NIH Public Access

Author Manuscript

Int J Biling Educ Biling. Author manuscript; available in PMC 2011 July 3.

Published in final edited form as:
Int J Biling Educ Biling. 2010 ; 13(3): 325–344. doi:10.1080/13670050903342019.

What You Hear and What You Say: Language Performance in Spanish English Bilinguals

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Abstract

Purpose—This study assesses the factors that contribute to Spanish and English language development in bilingual children.

Method—757 Hispanic Pre-kindergarten and kindergarten age children completed screening tests of semantic and morphosyntactic development in Spanish and English. Parents provided information about their occupation and education as well as their children's English and Spanish exposure. Data were analyzed using zero-inflated regression models (comprising a logistic regression component and a negative binomial or Poisson component) to explore factors that contributed to children initiating L1 and L2 performance and factors that contributed to building children's knowledge.

Results—Factors that were positively associated with initiating L1 and L2 performance were language input/output, free and reduced lunch, and age. Factors associated with building knowledge included age, parent education, input/output, free and reduced lunch and school district.

Conclusion—Amount of language input is important as children begin to use a language, and amount of language output is important for adding knowledge to their language. Semantic development seemed to be driven more by input while morphosyntax development relied on both input and output. Clinicians who assess bilingual children should examine children's language output in their second language to better understand their levels of performance.

Keywords

Second Language Acquisition; Language Use; Language Proficiency; Sequential Bilingualism; Bilingual Acquisition

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At school entry, children from bilingual backgrounds vary considerably in their knowledge of each of their languages. Children who have been exposed to two languages from birth may have acquired both languages, may understand but not use both languages, or may have only acquired the majority language. Early sequential bilinguals start to acquire their second language at different ages, learn their second language at different rates, and may or may not continue to acquire their first language at the same rate once they start to learn the second language. Skill in both languages provides a foundation for academic success (Oller and Eilers 2002). This study explored experiential factors that contribute to children getting started with a second language, which we refer to as gaining traction, in comparison to the factors that contribute to language growth.

Prior research has identified factors including amount of language experience (input and output), age of acquisition, education, socio-economic status, and personality variables that contribute to getting started and growing proficient in a language by adulthood (Flege *et al.* 1997; Flege *et al.* 1999; Jia *et al.* 2002; Johnson and Newport 1989; Kohnert *et al.* 1999). These different factors can help understand children's progress along a continuum of bilingual language proficiency when children begin formal schooling. Some children enter school speaking the majority language and a second language quite well. Other children begin school speaking a minority language but very little of the majority language. These children need to gain traction in the majority language fairly quickly. As children with a variety of bilingual language abilities enter the school system, a critical question is how factors such as amount of language input, amount of language use, types of language experiences, and timing of second language contact influence the initiation and development of a second language.

The goal of the current study is to explore the relationship between language experience (as quantified by parents) and language outcomes (as measured by performance on a screening test of semantic and morphosyntactic development) in a large group of children who have been exposed to English and Spanish at prekindergarten or early kindergarten, when they are just starting their formal education. We begin by reviewing studies that focus on the question of language transmission to gain insights into the factors that influence the conditions under which children gain traction in more than one language. Then we consider factors that influence growth in bilingual language acquisition. Finally we review studies that have looked specifically at the ways that language experience can be quantified.

Gaining Traction

Studies of language transmission provide insights into the conditions under which children begin to learn or gain traction in more than one language. Having bilingual parents or having two languages in the environment are not sufficient conditions for children to acquire two languages. Gathercole and Thomas (2007) interviewed 302 Welsh families about their language use with their children and other factors related to their proficiency and attitudes toward the use of Welsh. Factors that were moderately to highly associated with reporting bilingual language use at home were the parents' own language proficiency and the extent to which they used the language in a wider community. These factors suggest that for language transmission to occur, children need multiple opportunities to use the language. In a survey of 1,899 bilingual Belgian families, De Houwer (2007), found that 75% of the families reported their children were bilingual. Consistent with Gathercole and Thomas' findings, maintaining the home language was most likely if both parents spoke their non-majority language at home or if only one of the parents spoke the majority language. Results of these large survey studies suggest that input as well as output contribute to success in gaining traction in two languages.

Language growth and long-term attainment

When researchers have studied attainment in two languages they find strong associations between length of language experience and outcomes. For example, Kohnert and colleagues (Kohnert and Bates 2002; Kohnert *et al.* 1999) evaluated patterns of growth in picture naming and recognition in participants ranged in age from 5 to 21 years of age. After school experience, growth continued in the minority language (L1) even when the amount of time using that language decreased and dominance shifted to the majority language (L2). There were also differences in the time course of change in the vocabulary naming vs. comprehension. Specifically the dominance shift to L2 occurred earlier in comprehension and later in naming.

Differences in attainment have also been found for other domains. Jia, Aaronson, and Wu (2002) evaluated the relationship between first and second language attainment. Mandarin-English speaking young adults who immigrated to the United States as children completed self-ratings of proficiency across domains as well as tests of linguistic proficiency and grammaticality judgment tasks in both of their languages. Some tradeoffs were observed in the grammaticality judgment tasks. Participants who scored higher in L2 tended to score lower in L1. These findings suggest differences between patterns of growth in vocabulary and syntax. Unfortunately, the patterns are not directly comparable because the participants did not complete tasks in both domains.

In addition to amount of language exposure, other factors influenced first and second language attainment. Jia, Aaronson, and Wu (2002) found that age of acquisition was the best predictor of performance on their linguistic proficiency tasks. For English, mother and sibling knowledge of English were also significant predictors. This finding illustrates the value of breaking down language experience to better understand what experiential factors contribute to growth.

Length of exposure

One of the largest longitudinal studies of bilingual language acquisition in the US was conducted by Oller and Eilers (2002). Children were tested on a variety of oral language and literacy measures between kindergarten and 5th grade. Children who were bilingual from birth and those who first learned English in school both scored lower on measures of English at kindergarten. By the time children were in 5th grade, the gaps in performance between the bilingual children and the monolingual comparison group were small or absent. This converges with the observation that others have made that it takes up to 5 to 7 years for children to acquire the level of academic English needed for successful school success (Collier 1989; Cummins 1984). What then influences pattern of growth as young school age children move towards the acquisition of academic English?

