spanish proficiency, $t(20.36) = 2.17$, $p = .04$, $d = 0.88$, and age of English exposure, $t(25.5) = 1.98$, $p = .05$, $d = 0.74$. The O-HEU group differed significantly from the O-HSU group on English proficiency, $t(19.24) = 2.73$, $p = .01$, $d = 1.03$, but not Spanish proficiency or age of first English exposure ($t_s < 1$, $p_s > .05$). On the other hand, the Y-HEU and Y-HSU groups differed significantly on English proficiency, $t(18.83) = 2.30$, $p = .03$, $d = 0.93$, Spanish proficiency, $t(10.41) = -4.21$, $p = .001$, $d = -1.83$, and age of first English exposure, $t(25.67) = -2.44$, $p = .02$, $d = -0.92$.

Children in the HSU groups differed significantly from adults on English proficiency—O-HSU: $t(16.21) = -2.67$, $p = .01$, $d = -1.05$; Y-HSU: $t(22.08) = -2.26$, $p = .04$, $d = -0.96$ —and age of first English exposure—O-HSU: $t(30.81) = 2.78$, $p = .009$, $d = 0.92$; Y-HSU: $t(30.99) = 2.08$, $p = .04$, $d = 0.70$ —but not on Spanish proficiency ($t_s < 1$, $p_s > .05$). Children in the HEU groups differed significantly from the adults on Spanish proficiency—O-HEU: $t(13.23) = -2.20$, $p = .04$, $d = -0.90$; Y-HEU: $t(10.11) = -4.52$, $p = .001$, $d = -2.27$ —but not on English proficiency or age of first English exposure ($t_s < 1$, $p_s > .05$). Fisher's exact test for count data showed that the groups varied with respect to distribution of socioeconomic status ($p < .001$) and distribution of simultaneous versus sequential bilingualism ($p = .04$).

Category-Generation Task

With the aim of understanding category structure and typicality in bilingual children's semantic fluency, we used a production task involving category generation. Participants were asked to name as many items as possible that belonged to a particular category within a time limit of 60 s. As stimuli, we used three taxonomic semantic categories (animals, food, and clothes) and four slot-filler categories (farm animals, zoo animals, lunch food, and winter clothes). Participants listed the names of items for these seven categories in both English and Spanish.

Items were originally derived from Nelson and Nelson (1990) and translated into a Spanish dual-focus approach (Erkut, Alarcón, Coll, Tropp, & Vázquez García, 1999). To be more specific, elicitation prompts were developed in both languages, translated, and piloted to ensure that children generated a robust number of exemplars in response. We

retained the prompts in each language that elicited the most responses. There were originally up to three slot-filler items for each taxonomic category. Item analysis of responses from approximately 700 children who participated in the Bilingual English Spanish Assessment (Peña et al., 2014) led to a further reduction of items to the current set of seven that were most robust across Spanish and English.

Procedure

For the child and adult groups, individualized testing of category generation was conducted in the context of other tasks. The tasks were blocked by language, so that testing was completed in one language within a session and testing in the other language was conducted in another session. The order of the first language tested was counterbalanced. Although the individual items were translated across tasks, the order of presentation differed in each language. Taxonomic and slot-filler items were organized so that two items from the same category (e.g., farm animals and zoo animals) were never presented consecutively.

Children were tested in the schools in a quiet area designated for that purpose over three or four sessions. General instructions were "Tell me all the _____ (e.g., animals) you can think of. Ready? Start." Children were given 60 s to respond. Prompts were used to encourage them to continue if they paused while responding (e.g., "And . . . ?" "Is there more?"). Back-channeling cues were used to provide general encouragement to keep generating items (e.g., "uh-huh," "mmm-hmmm"). Children's responses were audio-recorded, and examiners transcribed responses verbatim during administration. Audio recordings were used to check the transcribed responses, and these were entered using Systematic Analysis of Language Transcripts (Miller & Iglesias, 2008). Repeated and code-switched responses were excluded from further analysis. The code-switched items were excluded because we were interested in understanding typicality in each of the participants' languages.

Adults were tested using the same general procedure, but they were tested in the lab. They were tested in two blocks with two sessions in each block to counterbalance the order of test language and presentation of the semantic categories. As with the child participants, the same category was not presented consecutively. All responses were audio-recorded and transcribed for analysis again using Systematic Analysis of Language Transcripts. Similar to the children's data, repeated and code-switched responses were excluded from further analysis.

