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Bilingual Effects on Cognitive and Linguistic Development: Role of Language, Cultural Background, and Education

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Abstract

A total of 104 6-year-old children belonging to four groups (English monolinguals, Chinese-English bilinguals, French-English bilinguals, Spanish-English bilinguals) were compared on three verbal tasks and one nonverbal executive control task to examine the generality of the bilingual effects on development. Bilingual groups differed in degree of similarity between languages, cultural background, and language of schooling. On the executive control task, all bilingual groups performed similarly and exceeded monolinguals; on the language tasks the best performance was achieved by bilingual children whose language of instruction was the same as the language of testing and whose languages had more overlap. Thus, executive control outcomes for bilingual children are general but performance on verbal tasks is specific to factors in the bilingual experience.

It is not surprising that the linguistic development of bilingual children is different from that of their monolingual peers, but increasing evidence shows that nonverbal cognitive development is also affected by bilingualism. These outcomes, however, are different. Linguistic tasks are often performed more poorly by bilingual children than monolinguals, especially assessments of vocabulary (Bialystok, Luk, Peets, Yang, 2010; Oller, Pearson, Cobo-Lewis, 2007), although tests of metalinguistic awareness are generally performed better by bilingual children (Bialystok, 1986; Cromdal, 1999; Ricciardelli, 1992). In contrast, many tests of executive control are performed better by bilinguals (Bialystok, 1999; Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Bialystok & Martin, 2004; Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Mezzacappa, 2004; Yang, Shih, & Lust, 2005) although there is no effect for tasks based on withholding a response even though that too is part of executive control (Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008).

Understanding these effects is complicated by the fact that bilingualism is often correlated with variables that may themselves influence performance. For example, Morton and Harper (2007) claimed that the reported bilingual advantage was due to socioeconomic (SES) differences between bilingual and monolingual children. There is no doubt that SES is a powerful influence on executive control, but it does not undermine the body of literature for which bilingual advantages have been recorded (Bialystok, 2009). Similarly, claims for cultural effects favoring Asian children on tests of executive control (e.g., Sabbagh, Xu, Carlson, Moses, & Lee, 2006) must be separated from the role of bilingualism in shaping this performance. The present study addresses these issues by examining three groups of bilingual children and one group of monolinguals performing verbal and nonverbal tasks. The bilingual children differ in terms of similarity between English and their other language, cultural background, and educational experience. It is not possible to achieve a parametric

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manipulation of these variables, so our approach is to compare specific groups to address each of these factors.

Two previous studies have examined the role of culture and immigration history on the cognitive outcomes of bilingualism. Bialystok and Viswanathan (2009) compared three groups of 8-year-old children on an executive control task. Children were matched on educational experience and social class and were English-speaking monolinguals in Canada, bilinguals in Canada (mixed cultural backgrounds, immigrants), or bilinguals in India (south Asian culture, non-immigrants). The results showed that the two bilingual groups outperformed the monolinguals on the conflict conditions, with no difference between the two bilingual groups. In another study, Bialystok et al. (2010) compared a group of bilinguals to two monolingual groups – an English-speaking group in Canada and a French-speaking group in France. Again, there was no difference between the two monolingual groups and better performance by the bilinguals on all the conflict tasks. Together, these results support the generality of the bilingual effects over the influence of immigration and culture on nonverbal tests of executive control.