Research suggests that amount of time spent learning a second language, as well as age of acquisition, influences language outcomes. For example, Golberg, Paradis, and Crago (2008) found that after an average of 34 months English, language learners from diverse linguistic backgrounds scored within the low average range for monolingual children on the Peabody Picture Vocabulary Test (Dunn and Dunn 1997). Within this group, children who had started to learn English after 5 years of age made relatively faster gains than children who started earlier. Changes in their first language were not tested.

In a study of the acquisition of English grammatical morphemes, Jia and Fuse (2007) focused on a group of 10 Mandarin-speaking children learning English in the US. There was a general positive correlation between length of English immersion and production of the target structures in English. Children who started to learn English at younger ages showed greater production accuracy after 5 years than children who learned English at older ages.

But, the age of first-exposure advantage was limited to the most difficult grammatical forms in English. Together, these findings suggest that the relationship between amount of language experience and language outcomes varies somewhat depending on the linguistic domain and even the specific target form measured. While vocabulary growth continues in both languages even as input shifts, tradeoffs are observed in at least some cases for grammatical outcomes. One way to disambiguate these findings is to measure vocabulary and morphosyntactic outcomes in the same children.

The Oller and Eilers (2002) study provides additional evidence of differences between initial and continued language exposure. Their study also assessed the impact of the length and amount of exposure on second language learning. The authors compared longitudinal outcomes of immersion in English compared to transitional bilingual education. While children's performance on oral language and literacy measures of English initially demonstrated an advantage for English immersion, the patterns were absent or sometimes inverted by the time children were in 5th grade. Similarly, Hammer, Lawrence, and Miccio (2007) found that Head Start children who had earlier exposure to English made greater gains in English language and reading skills than children who started learning English later. Their finding reflects the importance of cumulative exposure. At the same time changes in language and preliteracy skills did not appear to be language specific. Growth in either language had a positive impact on early reading outcomes in these children. These results highlight the importance of evaluating both of a bilingual child's languages as a mechanism for understanding developmental change overall and underscore the notion that factors beyond amount of exposure need to be systematically explored in children learning a second language.

Opportunities to use the second language also play a role in language knowledge at school entry. Rojas, Bunta, Iglesias, Goldstein, and Goldenberg (under revision) interviewed families of kindergarten children about use of Spanish and English between the child, sibling, peers and parents. Basic measures of productivity on narrative samples in English and Spanish were the outcome measure. Sibling and peer use of English predicted a greater amount of the variance of English language knowledge than did parent use in kindergarten age children.

Socio-economic status and home language use

Socioeconomic status (SES) has also been shown to impact language learning, but this factor has not been studied as widely in second language acquisition as in first language acquisition (Oller and Pearson 2002). In the analyses conducted by Golberg, Paradis, and Crago (2008) mother's educational level was associated with outcomes, but home use of English was not. Oller and Eilers (2002) found similar associations with SES independent of home language use patterns and type of school language program (English immersion vs. two-way bilingual) in which the child participated. Rojas et al (under review) found positive associations between maternal education and English language productivity measures but not Spanish language productivity measures. The role of SES merits further evaluation as a predictor in language outcomes and disambiguation in the US bilingual population. In at least some percentage of cases parental education is high relative to levels of income. About 28% of legal immigrants (and 15% of illegal immigrants) have a some college education or a college degree (Passel and Cohn 2009) even though the family income is near or below the poverty line. In some cases maternal education is higher than paternal education (Bedore *et al.* under review).

Quantifying language experience and language outcomes

Self-report questionnaires can be used to reliably quantify language history and language use (e.g., Li *et al.* 2006). For example, results of discriminant and multiple regression analysis showed that Li et al.'s web-based questionnaire successfully divides speakers into low, medium, and high proficiency levels. Parents can also reliably report on their children's language development (e.g., Dale *et al.* 1989; Thal *et al.* 1999). In the case of bilingual families parents are able to accurately report their children's language skills as well. Comparisons of parental report using Spanish and English versions of the MacArthur Bates Communication Development Inventory in which parents are asked to mark off the words that children use, show that parental report was positively correlated with the total number of items named (.72 and .78 for English and Spanish respectively) and number of different words used in a language sample (.79 and .60 for English and Spanish respectively) (Marchman and Martinez-Sussman 2002). In these studies the children are in early stages of language development but parents are also able to accurately rate their school age children's language as well. Massa, Gomes, Tartter, Wolfson, and Halperin (2008) asked parents of English learning school-age children to complete a questionnaire reflecting items that are present on the Clinical Evaluation of Language Functions (Semel *et al.* 2003). Parents' ratings were moderately but significantly correlated with their children's test performance.

Guttiérez-Clellen and Kreiter (2003) conducted a validation study of a questionnaire that focused on children's typical weekday and weekend experiences, separating input and output in each language. These values were extrapolated to generate overall percentages of input and output. Cumulative language experience was also quantified in regard to the total number of years of exposure to each. The questionnaire included parental ratings of the child's language skills in each of their languages as well as information about parental education and occupation. The researchers tested the relationship between parent ratings and language testing in one or both of a group of Spanish-English bilingual children between 7 and 8 years of age. Parent ratings correlated highly with grammaticality in narratives in Spanish (.75) and teacher ratings correlated with English grammaticality in narrative samples (.44). Input was found to be a better predictor of Spanish languages outcomes (grammaticality measures) than age of exposure. Output was not included in the analysis.

In additional work refining the above questionnaire (Peña *et al.* in preparation-b), Bedore, et al. (under review) found that parent and teacher ratings both correlated significantly with semantic and morphosyntactic development in English and/or Spanish for kindergarten age children. The children were tested in both languages if they were bilingual but only in their stronger language if they were not. For these children, parent questionnaires served to reliably quantify language experience and ability. However, a shortcoming of these studies is that language testing was not consistently conducted in both languages. This limits the ability to study and directly compare outcomes of both languages.

Questions

Many factors potentially contribute to dual language knowledge at school entry. At present, it is not possible to determine from the literature whether factors that contribute to children getting a start in a second language are the same factors that contribute to further progress in the second language. In the current study we address two questions. (1) What factors are most highly associated with initial learning of a second language (i.e., obtaining a score of zero versus a score of one or more on a language screening test)? (2) What factors are most highly associated with higher scores in Spanish and English semantics and morphosyntax?