Data Analysis

All correct and nonrepeated items in the target language (English or Spanish, depending on the language of elicitation) listed by participants under each semantic category were considered for analysis. Adult participants generated on average 14 different items for "animals," 13 for "clothes," and around 16 for "food." First, the data

obtained from 20 adult participants were analyzed to obtain the typical items. The production frequency of each item was calculated as the number of participants out of 20 who had generated that item for the respective category. Next, the five items from each category that had the highest production frequency were tabulated and identified as typical items. The list of 35 typical items in English and Spanish, with their production frequencies, is provided in the online supplemental materials (see Supplemental Material S1 and S2). Thus, five typical items from each of seven semantic categories in both English and Spanish were obtained, yielding a total of 70 typical items (35 in each language).

Because the primary aim of the study was to understand the typicality effect in bilingual children, data were analyzed to see whether children produced typical items more frequently than atypical ones. The items generated by younger and older children were analyzed according to the occurrence of typical items obtained from the adults. To be more specific, we tabulated the number of items out of five typical items children had produced in each semantic category. The mean number of typical items (for each category) for the four groups of children in the seven semantic categories for English and Spanish are shown in Table 2.

We explored whether typical items were accessed easily, as indicated by being produced early in a category-generation task. We used decaying weighted scores to capture the order in which children reported typical items. If a typical item was in Position 1, it was assigned a weight of 5; if it was produced in Position 2, the weight was 4; and so on. For items at Positions 5 and beyond, a weight of 1 was assigned regardless of position. For example, if a child produced three typical items at Positions 1, 2, and 5, the weights assigned would be $5 + 4 + 1 = 10$. In the original scoring scheme of assigning unit weights to typical items and ignoring the positions of the reported items, this response would have received a score of $1 + 1 + 1 = 3$.

Results

The number and positions (i.e., weighted scores) of typical items generated by children were subjected to further

analyses using mixed-model analyses of variance (ANOVAs). The between-subjects factors considered were Age (older children and younger children) and Language Use (HSU and HEU). Effect sizes (η_p^2) are interpreted on the basis of Cohen's (1988) guidelines, in which .009 is small, .059 is medium, and .138 is large = 0.138.

Number of Typical Items

Category, Age, and Language Use effects for Spanish and English. In order to analyze the effect of categories on the production of typical items, the slot-filler categories were collapsed with their respective taxonomic categories. The within-subject factors were Category (animals, food, and clothes) and Test Language (Spanish and English). The number of typical items was the dependent measure.

There were significant main effects for Category, $F(2, 56) = 20.76, p < .001, \eta_p^2 = .10$, and Test Language, $F(1, 56) = 4.25, p = .03, \eta_p^2 = .03$. There were no statistically significant main effects for Age, $F(1, 56) = 2.19, p = .13, \eta_p^2 = .01$, or Language Use, $F(1, 56) = 3.02, p = .08, \eta_p^2 = .001$. Children produced significantly fewer typical items for the category "food" ($M = 1.35, SD = 1.12$) than for "animals" ($M = 2.37, SD = 1.35$), and more typical items in English ($M = 2.18, SD = 1.32$) than in Spanish ($M = 1.74, SD = 1.27$). There was a statistically significant difference, $t(34) = 2.70, p = .01, d = 0.45$, in the production frequencies of 35 typical items by 20 adults in English ($M = 14.97, SD = 2.64$) compared with Spanish ($M = 13.77, SD = 2.61$).

There were significant Language Use $\times$ Test Language interactions, $F(1, 56) = 20.86, p < .001, \eta_p^2 = .01$. Post hoc multiple comparisons of means using Scheffé's test revealed that children in the HEU groups produced significantly fewer typical items in Spanish ($M = 1.62, SD = 1.23$) than in English ($M = 2.40, SD = 1.27$), indicating a larger effect for Test Language for those children. No other pairwise comparisons were statistically significant. Figure 1 illustrates the significant Language Use $\times$ Test Language interaction.

Condition, Age, and Language Use effects for Spanish and English. A second four-way ANOVA was conducted to analyze the effect of taxonomic and slot-filler conditions

Table 2. Mean (SD) number of typical items in each category by each group of children in English and Spanish.