Unlike cognitive outcomes, different groups of bilinguals do not perform comparably on linguistic tasks. Spanish-English bilinguals outperformed both monolinguals and Chinese-English bilinguals on a test of English phonological awareness, presumably because of the degree of similarity between the languages (Bialystok, Majumder, & Martin, 2003). Spanish orthography is also transparent in that it is based on consistent letter-sound mappings, and this factor might also contribute to the enhanced performance of Spanish-English bilinguals on phonological awareness tasks. In addition, phonological awareness appears to transfer easily across languages. Cross-language correlations in performance on phonological awareness tasks have been reported for English-Spanish bilinguals (Lindsey, Manis, & Bailey, 2003), English-French bilinguals (Comeau, Cormier, Grandmaison, & Lacroix, 1999), and English-Cantonese bilinguals (Luk & Bialystok, 2008) indicating a common basis for this ability across languages irrespective of its rate of development. The same is not true for early reading: In a study comparing Spanish-English, Hebrew-English, and Chinese-English bilingual children on a decoding task in both languages, better performance than monolinguals was found for the Spanish and Hebrew groups, with no advantage for the Chinese-English group (Bialystok, Luk, & Kwan, 2005). In these cases, the relation between the languages contributed to performance, and in contrast to the study of phonological awareness, there was no correlation in decoding ability across English and Chinese, languages with different writing systems, but strong cross-language correlations with English for both Spanish and Hebrew, languages with more similar writing systems. Therefore, the relation between languages has different effects on the development of basic metalinguistic and literacy concepts. No study to date has examined the effect of bilingual experience for both verbal and nonverbal outcomes in the same children to determine the role of bilingualism in each of these developmental outcomes.

In the present study, we examine the effects of specific language pairs, cultural background, and educational experience on verbal and nonverbal performance. The language factor reflects the possibility that the effect of bilingualism depends on the relation between the two languages. Previous studies have used either heterogeneous samples (i.e., children speaking a variety of language pairs: Bialystok & Senman, 2004; Bialystok & Shapero, 2005), or homogeneous samples (i.e., all children spoke the same two languages but with different languages across studies: Bialystok & Martin, 2004, study 2; Carlson & Meltzoff, 2008; Cromdal, 1999; Martin-Rhee & Bialystok, 2008, study 1; Ricciardelli, 1992). Therefore, it is not clear whether the specific language or the relation between the two languages mediates the results. In the present study, we compared homogenous groups of bilingual children and manipulated the similarity between the two languages.

Regarding culture, recent research has suggested that Chinese and Korean monolingual children show more advanced executive function performance than English monolingual children in North American and United Kingdom (e.g., Sabbagh et al., 2006; Oh & Lewis, 2008). Based on these findings, Carlson and Meltzoff (2008) argued that research with bilingual children needs to be replicated using non-Chinese samples to account for the possibility that results might be confounded by "cultural differences in the early socialization of self-control". However, these studies are vague about what aspects of culture contribute to differences in executive control and what mechanism underlies these cross-cultural differences. Lewis and colleagues, for instance, proposed that multiple factors could explain the improved control in Asian children including genetic factors, educational and parental practices, and language characteristics such as frequent use of verbs with young children (Lewis, Koyasu, Oh, Ogawa, Short, & Huang, 2009). Parmar, Harkness, and Super (2004) reported evidence that Asian- and Euro-American parents of American preschoolers differed in their beliefs and practices of raising children. Although these studies demonstrate that cultural factors impact aspects of monolingual performance on certain tasks, it is still unclear whether bilingual children of different cultural backgrounds (i.e., Asian, non-Asian) who are raised in the same communities and attend the same schools would show comparable patterns of linguistic and cognitive performance.

The language of education may also mediate the documented effects of bilingualism. The study by Bialystok et al. (2010) on English receptive vocabulary showed that words associated with schooling were responded to equally well by monolingual and bilingual children, whereas comprehension of words primarily associated with home was better in monolinguals. Related evidence from English monolingual children demonstrated that the development of emerging literacy skills (i.e., awareness of the characteristics of the English writing system) was strongly predicted by the degree to which children engaged in home activities involving reading and writing practice (Levy, Gong, Hessels, Evans, & Jared, 2005). However, research rarely controls for which language is used in school even though vocabulary size is a predictor of children's performance on tests of academic achievement such as spelling, reading and arithmetic (Smith, Smith, & Dobbs, 1991) and is positively related to executive control in preschoolers (Carlson & Moses, 2001). No studies to date have compared bilingual groups who are instructed in different languages to assess the effects on language and cognitive functions.