The answers to these questions will advance our understanding of early bilingual development in several ways. First, in our quantification of language experience we separate age of first exposure from current input and output. The separation of input and output may seem counterintuitive, as these are likely to be related. However, the work of Gathercole and Thomas (2007) indicates that using language in a community and amount of language practice are both needed to refine language knowledge. Another way in which this study will advance our understanding is that children's knowledge of both languages was assessed in two domains (semantics and morphosyntax). One criticism of the literature on language transmission is that what is meant by, "knowing a language" (e.g., De Houwer 2007) is rarely specified in terms of semantic or grammatical knowledge. By administering a semantic and morphosyntactic tasks in L1 and L2 we are able to assess language knowledge in two domains, regardless of the presumed level of knowledge indicated on the parent interview. Furthermore, it is not clear that gains in semantic and morphosyntactic knowledge are made at the same rate or in the same order (e.g., Golberg et al, 2008; Jia and Fuse, 2007). By evaluating these linguistic domains separately we can start to differentiate semantic and grammatical language growth and understand how language experiences influence them. Overall, the study questions address whether there may be two different processes underlying language acquisition each of which may have different factors associated with that process.

Method

Participants

All Latino children who entered kindergarten in two Central Texas schools districts or a Northern Utah district who spoke Spanish, English or both were invited to participate. The districts were selected for participation because they serve a large proportion of Hispanic children. These three districts represent a typical range of educational placements commonly available to bilingual children in the U.S. The central Texas districts (referred to as Texas A and B) have a range of ESL and bilingual classrooms in which children systematically transition toward greater use of English with the majority of children being enrolled in all English classes by second or third grade. In the Utah district (referred to here as Utah C) children receive all of their education in English from the time of school entry. Support for English language learning is offered by several bilingual classroom aids and English as a second language classes. The districts also serve a representative sample of children. One of the central Texas districts (Texas A) has a long history of serving bilingual children while the other district (Texas B) has experienced a more rapid and recent increase of English language learners in their population. Both of these districts serve first generation immigrants as well as families who have been in the area for one or more generations. The Utah district serves a larger proportion of recent immigrant families than does either of the Texas districts.

Of the 904 students who participated in the three districts, 147 students (16.3%) were excluded from this study due to incomplete parent questionnaire data (93; 10.3%), missing race or ethnicity identifiers (2; .2%), or having non-Hispanic ethnicity (52; 5.8%). Of the 757 Latino children included in this study, there were 300 (40.0%) from Texas A, 276 (36.5%) from Texas B, and 181 (23.9%) from Utah C. Table 1 shows the cross-tabulations and chi-square test results for the student and parent demographic statistics.

Measures

Participants' parents completed an interview by phone or in person. The interview included questions about years of monolingual and bilingual exposure as well as a detailed breakdown of daily input and output in English and Spanish for every hour of a typical weekday and typical weekend days. It also included questions about the parents' education and occupation and the child's free or reduced lunch status. Data on free and reduced lunch status is included as the primary indicator of socio economic status. In U.S. schools children qualify for free or reduced lunch status if their family is at or below the federal guideline for poverty status based on family size (USDA, http://www.fns.usda.gov/cnd/Lunch/ retrieved 5/12/09). The questionnaire was based on interview questions from Gutiérrez-Clellen and Kreiter (2003) and Restrepo (1998). All interviews were conducted by bilingual examiners.

Hour by hour indications of input and output in each language was averaged across weekdays and weekend days to obtain weekly percentages of language output and language input in both languages. Percentage of language output was used to classify the children into functionally monolingual groups and bilingual groups (see Table 1). Language output was considered to be the most functional measure of exposure for initial grouping of the children as it provides general index of their overall exposure (i.e., exposure over time as well as input and output at the time of interview); and has been shown to correlate significantly with grammatical productivity in the target language (Gutiérrez-Clellen and Kreiter 2003). Thus, our determination of language group (functional monolingual vs. bilingual) was based on the child's current level of use in each language.

Children completed the Bilingual English Spanish Oral Language Screener (BESOS, Peña *et al.* in preparation-a). The BESOS consists of 2 subtests (semantics and morphosyntax) in each language (Spanish and English). The semantics items focused on semantic knowledge (e.g., tell me all the foods you can eat for lunch; show me the dog that is different). Responses were permitted in either language. The morphosyntax tests included cloze and sentence repetition items that target forms that are challenging in each language such as past tense –ed in English and articles and clitics in Spanish. The BESOS screening items were drawn from the experimental item pool of the Bilingual English Spanish Assessment (BESA) (Peña *et al.* in preparation-b). The BESA is primarily intended as an assessment instrument for bilingual children who are at risk for language impairments. Items for the BESOS are sensitive to language development (in addition to being difficult for children with language impairment) Validity analyses based on the normative sample from the BESA, indicated significant correlations between the scores on the full BESA subtests and the screener subtests: Spanish semantics, $r(172) = .855$, $p < .001$; English semantics, $r(185) = .887$, $p < .001$; Spanish morphosyntax, $r(140) = .826$, $p < .001$ and English $r(127) = .893$, $p < .001$. Reliability analysis was conducted using a test-retest approach. In a pilot test, the BESA and BESOS were independently administered to 20 preschool and kindergarten Spanish-English speaking children. Results indicated significant positive correlations between corresponding subtests: Spanish semantics subtest, $r(19) = .696$, $p < .001$; English semantics, $r(19) = .639$, $p < .001$; Spanish morphosyntax $r(19) = .858$, $p < .001$ and English morphosyntax, $r = .754$, $p < .001$.

For the BESOS, a ceiling of five no-responses was utilized to minimize frustration over testing in a language in which a child had minimal competence. Bilingual testers (certified speech language pathologists and speech language pathology students) completed and scored all testing. Administration of all four sub-sections of the BESOS took approximately 20 minutes for each child.

Initial descriptive analyses were conducted to understand the distribution of scores in both languages in both domains. Table 2 shows the mean, standard deviation and percentage of zero scores for each screening scale. The percentage of zeros and means for each scale provided an important insight into two potential underlying processes related to language acquisition: establishing the initial ability that provides traction in a language and building on that foothold through greater mastery of the key language elements. Table 2 shows that Spanish morphosyntax and semantics had higher percentages of zeros than English morphosyntax and semantics. The morphosyntax scores in both languages had

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approximately 10% more zeros than the corresponding semantics scores for each language. Note that we report raw scores for each scale. Because each scale has slightly different numbers of items, means cannot be directly compared. Our analysis utilizes offset variables to calculate rate of correct response.