Group	Taxonomic category			Slot-filler category			
	Animals	Clothes	Food	Farm animals	Zoo animals	Winter clothes	Lunch food
Younger-higher Spanish use							
English	2.07 (1.10)	2.00 (1.51)	1.40 (1.12)	3.00 (1.41)	2.20 (1.21)	1.53 (0.99)	1.13 (0.99)
Spanish	1.33 (1.50)	1.73 (1.28)	1.00 (1.13)	1.73 (1.16)	2.40 (1.40)	1.87 (1.25)	1.27 (1.10)
Younger-higher English use							
English	1.93 (1.53)	2.73 (1.44)	1.40 (1.18)	3.80 (0.94)	2.73 (0.88)	1.80 (0.68)	1.73 (1.16)
Spanish	2.00 (1.31)	1.27 (0.80)	1.20 (1.01)	1.40 (1.18)	2.33 (1.68)	1.60 (0.83)	0.87 (0.99)
Older-higher Spanish use							
English	1.87 (1.19)	2.73 (1.28)	1.00 (1.00)	3.20 (1.42)	2.20 (1.08)	1.53 (1.06)	1.67 (1.54)
Spanish	1.87 (1.25)	1.93 (1.03)	1.27 (0.70)	2.40 (1.12)	3.67 (0.72)	2.20 (1.08)	1.40 (1.35)
Older-higher English use							
English	2.93 (0.88)	3.33 (1.05)	2.00 (1.00)	3.13 (1.25)	2.20 (1.01)	2.00 (1.25)	1.93 (0.96)
Spanish	2.40 (1.35)	1.53 (1.13)	1.47 (1.19)	1.93 (1.10)	2.20 (1.52)	1.67 (1.29)	0.87 (0.64)

Figure 1. Mean number of typical items by test language and language use.

on the production of typical items. This was achieved by collapsing the categories of “animals,” “food,” and “clothes” for the taxonomic factor and “farm animals,” “zoo animals,” “lunch food,” and “winter clothes” for the slot-filler factor. Similar to the previous analysis, the between-subjects factors considered were Age (older children and younger children) and Language Use (HSU and HEU). The within-subject factors were Condition (taxonomic and slot-filler) and Test Language (Spanish and English). The number of typical items was the dependent measure. Similar to the previous analysis, there was a significant main effect for Test Language, $F(1, 56) = 3.89, p = .04, \eta_p^2 = .02$. There were no significant main effects for Condition, $F(1, 56) = 2.21, p = .13, \eta_p^2 = .006$, for Age, $F(1, 56) = 2.00, p = .15, \eta_p^2 = .009$, or for Language Use, $F(1, 56) = 2.77, p = .09, \eta_p^2 = .001$. There were, however, a significant Language Use $\times$ Test Language interaction, $F(1, 56) = 19.08, p < .001, \eta_p^2 = .01$, and a significant Condition $\times$ Language Use interaction, $F(1, 56) = 5.31, p = .02, \eta_p^2 = .006$. Children in the HSU groups produced significantly fewer typical items in the taxonomic condition ($M = 1.68, SD = 1.25$) than in the slot-filler condition ($M = 2.08, SD = 1.35$), indicating that the effect of Condition was larger for those children; however, the effect size of this interaction effect was very small. Figure 2 illustrates the significant Condition $\times$ Language Use interaction.

Position of Typical Items

Category, Age, and Language Use effects for Spanish and English. Here, we were interested in evaluating how early in the word list children produced typical items. Two similar analyses (one each for category and condition) were conducted with weighted scores as the dependent variable. Age (older children and younger children) and Language Use (HSU and HEU) were between-subjects factors; Category (animals, food, and clothes) and Test Language (Spanish and English) were the within-subject factors. The results were similar to those of the first analysis, with a significant main effect for Category, $F(1, 56) = 20.99,$

$p < .001, \eta_p^2 = .02$. There was also a significant main effect for Language Use, $F(1, 56) = 8.41, p = .003, \eta_p^2 = .008$, despite a very small effect size. There was no main effect for Age, $F(1, 56) = 0.007, p = .93, \eta_p^2 = .0004$. Children in the HEU groups generated typical items earlier ($M = 6.02, SD = 4.03$) than children in the HSU groups ($M = 5.34, SD = 4.03$).