We compared bilingual children whose two languages were English plus one of Chinese (Mandarin or Cantonese), French, or Spanish, with a group of English-speaking monolingual children. French and Spanish have some similarity with English and have shared cognate words and comparable grammatical structures (Finkenstaedt & Wolff, 1973), but Chinese is different from the other languages in these dimensions (Chen & Zhou, 1999). At the phonological level, Chinese is a tonal language whereas English, French and Spanish are non-tonal languages (Ye & Connine, 1999). In terms of writing system, French, Spanish and English use an alphabetic system (Goswami, Gombert, & de Barrera, 1998), whereas Chinese is a logographic language (Shen & Forster, 1999). Morphologically, Chinese differs from English and other alphabetic languages in the relative number of compound words (i.e., snowman, toothpaste) such that they represent about 75% of all words in the Chinese language but only a very small proportion in the alphabetic languages (Chen, Hao, Geva, Zhu, & Shu, 2009; Liu & McBride-Chang, 2010). Finally, the overall classification of languages places them in different language families: English, French, and Spanish are Indo-European (with French and Spanish being Latin) and Chinese is Sino-Tibetan (Comrie, 1987). Thus, by contrasting French and Spanish bilinguals to Chinese bilinguals it is possible to understand how the similarity between languages affects the linguistic and nonlinguistic outcomes of bilingualism.

The comparison between Chinese-English bilingual children and the other two bilingual groups allowed for the examination of the role of culture in the performance of these linguistic and executive control tasks by contrasting Asian bilinguals with non-Asian bilinguals. Finally, all the children lived in an English-speaking community, but the French-English bilingual children attended schools in which French was the medium of instruction while children in the other three groups were instructed in English. All testing was conducted in English, so the language of schooling might independently impact on performance. Because cultural background and language similarity are correlated, only tentative conclusions about these factors will be offered, a point to which we return in the Discussion.

Previous research has demonstrated that differences in executive control for bilingual children are not influenced by immigration history (Bialystok & Viswanathan, 2009) or culture variables (Bialystok et al., 2010), but the role of these factors on language performance has been less explored. Therefore, the verbal tasks in the present study covered three aspects of language proficiency: receptive vocabulary, grammatical ability, and metalinguistic knowledge. The nonverbal task was a task-switching paradigm. This task was chosen because it (a) involves processes similar to those children use to switch attention between languages, (b) distinguishes between global and local switch costs, each of which indexes different cognitive processes with different developmental trajectories, and (c) has been used with children (Bialystok & Viswanathan, 2009) and adults (Bialystok, Craik, & Ryan, 2006; Costa, Hernández, & Sebastián-Gallés, 2008) to show bilingual advantages in global but not local costs. Moreover, previous research has demonstrated bilingual advantages in inhibition using such tasks as the flanker ANT task (Mezzacappa, 2004; Yang et al., 2005) and dimensional change card sort task (Bialystok, 1999; Bialystok & Martin, 2004), but other executive control components, particularly switching and flexibility, have been less studied.

There are two possibilities for the effect of language similarity on executive control. The first is that languages that are more similar require more control to discriminate and therefore lead to more enhanced control mechanisms. Conversely, it may be that languages that are more distant require more switching and monitoring and that may be the source of greater enhancement. Our hypothesis was that both types of experiences should lead to equivalent enhancement because both require effortful attention. Thus, we expected that all three bilingual groups would perform similarly on nonverbal test of control but that the relation between the two languages and the language experience in education would affect the outcomes of the verbal tasks, with better performance by children whose two languages are more related (French and Spanish groups) and whose education is in English, the language of testing (Spanish group).

Method

Participants

Participants were 104 children comprised of 26 English monolingual children, 30 Chinese-English bilingual children, 28 French-English bilingual children, and 20 Spanish-English bilingual children. All the children lived in a large multicultural city and attended public schools. The French-English bilinguals attended a school in which the language of instruction was French, all other children received school instruction in English. All parents completed the Language and Social Background Questionnaire (LSBQ) in which they answered questions about language use patterns on a scale from 1 to 5, where 1 indicated the exclusive use of English, 5 indicated the exclusive use of a non-English language and 3 indicated balanced use of the two. The scales were combined to produce a mean score for language use at home and a mean score for the language spoken by the child at home. These scores are reported in Table 1.