Results

Statistical Analysis

The data used for analyses were the screening test scores and the language output and input percentages that were derived from parent questionnaires. Based on the initial review of the outcome distributions, zero-inflated Poisson (ZIP) or zero-inflated negative binomial (ZINB) regression analysis were chosen to test whether there was a relationship between language screening score and language experience, adjusting for age, gender, free lunch status, site, and parent education. Both models jointly estimate predicting zero correct versus one or more correct (to evaluate whether or not the children have gained traction in a particular language) and then the number correct (to evaluate how much knowledge children have gained in each domain in each language) (Long 1997). In particular, estimation of zero-correct versus one or more correct captures an important distinction we identify as gaining traction in a language, which can also be viewed as crossing a threshold of language comprehension. Once traction has been gained (scoring at least one correct), then the second component of the model examines improvement in language utilization. The first research questions will identify factors relating to gaining enough traction to cross the threshold of initial semantic and morphosyntax usage, while the second research question examines factors that influence language development after crossing the initial performance threshold. The ZINB model adds an additional parameter to account for additional variation (overdispersion) in scores due to between student variability in scores (Long 1997). A statistical test of the additional overdispersion parameter determined the choice of the ZIP versus ZINB models.

The regression coefficient parameter estimates in each model were exponentiated to aid in interpretation (Long 1997). For the logistic regression component of the models, these exponentiated regression coefficients represent odds ratio. Odds ratios greater than one indicate a positive relationship between a one unit increase in the predictor and a corresponding *increase* in the conditional odds of having a zero response. Odds ratios less than one indicate a negative relationship between a one unit increase in the predictor and a corresponding *decrease* in the conditional odds of having a zero response. For example, an odds ratio of 1.25 indicates that a one percentage increase in language input increases the odds of having at least one correct response on the Spanish semantics subtest by 1.25.

For the Poisson or Negative Binomial component of the model, the exponentiated regression coefficients represent incidence rate ratios (IRR). The exponentiated value is the change in ratios of correct response rates per one unit increase. The unexponentiated coefficients represent the difference between the logs of expected counts given a unit increase in the predictor. A positive IRR shows the increase in rate in correct responses for a one unit increase in the predictor. A negative IRR shows the decrease in rate of correct responses for a one unit increase in the predictor. The coefficients are also adjusted for all of the other predictors in the models and are identified as adjusted odds ratios (AOR) and adjusted incidence rate ratios (AIRR).

There were 130 of 757 students who would have been eliminated from the analysis due to missing data on one of the predictors. To avoid the potential selection bias, missing data were estimated using multiple imputation using Proc MI in SAS® 9.1.3SP4. Multiple imputation assumes data were missing at random which assumes the missing mechanism is accounted for by the covariates included in the model. Fifty imputations of the missing values were generated based on all predictors in the model using the Markov Chain Monte Carlo method that assumes arbitrary missing patterns. A larger number of imputations was chosen than originally recommended by Rubin (1987) due to the increased power to detect smaller effects (Graham *et al.* 2007).

Predicting Zero Correct

Spanish assessment scales—Table 3 shows the results from the model predicting Spanish morphosyntax and semantics zero correct versus one or more correct. For Spanish morphosyntax, the logistic regression component of the ZINB model identified being female (AOR=.49) and receiving free (AOR=.43) or reduced lunch (AOR=.32) as being significantly negatively related to the conditional odds of having a zero score. In addition, 20% increases in Spanish language output (AOR=.25) and input (AOR=.56) were also negatively related to having a zero score. The negative relationships indicate that each unit increase resulted in a reduced conditional probability of having a zero score.

For Spanish semantics, the ZIP model logistic regression results showed that receiving free (AOR=.41) or reduced lunch (AOR=.24) were negatively related to the conditional odds of having a zero score to a statistically significant degree. In addition, 20% increases in Spanish language output (AOR=.35) and input (AOR=.67) were also negatively related to having a zero score. The negative relationships indicate that each unit increase resulted in a reduced conditional probability of having a zero correct responses.

English assessment scales—For English morphosyntax, the logistic regression component of the ZINB model showed that increased age in months (AOR=.42) and a 20% increase in English language output (AOR=.49) were negatively related to the conditional probability of having a zero score (see Table 3). The negative relationships indicate that each unit increase resulted in a reduced conditional probability of having a zero score.

For English semantics, the ZIP model logistic regression results showed that receiving free lunch (AOR=.48), mother having a high school degree (AOR=.48), older age in months (AOR=.37) and a 20% increase in English language output (AOR=.47) were negatively related to having a zero score. The negative relationships indicate that each unit increase resulted in a reduced conditional probability of having no correct responses.

Predicting Mean Correct

Tests for overdispersion—The test for overdispersion was statistically non-significant for Spanish semantics but was statistically significant for Spanish morphosyntax (Alpha =1.11, $p < .001$). As a result, the ZIP model was used for semantics and the ZINB model was used for morphosyntax. The same pattern of results was obtained for the English subtests. The test for overdispersion was statistically non-significant for English semantics and was statistically significant for English morphosyntax (Alpha =1.21, $p < .001$). As a result, the ZIP model was used for semantics and the ZINB model was used for morphosyntax. The results indicate that morphosyntax responses showed greater individual variability (overdispersion) than expected by the Poisson distribution while the semantics scores did follow the Poisson distribution. Table 4 shows the results from the model predicting English morphosyntax and semantics scores.

Spanish assessment scales—Table 4 shows the results for each language (Spanish and English) and domain (morphosyntax and semantics). The ZINB negative binomial model for Spanish morphosyntax indicated that being in the Texas B (AOR=1.1) or Utah C (AIRR=1.18) subgroups and being female (AIRR=1.13) were positively related to having a higher mean number of correct responses to a statistically significant degree. In addition, 20% increases in Spanish language output (AIRR=1.15) and age (AIRR=1.14) were also positively related to higher correct responses. For Spanish semantics the ZIP Poisson regression component showed that being in the in Utah C district (AIRR=1.14), receiving free lunch (AIRR=1.11), and 20% increases in Spanish language output (AIRR=1.1) and input (AIRR=1.08) were also positively related to a higher number of correct responses to a statistically significant degree.

English assessment scales—The ZINB negative binomial model for English morphosyntax showed 20% increases in English language output (AIRR=1.15), and language input (AIRR=1.07) and older age in months (AIRR=1.48) were also positively related to higher correct responses. The ZIP Poisson regression component for English semantics showed that being in the Utah C district (AIRR=1.14), receiving free lunch (AIRR=1.11), and 20% increases in English language output (AIRR=1.1 and input (AIRR=1.08) had a significant positive relationship to higher number of correct responses.