A significant Language Use $\times$ Test Language interaction, similar to the one in the examination of the number of typical items in the first set of analyses, was observed, $F(1, 56) = 5.34, p = .02, \eta_p^2 = .002$. A larger Test Language effect was observed for children in the HEU groups: They generated typical items earlier in English ($M = 7.02, SD = 3.80$) than in Spanish ($M = 5.03, SD = 4.01$). Children in the HEU groups generated typical items earlier in English ($M = 7.02, SD = 3.80$) than did children in the HSU groups in Spanish ($M = 4.71, SD = 3.70$).

Condition, Age, and Language Use effects for Spanish and English. In this analysis, we explored how early in the word list children produced typical items in the taxonomic and slot-filler conditions. An ANOVA was conducted with weighted scores as the dependent variable, Condition (taxonomic and slot-filler) and Test Language (Spanish and English) as within-subject factors, and Age (older children and younger children) and Language Use (HSU and HEU) as between-subjects factors. The analysis revealed similar patterns as before, with a significant main effect for Language Use, $F(1, 56) = 7.98, p = .004, \eta_p^2 = .008$. A significant main effect was seen for Condition, $F(1, 56) = 7.61, p = .005, \eta_p^2 = .02$. Children generated typical items earlier in the slot-filler condition ($M = 6.23, SD = 4.11$) than in the taxonomic condition ($M = 4.95, SD = 3.84$). The analysis also revealed a significant Language Use $\times$ Test Language interaction, $F(1, 56) = 5.34, p = .02, \eta_p^2 = .002$, and a significant Condition $\times$ Language Use interaction, $F(1, 56) = 5.34, p = .02, \eta_p^2 = .002$. Children in the HEU groups generated typical items earlier in the slot-filler condition ($M = 6.34, SD = 4.13$) than did children in the HSU groups in the taxonomic condition ($M = 4.30, SD = 3.72$).

Figure 2. Mean number of typical items by condition and language use.

Discussion

The first study was aimed at understanding the effects of age, language use, and test language in the development of semantic-category structure in bilingual children. We analyzed the number and positions of typical items in the children's data. The results for both of the dependent measures revealed a significant influence of the amount of language use and the test language. We noted that children in the HEU groups generated more typical items and also produced them earlier in English than in Spanish. But the results for Spanish were remarkably different: Children consistently produced fewer typical items in Spanish irrespective of their amount of Spanish use. This may be attributed to a lesser agreement among participants on items they consider typical in a category. This difference between English and Spanish was also noted in the production frequencies for typical items by adults. The children in the present study are generally exposed to Spanish at home and used it with family. They used English mainly at school and may also have used it at home with siblings. Schooling may lead to more similar experiences in English than in Spanish, which was mainly used at home.

With respect to the effect of age on typicality, there were no significant differences in the number and positions of typical items in the older and younger groups of children. Results support the hypothesis that the typicality effect may not vary as a function of age but rather be more strongly influenced by the amount of experience an individual has with the category exemplars (Duncan & Kellas, 1978). With the aim of further understanding the influence of test language and age on the typicality effect, we conducted a second study where participants were matched for their amount of current Spanish and English language use.

Study 2

From the first study, it was noted that both test language and current language use significantly influenced

children's production of typical items. To further delineate the effects of age and test language, current language use was controlled for in the second study. This was achieved by reanalyzing data from the subgroup of Study 1 participants who were matched on the basis of Spanish use.

Participants

Participants in this study were 15 younger and 15 older typically developing Spanish–English bilingual children drawn from the original set of 280, along with 15 Spanish–English bilingual adults drawn from the original 20 (see Table 3). These adult participants were selected for the current analysis because their amount of language use matched with that of children in the younger and older groups. They reported learning Spanish at home and English at school, as did the child participants in this study. Hence, they best represent the adult version of child English-language learners in the United States. Spanish and English use were determined using (for children) information about language history and use obtained from parents or caregivers (Peña et al., 2014) and (for adults) the extended language-use questionnaire (Kiran et al., 2010) obtained from Study 1. The current Spanish use of participants in all three age groups ranged from 20% to 58% ($M = 34\%$, $SD = 9\%$) and did not differ across the three groups, $F(2, 42) = 0.01$, $p = .98$. Each participant in one age group was matched to a participant with an equivalent amount of current language use in each of the other two age groups. Participants in the adult group ranged in age from 18 to 28 years ($M = 21.13$, $SD = 2.32$), the older children from 8.5 to 9.8 years ($M = 9.25$, $SD = 0.37$), and the younger children from 7.2 to 8.3 years ($M = 7.82$, $SD = 0.35$). Age differed significantly across the three groups, $F(2, 42) = 423.5$, $p < .001$, $\eta_p^2 = .95$.