The English monolingual group (M = 71.5 months, SD = 6.3, range = 62.4 – 86.7 months, 13 girls and 13 boys) reported little exposure to a non-English language. In the Chinese-English bilingual group (M = 71.5 months, SD = 6.5, range = 63.3 – 87.0 months, 14 girls and 16 boys), two one-sample *t*-tests comparing the home language to 3 (balanced use of the languages) showed that parents used Chinese more frequently to communicate with the children, $t(27) = 5.73$, $p < .0001$, but that children spoke both languages equally, $t(28) = -0.65$, n.s. For the French-English bilingual group (M = 74.8 months, SD = 3.8, range = 67.4 – 81.0 months, 12 girls and 16 boys) neither home exposure to English, $t(26) = 1.24$, n.s., nor home use of English, $t = 0$, differed from balanced usage. Finally, in the Spanish-English bilingual group (M = 74.4 months, SD = 9.9, range = 56.4 – 91.0 months, 10 girls and 10 boys), home exposure to English indicated more exposure to Spanish than English, $t(19) = 2.36$, $p < .03$, but children's home use of English did not differ from balanced use, $t(19) = -1.79$, n.s. Comparing the three bilingual groups in terms of home language exposure, a one-way ANOVA indicated a main effect of language group, $F(2, 72) = 4.21$, $p < .02$. Post-hoc Bonferroni contrasts showed that Chinese-English bilingual children received more home exposure to the non-English language than the French-English bilinguals, with the Spanish-English bilinguals not significantly different from the other two groups. A one-way ANOVA for the home language spoken by the child showed no differences among the three groups, $F < 1$.

Procedures and Tasks

Children were tested individually at their school by the same female experimenter during a single session. Prior to testing, parents gave written consent, and children provided verbal assent before testing. All tasks were administered in English. The battery consisted of two background measures (Kaufman Brief Intelligence Test, box completion), three language measures (Peabody Picture Vocabulary Test-III, the Wugs test, Formulated Sentences from the Clinical Evaluation of Language Fundamentals Test), and a computerized executive control task (color-shape task switching). The tasks were administered in a fixed order: Wugs, Peabody Picture Vocabulary Test-III, Formulated Sentences, color-shape task switching, box completion and Kaufman Brief Intelligence Test. This order was chosen to ensure that there was enough variety in the tasks to keep children's interest during the testing session. Children were given stickers after the completion of each task.

Kaufman Brief Intelligence Test, 2nd edition (KBIT-2)—The Matrices subtest of the KBIT-2 was administered to assess fluid reasoning (Kaufman & Kaufman, 2004). The test consists of 46 items divided into three sections of increasing difficulty. On each trial, the child was presented with visual stimuli representing either drawings of concrete objects or abstract figures. In the first part of the test the child saw one target drawing at the centre of the page and five additional drawings below it and was asked to identify one of the five stimuli matching the target image. For the other two sections the child saw an incomplete display of 2 × 2 or 3 × 3 visual stimuli with one stimulus missing, and five stimuli below the display. The task was to choose the stimulus to complete the displayed pattern. The testing, scoring and standardization followed the standard procedure described in the manual.

Box completion—This task is a measure of psychomotor speed (Salthouse, 1996). The child was presented with a letter-sized sheet of paper containing an array of 35 3-sided squares arranged in 5 columns and 7 rows. The squares were identical in size (side length of 1.9 cm). The child's task was to complete the squares by filling in the fourth side as fast as possible using a crayon. Children were shown examples of how to perform the task before testing began. The time to complete the task (in seconds) was recorded from the moment the child started drawing the first line to the moment the last square was finished.

Peabody Picture Vocabulary Test, 3rd edition (PPVT-III)—This is a standardized test of receptive vocabulary (Dunn and Dunn, 1997) in which children select a picture from four options to match a word given by the experimenter. The testing and scoring were done according to the procedures described in the manual.