Discussion

To better understand variability in language skills of bilingual children at school entry, we explored the language experience factors that were associated with scores on Spanish and English semantics and morphosyntax screening tests. Factors associated with a zero versus nonzero score were evaluated to understand what contributes to gaining traction in two languages. Total scores were evaluated to determine which factors contributed to growth in language knowledge in L1 or L2. Some factors contributed to gaining traction as well as to gaining knowledge. Most of the factors studied were more highly associated with either gaining traction or continued growth or they contributed to growth in one language but not the other language. In general, experience factors were differentially related to getting started or to making continued progress in one language or domain.

Gaining Traction in a Language

The factors most related to gaining traction in either Spanish or English were the amount of language experience as measured by a 20% increase in input or output in each language. For English, scoring above zero on the screening measures was additionally related to age. Amount of experience has been well documented as a predictor of language performance in bilinguals (e.g., Golberg *et al.* 2008; Jia *et al.* 2002; Kohnert and Bates 2002; Paradis *et al.* 2008). The unique finding here is that language *output* was important for both languages and for performance in both semantic and morphosyntax domains. *Input* was a significant predictor for Spanish semantics and morphosyntax but not for English semantics or morphosyntax in this part of the analysis. This finding partially converges with past findings. In some studies only one variable has been selected for evaluation because they are similar (e.g., Gutiérrez-Clellen and Kreiter, 200) while in other studies, the role of input was subsumed by output (e.g., Rojas et al., under review). In the current data set, input and output have independent contributions to variance in our dependent measures. One possibility is that using a language (i.e., output) forces the learner to process the language in a way that only hearing it (i.e., input) does not.

In evaluating the children's year-by-year language histories (Table 1), it appeared that children fell into two main groups: those who had Spanish and English input from birth and those who had Spanish input only until preschool age. For this second group, English input corresponded with onset of schooling (at age 3, 4, or 5). It may be that this second group of children did not yet have sufficient cumulative experience in using English, which affected their ability to respond correctly to English testing.

Age was also an important factor in predicting non-zero scores in English. Older children were less likely to score a zero in English. In contrast, age was not related to this aspect of Spanish performance. In the US, many bilingual children are early sequential bilinguals who acquire English via their school experiences, usually starting at preschool or kindergarten. This pattern holds for many of the children who participated in this study. The older children were the most likely to have started to gain traction in English. Indeed, examination of Table 1 indicates that sequential bilinguals had their first contact with English at age 3 or 4, indicating that the older children had the longest accumulated exposure to English.

For our Spanish measures, socio-economic status (indexed by receiving free or reduced lunch) was an additional predictive factor for the zero/nonzero score analysis. Eligibility for free or reduced school lunch was related to scoring above zero in Spanish. SES has not been consistently or systematically explored as a variable in second language outcomes. It has been implicated as a factor in first language development and is often treated as a risk factor. That is not necessarily the case here as lower SES was significantly related to scoring above zero on the Spanish subtests, which was a better outcome. In this study, the SES-related variable might be tied to immigration and level of acculturation to mainstream American culture. Specifically, children who were eligible for free or reduced lunch may have been more likely to represent families who were more recent immigrants to the US, and thus, more likely to use Spanish at home. First generation immigrants are most likely to be dominant in their language of origin, as are their children (Brodie *et al.* 2002; Suro and Passel 2003). Parents who are educated in their home country may have less earning power as new immigrants (Passel and Cohn 2009). Thus, children of first generation immigrants who speak their native language may be concentrated in the free and reduced lunch category. A finding from one of our questionnaire validation studies was that approximately 85% of the parents of the Spanish dominant children were educated in their country of origin (Bedore *et al.* under review). The current results are consistent with De Houwer (2007) who found that children of first generation immigrants are highly likely to learn the minority language if both parents speak it. First generation immigrants are more likely to marry within their immigrant (and language) group (Suro and Passel 2003) thus increasing the likelihood both parents will speak the native language at home.

Adding to Language Knowledge

Once children gain traction in their first and second languages, different factors may influence their ability to add knowledge in each language. Our results indicated that higher scores in Spanish were associated with location. Specifically, children in Texas B and Utah C received higher scores on both semantics and morphosyntax in Spanish than children in Texas A. This may be a reflection of age and the timing of first and second language learning. Children in the Texas A schools were somewhat younger than children in the other two groups, and a larger proportion of them had been exposed to both English and Spanish from a younger age. It makes sense that children with more experience using Spanish would score higher on the Spanish language development measures.

The only location difference for English was on the semantics measure. The children in the Texas B group were more likely to score higher on the English semantics subscale than children in the Texas A group. First age of English and Spanish contact was comparable for these two groups, but the children in Texas A were slightly younger. Also, fewer children from Texas B group qualified for fee lunch compared to those from the Texas A group. Finally, while mother level of education was comparable for the two districts, more fathers from Texas B had completed high school. Together, increased age, SES, and father education was associated with higher performance on the English semantics measure.

An interesting contrast is that there were no site differences for proportion of zero scores, which examined factors related to starting to learn a language. The site differences were relevant for level of mastery in each of the languages. We believe that the site differences reflect a combination of amount of cumulative exposure to each language, age at time of testing, and factors related to SES. The SES findings are similar to those reported for first language acquisition (Hart and Riseley 1995; Hoff and Tian 2005) as well as those found in second language acquisition (Oller and Eilers 2002). The notion that cumulative exposure is related to language learning is also consistent with findings in first language learning (Hoff and Naigles 2002).

The differences in factors related to English semantics may be further related to cumulative exposure. The Texas B children were older (similar to Utah C) and more of them had exposure to both languages from a younger age (similar to Texas A). We propose that the combination of their age and longer exposure to English allowed them to score higher on the English semantics subscale in comparison to the children in Texas A. Morphosyntax however seems to require both input and output. It may be that Texas B children's cumulative input allowed them to make gains in semantics in a second language, but that they needed additional exposure before showing the same advantage in morphosyntax. Indeed, these patterns have been well documented in first language acquisition in which children need to first develop a basis in word knowledge before using word combinations productively (Bates *et al.* 1991; Caselli *et al.* 1999; Marchman and Bates 1994; Marchman *et al.* 2004).

Consistent with the zero analysis, we found that output in each language was related to higher scores on the screening measures. The relationships between language input and language scores were more complex. Spanish input did not significantly correlate with Spanish morphosyntax and English input did not significantly correlate with English semantics. However, there was a significant correlation between English input and English morphosyntax scores. After starting to learn a second language, children need to use the language in order to add knowledge in that language. The importance of access to the new language through exposure depends on the language and the domain being measured. Recall that most children had Spanish exposure from birth. Since they already used Spanish grammatical morphemes productively, the amount of input may not have been as important for adding to language knowledge. In this case, output appears to have been the most important factor for maintaining the proficiency of the language skills the children had. Similarly, they may have achieved sufficient semantic knowledge to gain traction in English. If this was the case, English input may not be as important for semantics as it is for morphosyntax. But at this stage in English language morphosyntactic learning, children seem to require both exposure and practice.