With respect to English proficiency, there was no significant difference among the younger children, older children, and adults on Welch's t tests ($ts < 1$, $ps > .05$). Similar patterns were seen for age of first English exposure

Table 3. Participant details of Study 2.

Characteristics	Younger children (<i>n</i> = 15)	Older children (<i>n</i> = 15)	Adults (<i>n</i> = 15)
Mean (<i>SD</i>) age (years)	7.82 (0.35)	9.25 (0.37)	21.13 (2.32)
Mean (<i>SD</i>) current English use (%)	65 (10.00)	65 (9.00)	66 (10.00)
Mean (<i>SD</i>) current Spanish use (%)	34 (10.00)	34 (9.00)	34 (10.00)
Breakdown of bilingualism types	SEQ-9 SIM-6	SEQ-7 SIM-8	SEQ-12 SIM-3
Mean (<i>SD</i>) age of English onset (years)	2.12 (1.96)	3.18 (2.42)	4.70 (2.11)
Mean (<i>SD</i>) English exposure (years)	5.76 (2.16)	6.18 (2.47)	17.93 (3.71)
Breakdown of SES status ^a	11 low, 4 middle	14 low, 1 middle	—
Mean (<i>SD</i>) education ^b (years)	—	—	15.50 (1.16)
Mean (<i>SD</i>) English proficiency ^c	4.48 (0.51)	4.38 (0.61)	4.27 (0.50)
Mean (<i>SD</i>) Spanish proficiency ^c	2.42 (2.11)	3.93 (1.81)	4.84 (0.23)
Mean (<i>SD</i>) language use in education (%)			
English	76.00 (38.10)	71.00 (26.28)	51.00 (37.08)
Spanish	4.00 (1.88)	7.00 (9.11)	3.90 (3.72)
Both	20.00 (18.77)	22.00 (21.92)	45.10 (35.33)

Note. SEQ = sequentially bilingual (exposure to English at age 3 years or older); SIM = simultaneously bilingual (exposure to English before age 3 years).

^aSES for children was calculated based on their lunch program. Children with low SES received free and/or reduced lunch and children with middle SES did not receive free/reduced lunch. ^bOne adult did not report number of years of education. ^cLanguage proficiency given on a 5-point scale; children's ratings were obtained from parents or caregivers.

among the three groups ($t_s < 1$, $p_s > .05$). However, younger children differed in Spanish proficiency compared with older children, $t(17.41) = -2.41$, $p = .02$, $d = -1.02$, and adults, $t(10.18) = -3.82$, $p = .003$, $d = -1.74$. Fisher's exact test for count data showed that the three groups did not differ in distribution of sequential and simultaneous bilingualism ($p = .20$). With respect to socioeconomic status, there was no difference in distribution between younger and older children ($p = .32$), but there was a significant difference when the adult group was also considered ($p < .001$).

The category-generation data obtained in Study 1 were reanalyzed for the participants in Study 2. The five typical items with the highest production frequency for each of the seven semantic categories in Spanish and English were obtained from the 15 adult participants. The occurrences of these five typical items were examined in data from 15 older and 15 younger children.

Results

The mean (*SD*) number of typical items generated by older and younger children for each category in English and Spanish is shown in Table 4. In order to explore the possible effects on generation of typical items from age, test language, category, and condition after controlling for the amount of language use, we subjected the data to statistical analysis. The number and positions of typical items were analyzed using mixed-model three-way ANOVAs.

Number of Typical Items

In this analysis, the between-subjects factor considered was Age (older children and younger children); within-subject factors were Test Language (Spanish and English)

and Category (animals, clothes, and food); and the number of typical items was the dependent variable. The results revealed significant main effects for Test Language, $F(1, 28) = 18.60$, $p < .001$, $\eta_p^2 = .11$, and Category, $F(2, 28) = 18.00$, $p < .001$, $\eta_p^2 = .19$. However, there was no significant main effect for Age, $F(1, 28) = 2.99$, $p = .08$, $\eta_p^2 = .01$. The mean number of typical items generated in English ($M = 2.48$, $SD = 1.34$) was significantly higher than in Spanish ($M = 1.68$, $SD = 1.24$), consistent with the results of Study 1. Children generated significantly fewer typical items for the categories "food" ($M = 1.35$, $SD = 1.09$) and "clothes" ($M = 1.91$, $SD = 1.04$) than for "animals" ($M = 2.67$, $SD = 1.43$). Analysis of taxonomic and slot-filler conditions on production of typical items, similar to the previous analysis, revealed a significant main effect for Test Language, $F(1, 28) = 15.04$, $p < .001$, $\eta_p^2 = .01$.