Clinical Evaluation of Language Fundamentals – fourth edition (CELF-4)—The Formulated Sentences subtest was used to assess children's ability to construct sentences which are grammatically and semantically intact (Semel, Wiig, and Secord, 2003). For each item, children were presented with a picture and a target word and were asked to create a sentence about the picture that incorporated the target word. There were two practice trials before the administration of the test items. Testing, scoring and standardization followed the standard procedure described in the manual.

The Wugs test—This test assesses children's ability to apply morphological rules of English (Berko, 1958) to unfamiliar forms, therefore reflecting children's metalinguistic awareness. Children were shown 27 pictures illustrating novel objects, animals, plants, and actions. The experimenter pointed to each picture and read the associated text. Thirty of the 33 texts introduced a target nonsense word (e.g., wug, kazh, gutch, etc.) and the remaining three included English target words (glass, melt, ring). Children needed to complete the sentence using the target word by applying English morphology to the new words. The rules were the formation of noun plural, past tense, third person singular for simple present tense, singular and plural possessives, comparative and superlative of adjectives, diminutives, derived adjectives, compounded words, progressive and derived agentive. Two practice trials in which children created plurals for real English words (e.g., cat, dog) preceded the test. Each correct answer received 1 point, with the maximum being 33.

Color-shape task switching—This test assesses children's ability to switch between tasks, a central component of the executive function (Miyake, Friedman, Emerson, Witzki, & Howerter, 2006). The task was programmed in Macromedia Flash Player 7 and administered on a Lenovo X61 tablet computer with a 12-inch touch-screen monitor. The stimuli were schematic drawings of a cow and horse that were red or blue. A blue horse and a red cow appeared on the top of the screen, each surrounded by a black square. On each trial, a stimulus red horse or blue cow) appeared on the bottom center of the screen with a visual cue indicating whether the stimulus was to be matched by color or shape to the targets. Children responded by touching the target picture that matched the stimulus on the designated dimension. The cue for color was a circular color wheel about 0.5 cm in diameter and the cue for shape was a black and white star-like shape of similar size.

There were 200 trials across 2 non-switch blocks (25 trials each) and 3 switch blocks (50 trials each). In non-switch blocks, all trials appeared with the same matching criterion, and in switch blocks, the matching criterion for each trial was generated randomly by the program with 50% of the trials containing each cue. In switch blocks, successive trials could either have the same matching criterion (non-switch trials), or different matching criteria (switch trials). Blocks were administered in a fixed order starting with the two non-switch blocks and continuing with the three switch blocks. Half of the children started the test with the non-switch color block and the other half with the non-switch shape block. The stimulus remained on the screen until the child made a response. Children were instructed to perform as quickly as possible without making mistakes. Following the response, the next trial started after a delay of 1000 ms.

Reaction time (RT) and accuracy were recorded for each trial. Global and local switch costs were calculated from the RTs of correct trials. Global cost was calculated as the difference between mean RT for non-switch trials in the two non-switch blocks and mean RT of non-switch trials in the switch blocks. Local switch cost was calculated as the difference between mean RT of non-switch trials and mean RT of switch trials in the switch blocks (Cepeda, Kramer, & Gonzalez de Sather, 2001).

Results

Preliminary two-way ANOVAs of gender and language group for each task indicated no main effects of gender and no interaction between gender and language group in any analysis. Consequently, the analyses reported below were performed by collapsing across gender groups. All significant main effects of language group were followed up with post-hoc Bonferroni contrasts to adjust for multiple comparisons.

Table 1 presents the mean and standard deviations for the background measures. There were no differences in age, $F(3, 100) = 1.95$, n.s., or SES, $F(3, 98) = 1.66$, n.s., as measured by parents' years of education reported on the LSBQ. Similarly, one-way ANOVAs with language group as a between-subject factor indicated no difference between groups for KBIT-2 scores, or box completion times, *F*s < 1.