Recall that in the zero analysis, mother education was related only to initial knowledge of English semantics. Mother educational level was related to higher scores in both English semantics and morphosyntax. Mothers with higher education were more likely to be educated in the US and had more access to schooling in English. Indeed, Bedore, et al (under review) found that parents of English dominant children had higher educational levels (approximately 30% with at least some college education) in comparison to parents of children who presented as balanced bilinguals (some college education 19% paternal, 24% maternal) and parents of children who were Spanish dominant (some college education 6.5% paternal, 13% maternal). Higher language achievement has also been correlated to parent educational level (Craig *et al.* 2005; Golberg *et al.* 2008; Hart and Riseley 1995).

Conclusion

In this study, we identified factors related to establishing initial performance in language when children were learning language in a bilingual environment. We also identified factors related to adding to linguistic knowledge in English and Spanish. In general, our results point to the importance of input as children begin to use a language and the importance of output as they add knowledge to their language. The language domain measured however was also differentially related to input and output in each language. Initial performance on semantics depended on input more heavily than output. Morphosyntax relied on both input and output, pointing to the role of practice in learning to use inflectional morphology in a productive manner.

Bilingual children learn two languages within particular environments. What they learn and how well they know it by school entry depends on the amount of language input and the amount of language output for each language. It appears that language input and output may be differentially important as children progress in their acquisition of semantics and syntax in both of their languages. Through careful documentation of initial exposure to both languages, of environmental factors, and of weekly patterns of input and output in each language we can better understand the process through which early bilingualism unfolds. Further work in this area needs to be conducted in order to understand the relationship between initial traction in two languages and later attainments in bilingual language acquisition.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

Bates, E.; Bretherton, I.; Snyder, L. From first words to grammar: Individual differences and dissociable mechanisms. Cambridge: Cambridge University Press; 1991.

Bedore LM, Peña E, Macken C, Kaufman D. Parent and teacher rating of bilingual language Proficiency and language development concerns: Accurate interpretations from different observations. under review.

Brodie, M.; Steffenson, A.; Vasquez, J.; Levin, R.; Suro, R. 2002 National Survey of Latinos. Menlo Park, CA: Henry J. Kaiser Family Foundation and Pew Hispanic Trust; 2002.

Caselli MC, Casadio P, Bates E. A comparison of the transition from first words to gramar in English and Italian. Journal of Child Language. 1999; 26:69–112. [PubMed: 10217890]

Collier VP. How long? A synthesis of research on academic achievement in a second language. TESOL Quarterly. 1989; 23:509–31.

Craig HK, Washington JA, Thompson CA. Oral language expectations for African American children in grades 1 through 5. American Journal of Speech-Language Pathology. 2005; 14:119–30. [PubMed: 15989387]

Cummins, J. Bilingualism and special education: Issues in assessment and pedagogy. Austin, TX: PRO-ED; 1984.

Dale P, Bates E, Reznick JS, Morisset C. The validity of a parent report instrument of child language at twenty months. Journal of Child Language. 1989; 16:239–49. [PubMed: 2760125]

De Houwer A. Parental language input patterns and children's bilingual use. Applied Psycholinguistics. 2007; 28:411–24.

Dunn, LM.; Dunn, LM. Peabody Picture Vocabulary Test. 3. Circle Pines, MN: American Guidance Service; 1997.

Flege JE, Frieda EM, Nozawa T. Amount of native language (L1) use affects the pronunciation of an L2. Journal of Phonetics. 1997; 25:169–86.

Flege JE, Yeni-Komishian G, Liu S. Age constraints on second language acquisition. Journal of Memory and Language. 1999; 41:78–104.

Gathercole, V.; Thomas, EM. Language Transmission in Bilingual Families in Wales. Bangor: University of Wales; 2007. Factors contributing to language transmission in bilingual families: The core study - adult interviews; p. 59-182.

Golberg H, Paradis J, Crago M. Lexical acquisition over time in minority rst language children learning English as a second language. Applied Psycholinguistics. 2008; 29:41–65.

Graham JW, Olchoswski AE, Gilreath TD. How many imputations are really needed? Some practical clarifications of multiple imputation theory. Prevention Science. 2007; 8:206–13. [PubMed: 17549635]

Gutiérrez-Clellen VF, Kreiter J. Understanding child bilingual acquisition using parent and teacher reports. Applied Psycholinguistics. 2003; 24:267–88.

Hammer CS, Lawrence F, Miccio A. Bilingual children’s language abilities and early reading outcomes in Head Start and Kindergarten. Language, Speech, and Hearing Services in Schools. 2007; 38:327–248.

Hart, B.; Riseley, T. Meaningful differences in the everyday experience of young American children. Baltimore: Brookes; 1995.

Hoff E, Naigles L. How children use input to acquire a lexicon. Child Development. 2002; 73:418–33. [PubMed: 11949900]

Hoff E, Tian C. Socioeconomic status and cultural influences on language. Journal of Communication Disorders. 2005; 38:271–78. [PubMed: 15862810]

Jia G, Aaronson D, Wu YH. Long-term language attainment of bilingual immigrants: Predictive factors and language group differences. Applied Psycholinguistics. 2002; 23:599–621.

Jia G, Fuse A. Acquisition of English grammatical morphology by native Mandarin-speaking children and adolescents: age-related differences. Journal of Speech, Langauge, and Hearing Research. 2007; 50:1280–99.

Johnson JS, Newport E. Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. Cognitive Psychology. 1989; 21:60–99. [PubMed: 2920538]

Kohnert K, Bates E. Balancing bilinguals II: Lexical compehension and cogitive processing in children learning Spanish and English. Journal of Speech, Language, and Hearing Research. 2002; 45:347–59.

Kohnert K, Bates E, Hernandez A. Balancing bilinguals: Lexical-semantic production and cognitive processing in children learing Spanish and English. Journal of Speech, Language, and Hearing Research. 1999; 42:1400–13.

Li P, Sepanski S, Zhao X. Language history questionnaire: A Web-based interface for bilingual research. Behavior Research Methods. 2006; 38:202–10. [PubMed: 16956095]

Long, SJ. Regression Models for Categorical and Limited Dependent Variables. Thousand Oaks, CA: Sage; 1997.