Positions of Typical Items

Two more analyses (one each for category and condition) were conducted with weighted scores as the dependent variable. An ANOVA conducted with Age (older children and younger children) as the between-subjects factor and Category (animals, food, and clothes) and Test Language (Spanish and English) as the within-subject factors revealed the following: There were significant main effects (with small effect sizes) for Age, $F(1, 28) = 4.21$, $p = .04$, $\eta_p^2 = .01$, for Test Language, $F(1, 28) = 8.66$, $p = .003$, $\eta_p^2 = .05$, and for Category, $F(1, 28) = 17.12$, $p < .001$, $\eta_p^2 = .12$. Older children generated typical items earlier ($M = 6.56$, $SD = 3.91$) than younger children ($M = 5.76$, $SD = 4.14$). Children generated typical items more and earlier in English ($M = 7.07$, $SD = 3.86$) than in Spanish ($M = 5.25$, $SD = 4.02$). They produced more and

Table 4. Mean (*SD*) number of typical items produced by children in English and Spanish categories.

Group	Taxonomic category			Slot-filler category			
	Animals	Clothes	Food	Farm animals	Zoo animals	Winter clothes	Lunch food
Older children							
English	3.20 (1.21)	2.87 (0.83)	1.53 (0.92)	3.40 (1.30)	3.33 (0.98)	2.20 (1.08)	1.87 (1.30)
Spanish	2.47 (1.36)	1.60 (0.91)	1.33 (1.18)	2.00 (1.07)	2.47 (1.55)	1.73 (1.16)	1.40 (0.99)
Younger children							
English	2.47 (1.41)	2.47 (1.13)	1.00 (0.85)	3.93 (0.96)	3.33 (1.11)	1.67 (0.62)	1.47 (1.06)
Spanish	1.87 (1.30)	1.33 (0.90)	1.00 (1.25)	1.33 (1.11)	2.27 (1.67)	1.47 (0.74)	1.27 (1.16)

earlier typical items for the category “animals” ($M = 7.48$, $SD = 4.37$) than for “food” ($M = 4.17$, $SD = 3.53$).

An ANOVA conducted with weighted scores as the dependent variable, Condition (taxonomic and slot-filler) and Test Language (Spanish and English) as within-subject factors, and Age (older children and younger children) as a between-subject factor revealed significant main effects for Age, $F(1, 28) = 3.99$, $p = .04$, $\eta_p^2 = .01$, for Condition, $F(1, 28) = 7.04$, $p < .008$, $\eta_p^2 = .06$, and for Test Language, $F(1, 28) = 8.20$, $p = .004$, $\eta_p^2 = .05$. However, the effect size for Age was small. Older children produced typical items earlier ($M = 6.56$, $SD = 3.91$) than younger children ($M = 5.76$, $SD = 4.14$). Children generated typical items earlier in the slot-filler ($M = 7.00$, $SD = 4.15$) than the taxonomic condition ($M = 5.04$, $SD = 3.60$). A significant interaction Condition $\times$ Test Language interaction, $F(1, 56) = 5.34$, $p = .02$, $\eta_p^2 = .01$, was also noted. Children generated typical items earlier in the slot-filler condition in English ($M = 8.30$, $SD = 3.94$) than in either the taxonomic ($M = 4.64$, $SD = 4.04$) or the slot-filler ($M = 5.70$, $SD = 3.97$) conditions in Spanish.

Discussion

In Study 2, child and adult participants were matched for amount of language use. When the number of typical items was compared across children, the results revealed that the effect of test language was consistent with the results of Study 1: Children generated fewer typical items in Spanish than in English. This finding provides convergent evidence of a lesser agreement among participants on typicality of items in Spanish than in English. Another interesting finding was with respect to age: We noted that when compared on number of typical items irrespective of the order in which they were listed, older and younger children did not differ. Children in both age groups thus converged on the same set of typical items. The amount of experience in a language helps individuals reorganize their category structure by reweighing and extracting the attributes that define the category and converging on a set of items with these attributes as typical items. But when the positions of typical items were also considered, there were significant performance differences between younger and older children. Older children generated typical items earlier than younger children even after amount of language use was controlled for. This result might imply developmental differences in the ease

with which typical items are accessed by children. Similar developmental differences have been reported in monolingual children in studies analyzing reaction times required to access typical items, namely priming (Duncan & Kellas, 1978; Keller, 1982) and category-verification tasks (Jerger & Damian, 2005) for natural language categories.