Marchman VA, Bates E. Continuity in lexical and morphological development: A test of the critical mass hypothesis. Journal of Child Language. 1994; 21:339–66. [PubMed: 7929685]

Marchman VA, Martinez-Sussman C. Concurrent validity of caregivier/parent report measures of language for children who are learning both English and Spanish. Journal of Speech, Langauge and Hearing Research. 2002; 45:983–97.

Marchman VA, Martinez-Sussmann C, Dale PS. The language-specific nature of grammatical development: Evidence from bilingual language learners. Developmental Science. 2004; 7:212–24. [PubMed: 15320381]

Massa J, Gomes H, Tartter V, Wolfson V, Halperin JM. Concordance rates between parent and teacher clinical evaluation of Language Fundamentals Observational Rating Scale. International Journal of Language & Communication Disorders. 2008; 43:99–110. [PubMed: 17852530]

Oller, DK.; Eilers, RE., editors. Language and literacy in bilingual children. Buffalo, NY: Multilingual Matters; 2002.

Oller, DK.; Pearson, BZ. Language and Literacy in Bilingual Children. Clevedon: Multilingual Matters; 2002. Assessing the effects of bilingualism: A background; p. 3-21.

Paradis J, Rice ML, Crago M, Marquis J. The acquisition of tense in English: Distinguishing child second language from first language and specific language impairment. Applied Psycholinguistics. 2008; 29:689–722. [PubMed: 18852844]

Passel, J.; Cohn, D. A Portrait of Unauthorized Immigrants in the United States. Washington D.C: Pew Hispanic Center; 2009.

Peña, ED.; Bedore, LM.; Gutiérrez-Clellen, VF.; Iglesias, A.; Goldstein, BA. Bilingual English Spanish Oral Screener (BESOS). in preparation-a

Peña, ED.; Gutiérrez-Clellen, VF.; Iglesias, A.; Goldstein, BA.; Bedore, LM. Bilingual English Spanish Assessment (BESA). in preparation-b

Restrepo MA. Identifiers of predominantly Spanish-speaking children with language impairment. Journal of Speech, Language, & Hearing Research. 1998; 41:1398–411.

Rojas, R.; Bunta, F.; Iglesias, A.; Goldstein, BA.; Goldenberg, C. Interlocutor Differential Effects on Bilingual Children's Oral Language. under revision

Rubin, DB. Multiple Imputation for Nonresponse in Surveys. New York: J. Wiley & Sons; 1987.

Semel, E.; Wiig, EH.; Secord, WA. Clinical Evaluation of Language Fundamentals®. 4. San Antonio: Harcourt; 2003.

Suro, R.; Passel, J. The rise of the second generation: Changing patterns in Hispanic population growth. Washington D.C: Pew Hispanic Center; 2003.

Thal DJ, O'hanlon L, Clemmons M, Fralin L. Validity of a parent report measure of vocabulary and syntax for preschool children with language impairment. Journal of Speech Language & Hearing Research. 1999; 42:482–96.

Table 1

Participant and parent characteristics by school district

	Texas-A (n=300)	Texas-B (n=276)	Utah-C (n=181)
Age group		**$X^2(4)=105.3$, p<.001**	
Age <= 59	26.4%	21.7%	1.7%
60 <= Age <= 66	51.7%	57.6%	40.6%
67 <= Age	22.0%	20.7%	57.8%
Father Education		**$X^2(2)=76.6$, p<.001**	
Less than HS	45.2%	36.8%	77.6%
HS Graduate	32.9%	38.5%	21.8%
Some college or more	21.9%	24.7%	0.6%
Mother Education		**$X^2(2)=46.7$, p<.001**	
Less than HS	42.1%	43.9%	70.7%
HS Graduate	36.1%	30.5%	21.8%
Some college or more	21.7%	25.7%	7.5%
Gender		**$X^2(2)=8.0$, p<.05**	
Female	51.0%	43.6%	56.9%
Male	49.0%	56.4%	43.1%
Language Group *		**$X^2(4)=67.7$, p<.001**	
BL	37.3%	41.7%	72.8%
FME	36.0%	27.2%	12.2%
FMS	26.7%	31.2%	15.0%
Free or reduced lunch		**$X^2(4)=116.3$ p<.001**	
Free	69.3%	52.1%	100%
Reduced	13.9%	25.6%	0%
Regular	16.8%	22.3%	0%
Missing data status		**$X^2(2)=9.6$, p<.01**	
0 Missing data	90.2%	93.7%	85.1%
1+ Missing data	9.8%	6.3%	14.9%
Year First English Experience	**$X^2(10)=42.9$, p<.001**		
0	61.0%	51.2%	45.9%
1	1.1%	1.2%	1.9%
2	1.1%	3.3%	6.4%
3	7.3%	9.9%	19.1%

	Texas-A (n=300)	Texas-B (n=276)	Utah-C (n=181)
4	24.5%	28.5%	14.7%
5	5.1%	5.8%	12.1%
Year First Spanish Experience	**$X^2(8)=9.79$, p = .29**		
0	91.4%	92.7%	97.7%
1	0.9%	2.2%	0.6%
2	1.8%	1.3%	0.6%
3	4.1%	2.6%	0.6%
4	1.8%	1.3%	0.6%

*Based on language output data. Bilingual children (BL) have 20–80% output in each language; Functionally monolingual English (FME) children have 80–100% English output and 0–20% output in Spanish. Functionally monolingual Spanish (FMS) children have 80–100% Spanish output and 0–20% output in English.

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Table 2

N, Mean, standard deviation and percentage zeros for BESA scores

Total Correct Scores (different item sets used for 4 and 5-yo)	N	Mean Correct	SD	Number of Items	Percent Zero
English morphosyntax	757	5.17	4.73	17	27%
English semantics	757	4.86	2.97	10, 11[1]	18%
Spanish morphosyntax	755	6.73	5.51	16	22%
Spanish semantics	748	5.62	3.70	12	11%

Note:

[1] = BESOS 4 year olds are administered a total of 10 items, 5 year olds respond to 11 items, there are 6 items in common.

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Table 3

Predicting binary zero non-zero language outcomes for English and Spanish Morphosyntax and semantics outcomes

	Morphosyntax				Semantics			
Parameter	**Odds Ratio**	**Lower 95% CI**	**Upper 95% CI**	**P-value**	**Odds Ratio**	**Lower 95% CI**	**Upper 95% CI**	**P-value**
Spanish Language Outcomes								
Texas B (vs. Texas A)	.63	.33	1.18	.148	1.03	.61	1.72	.922
Ogden (vs. Texas A)	.62	.27	1.42	.258	.98	.45	2.15	.959
Female	**.49**	**.28**	**.85**	**.012**	.95	.60	1.52	.842
Free Lunch (vs. Regular)	**.43**	**.20**	**.90**	**.025**	**.41**	**.21**	**.81**	**.010**
Reduced Lunch (vs. Regular)	**.32**	**.12**	**.85**	**.022**	**.24**	**.11**	**.55**	**.001**
Father HS (vs. no HS)	1.20	.58	2.48	.620	1.16	.60	2.24	.654
Father College (vs. no HS)	1.03	.42	2.52	.954	1.38	.68	2.80	.370
Mother HS (vs. no HS)	1.57	.75	3.27	.226	1.69	.87	3.29	.123
Mother College (vs. no HS)	1.52	.66	3.49	.328	1.33	.63	2.79	.456
Age in months (12 months increase)	.77	.38	1.55	.458	1.29	.70	2.38	.421
Spanish language output (20% increase)	**.25**	**.18**	**.35**	**<.001**	**.35**	**.24**	**.51**	**<.001**
Spanish language input (20% increase)	**.56**	**.42**	**.75**	**<.001**	**.67**	**.50**	**.89**	**.006**
English Language Outcomes								
Texas B (vs. Texas A)	.75	.45	1.25	.276	1.04	.57	1.90	.892
Utah C (vs. Texas A)	.93	.48	1.79	.828	1.36	.59	3.16	.469
Female	.78	.50	1.22	.274	.77	.45	1.32	.347
Free Lunch (vs. Regular)	.69	.37	1.29	.245	**.48**	**.23**	**.97**	**.042**
Reduced Lunch (vs. Regular)	.43	.18	1.02	.055	.44	.17	1.14	.090
Father HS (vs. no HS)	1.56	.87	2.79	.137	1.84	.91	3.71	.088
Father College (vs. no HS)	1.02	.42	2.52	.960	.68	.18	2.58	.569
Mother HS (vs. no HS)	.58	.33	1.04	.066	**.48**	**.24**	**.99**	**.046**
Mother College (vs. no HS)	.43	.17	1.06	.067	.24	.05	1.05	.059
Age in Months (12 months increase)	**.42**	**.21**	**.81**	**.010**	**.37**	**.17**	**.84**	**.017**
English language output (20% increase)	**.49**	**.37**	**.64**	**<.001**	**.47**	**.33**	**.67**	**<.001**
English language input (20% increase)	.81	.62	1.07	.137	.71	.49	1.01	.059

Note: Odds ratios greater than one indicate a positive relationship between a one unit increase in the predictor and a corresponding increase in the conditional odds of having a zero response. Odds ratios less than one indicate a negative relationship between a one unit increase in the predictor and a corresponding decrease in the conditional odds of having a zero response. All Odds ratios are adjusted for the other predictors in the model.

Table 4

Predicting mean correct language outcomes for English and Spanish Morphosyntax and semantics

	Morphosyntax				Semantics			
Parameter	**IRR**	**Lower 95% CI**	**Upper 95% CI**	**P-value**	**IRR**	**Lower 95% CI**	**Upper 95% CI**	**P-value**
Spanish Language Outcomes								
Texas B (vs. Texas A)	**1.10**	**1.00**	**1.21**	**.042**	.97	.90	1.04	.397
Utah C (vs. Texas A)	**1.18**	**1.06**	**1.32**	**.003**	**1.14**	**1.04**	**1.24**	**.004**
Female	**1.13**	**1.05**	**1.22**	**.002**	1.05	.99	1.11	.108
Free Lunch (vs. Regular)	1.04	.92	1.17	.511	**1.11**	**1.01**	**1.22**	**.027**
Reduced Lunch (vs. Regular)	.92	.79	1.06	.252	1.08	.96	1.21	.208
Father HS (vs. no HS)	.95	.86	1.05	.292	1.00	.92	1.09	.982
Father College (vs. no HS)	.92	.79	1.08	.317	.99	.88	1.12	.870
Mother HS (vs. no HS)	.98	.89	1.07	.609	.97	.90	1.05	.475
Mother College (vs. no HS)	.88	.76	1.02	.079	.97	.87	1.09	.596
Age in months (12 months increase)	**1.14**	**1.02**	**1.28**	**.017**	1.07	.98	1.17	.119
Spanish language output (20% increase)	**1.15**	**1.10**	**1.20**	**<.001**	**1.10**	**1.07**	**1.14**	**<.001**
Spanish language input (20% increase)	1.03	.98	1.07	.225	**1.08**	**1.04**	**1.11**	**<.001**
English Language Outcomes								
Texas B (vs. Texas A)	.97	.87	1.08	.600	**.93**	**.87**	**1.00**	**.043**
Utah C (vs. Texas A)	1.08	.94	1.25	.281	.95	.86	1.04	.235
Female	1.08	.98	1.18	.124	**1.07**	**1.01**	**1.14**	**.031**
Free Lunch (vs. Regular)	.94	.83	1.07	.380	.98	.90	1.07	.622
Reduced Lunch (vs. Regular)	1.01	.86	1.18	.943	.98	.88	1.09	.710
Father HS (vs. no HS)	.97	.86	1.10	.680	1.04	.95	1.12	.406
Father College (vs. no HS)	1.02	.87	1.19	.841	1.06	.96	1.17	.253
Mother HS (vs. no HS)	**1.17**	**1.04**	**1.32**	**.011**	1.08	.99	1.16	.070
Mother College (vs. no HS)	**1.24**	**1.07**	**1.45**	**.005**	**1.14**	**1.03**	**1.25**	**.009**
Age in Months (12 months increase)	**1.48**	**1.30**	**1.68**	**<.001**	**1.25**	**1.15**	**1.36**	**<.001**
English language output (20% increase)	**1.18**	**1.12**	**1.25**	**<.001**	**1.11**	**1.07**	**1.15**	**<.001**
English language input (20% increase)	**1.07**	**1.02**	**1.13**	**.009**	1.02	.99	1.06	.232

Note: IRR represents incidence rate ratio. A positive IRR shows the increase in rate in correct responses for a one unit increase in the predictor. A negative IRR shows the decrease in rate of correct responses for a one unit increase in the predictor. All IRRs are adjusted for the other predictors in the model.