General Discussion

The present study was conducted to examine the development of the typicality effect in Spanish–English bilingual children. The study aimed at exploring the influence of the amount of language use on the typicality effect in Spanish and English. We examined whether there were any age-related changes or differences in the generation of typical items in these children. For this purpose, we analyzed the number and positions of typical items the children produced during a category-generation task. In the first study, four groups of children who varied with respect to age (younger, older) and amount of language use (HEU, HSU) were compared on adult-generated typical items. In the second study, the differential influences of amount of language use, test language, and age were explored in detail by comparison of three age groups matched for amount of Spanish and English language use.

With respect to the influence of amount of language use, the results show that there is an interaction of language use with the language in which participants generate items (see Figure 1). A positive relationship was seen in English, where children in the HEU groups produced more and earlier typical items in English than in Spanish. The performance of children in the HEU groups may result from variation in the amount of exposure individuals have with a set of category-related attributes. Increased exposure helps individuals develop the ability to analyze the importance of each attribute with respect to a particular category. The patterns can also be attributed to the limited Spanish proficiency of the HEU groups, especially the younger children.

Typical items are the earliest items children add to their vocabulary repertoire. With respect to number of typical items, it was noticed in both studies that although older children generated more typical items than younger children, the differences did not reach statistical significance. The results reflect the relative importance of language use in

the development of typicality over developmentally related maturational factors. There is also evidence in the literature, as discussed earlier, that the mechanism of formation of prototypes and use of the typicality effect is a fundamental phenomenon that children experience at a very early age (Anglin, 1977). Further, with experience with category exemplars controlled for by teaching artificial categories, both children and adults have demonstrated a similar typicality effect (Posnansky & Neumann, 1976), highlighting the role of use over maturation in the development of prototypes.

The findings of the present study are also comparable to those of Malt and Sloman's (2003) study that highlighted the importance to second-language learners of duration of second-language immersion rather than age of immersion in acquiring native-like categorization. Increased language exposure and use provide greater opportunities to master category members in different contexts. Acquiring extensive experience with exemplars thus plays a crucial role in the formation of adultlike category structure and typicality. Also, increased exposure facilitates the integration of linguistic forms with implicit sociocultural interpretations that play a significant role in typicality. Our study thus emphasizes the importance of language exposure and use in acquisition of adultlike typicality effects and semantic structures.

Lexical access during category generation in bilingual people was influenced by their two languages. In Study 1, children in the HEU groups generated significantly fewer typical items in Spanish than in English, possibly an influence of their limited proficiency in Spanish. Also, those children produced typical items earlier in English than children in the HSU groups did in Spanish. A similar pattern was observed for Spanish in Study 2, where the younger children had lower proficiency in Spanish. The differences in production of typical items across the test languages cannot be completely attributed to participants' language proficiency. The difference in production frequency for the top five typical items in English and Spanish collected from 20 adults was statistically significant. This pattern shows a greater amount of agreement on the typicality of items in English than in Spanish across both children and adults. It may be that children and adults in the present study have acquired and are exposed to English in a rather uniform manner. Exposure to English at school through reading and curriculum may converge on a similar set of experiences and vocabulary. Spanish, on the other hand, is usually acquired in the home environment from parents and caregivers in the U.S. context. Spanish may be spoken by fewer speakers in children's environments. In contrast, English was likely to be used with a broader range of speakers and contexts. The experience of hearing the language spoken by few in Spanish versus many in English (Gollan, Starr, & Ferreira, 2015) may have contributed to the difference in typicality of exemplars. According to the United States Census (U.S. Census Bureau, 2010), the Hispanic population in the United States had several origins, namely Mexico, Cuba, Puerto Rico, the Dominican Republic, Spain, and Spanish-speaking Central or South American countries. Parents, who are the primary

source of Spanish input, may vary more in their educational experiences with respect to attainment, language of education, and country of education. The Spanish of the participants was also influenced by the amount of time they have spent in the United States. Examination of language-use questionnaires shows that the parents were schooled in a number of countries, consistent with the Census. These included mainly Mexico and the United States but also Cuba, Honduras, and El Salvador. There are differences in dialects affecting lexical use among these countries.

These different backgrounds might have contributed to variability in use of typical items, similar to the findings reported by Lin et al. (1990), who reported that cultural familiarity and cultural variations correlated with typicality ratings in Chinese younger and older children. Schwanenflugel and Rey (1986) have similarly claimed that typicality gradients differ when the prototypical exemplars between two cultures differ, as evidenced in Spanish and English monolingual speakers. In that study, the correlations of typicality ratings between Spanish and English speakers ranged from .16 for the category "bird" to .94 for "part of the human body." Typical items for "bird" in Spanish included *canary* and *woodpecker*, whereas *eagle* and *robin* were considered typical in English. These factors may have contributed to the subtle discrepancies in typicality among items in Spanish and resulted in the generation of fewer typical items in common across participants.

Another contrasting finding with respect to age was observed in the second study, where the positions of typical items were considered using weighted scores. Although both older and younger children (matched for language use) produced a comparable number of typical items, older children produced them earlier in the task than younger children. This result may reflect younger children's inability to use typicality as a strategy for recalling category members (Keller, 1982). It is true that typical members of the category are easily accessed and produced earlier by adults, because they have a higher resemblance to the category prototype. Because the prototype is the abstract representation of features that are considered salient for category membership, children have to differentially use the features of category members on the basis of importance for category membership. Younger children may have difficulty understanding and using this strategy to categorize members, and may not demonstrate the preferential processing of typical members that resemble the category prototype over other members. This difference in the performance of younger children compared with older children can be attributed to be a function of age.

With respect to the taxonomic and slot-filler condition, the results were different for the two measures (i.e., number and positions of typical items) in the two studies. When the number of typical items was compared across the two conditions, there was no significant difference between older and younger children. These results agree with previous findings that bilingual children start shifting from slot-filler organization to more advanced taxonomic organization at around age 6–6.5 years (Peña et al., 2002; Sheng & Lam,

2015). Both the younger (ages 7.3–8.4 years) and older (ages 8.7–9.11 years) groups of children in the present study followed patterns similar to adults, producing a comparable number of items in both conditions. However, the results with weighted scores suggest that there were significant differences between the slot-filler and taxonomic conditions: Children produced typical items earlier in the slot-filler condition. This finding may be due to the fact that slot-filler categories have narrow semantic fields, and hence accommodate only a few items in each category. Children begin to use slot-filler organization to learn and categorize items from an early age and thus may have more experience categorizing items in that condition. Taxonomic categories, on the other hand, involve larger numbers of exemplars that children have to categorize on the basis of several organizational principles. A higher number of category exemplars may mean a higher number of items that can be considered typical, resulting in less agreement among participants.

The results also revealed differences in the number and positions of typical items generated across categories. It is interesting that in both studies, the category “animals” had more typical items generated earlier, indicating greater agreement among participants. The category “food” had the smallest number of typical items generated. The differences seen across categories may result from the inherent nature of the category. For instance, knowledge about the category “animals” is acquired by individuals mainly through observation and communication from others, and less through direct interaction (Ross & Murphy, 1999). Thus, there may be little individual variation in this particular category structure. The category “food,” on the other hand, is acquired usually on the basis of interactions with the exemplars on a daily basis, and as a result can be highly variable; thus, there may be less agreement on the number of items considered typical for this category.

Limitations and Future Directions

One of the limitations of this study was that, despite matching the participants in Study 1 orthogonally for age and language use, it was not possible for us to match for other factors that may have influenced their production of typical items, such as Spanish proficiency, socioeconomic status, and age of first English exposure. However, we were able to match on these factors in Study 2 to further tease out the influence of age and test language.

To summarize, the present study revealed that amount of language use was a stronger factor than age in the development of adultlike category structures and the typicality effect in English for bilingual children. There was less agreement among participants on the typicality of items in Spanish than in English, indicating the influence of variation in cultural experiences on their Spanish. The study also revealed the nature of the typicality effect in taxonomic and slot-filler conditions and across three semantic categories. It thus emphasizes the importance of amount of language use and exposure for development of sophisticated semantic-category structures. Increased exposure to and use

of language in various contexts allows children to master adultlike organizational principles such as using the typicality of members for category membership.

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