Table 2 presents the mean scores and standard deviations for the language tasks. A one-way ANOVA on PPVT scores showed a main effect of language group, $F(3, 100) = 8.27$, $p < .0001$. Post-hoc Bonferroni contrasts indicated that the monolingual children and the Spanish-LANGUAGE, English bilingual children outperformed the other two bilingual groups who did not differ from each other. For scores from the CELF test, the one-way ANOVA also indicated a main effect of language group, $F(3, 100) = 4.35$, $p < .01$, with post-hoc Bonferroni contrasts showing that monolingual and Spanish-English bilingual children outperformed the French-English bilingual group. Chinese-English bilinguals were not significantly different from any of the other three language groups. Finally, the ANOVA on Wug scores showed a main effect of language group, $F(3, 100) = 7.65$, $p < .0001$, in which the Spanish-English bilingual children outperformed the other three groups.

Mean accuracy and reaction times (RT) for the switching task are presented in Table 3. Accuracy data were analyzed by a two-way ANOVA for language group and block type and showed a main effect of block type, $F(1, 99) = 48.47$, $p < .0001$, with fewer errors in the non-switch blocks than switch blocks and no other effects. A similar two-way ANOVA for RT revealed a main effect of language group, $F(3, 99) = 5.79$, $p < .002$, with all three bilingual groups showing faster RTs than the monolingual children, a main effect of block type, $F(1, 99) = 405.70$, $p < .0001$, with faster RTs in the non-switch blocks than in switch blocks, and an interaction between them, $F(3, 99) = 6.23$, $p < .001$. Tests for simple effects indicated no differences among language groups in non-switch blocks, $F(3, 99) = 1.23$, n.s., but a significant difference in switch blocks, $F(3, 99) = 6.52$, $p < .001$. Post-hoc Bonferroni tests showed that all three bilingual groups had faster RTs than the monolingual children with no difference among the three bilingual groups.

Local and global switch costs are displayed in Figure 1. Separate one-way ANOVAs for language group showed no effect on local cost, $F<1$, but a significant effect of language group on global cost, $F(3, 99) = 6.14$, $p < .001$. Post-hoc Bonferroni tests indicated that the three bilingual groups experienced smaller global costs than the monolingual children, with no difference among the bilingual groups.

Discussion

The purpose of the present study was to investigate the effects of language similarity, cultural background, and educational experience on the verbal and nonverbal outcomes of bilingualism. Six-year-old monolingual and bilingual children with equivalent psychomotor speed, general cognitive level, and SES, performed language tasks measuring vocabulary, grammar, and metalinguistic knowledge, and a nonverbal executive control task assessing task switching. The three bilingual groups differed on several factors yet demonstrated similar performance in task switching, exceeding that of their monolingual peers. Consistent with other research (e.g., Bialystok & Viswanathan, 2009), bilingual children showed smaller global switch costs than monolingual children. These results offer strong support for the claim that bilingualism acts independently of variables such as language similarity, cultural background, and language of schooling in influencing nonverbal outcomes. In previous studies, East Asian preschoolers showed an advantage over children from non-Asian cultures on both conflict inhibition measures (e.g., day/night task, Luria’s hand game task) and delay inhibition measures (e.g., gift delay) (e.g., Oh & Lewis, 2008; Sabbagh et al., 2006). However, research with bilinguals only shows advantages on conflict tasks with no advantage on delay tasks (e.g., Carlson & Meltzoff, 2008). Therefore, it may be that influences of Asian culture affect delay inhibition independently of bilingual effects on conflict resolution. In the present study, Chinese-English bilinguals did not differ from the Spanish- and French-English bilinguals on executive control, suggesting that cultural background did not contribute to performance above and beyond bilingualism. Taken together with other results (Bialystok et al., 2010; Bialystok & Viswanathan, 2009), these findings demonstrate the generality of the bilingual advantage in executive functioning.

In contrast to nonverbal performance, scores on the verbal tasks were mediated by language similarity and language of schooling. The Spanish bilingual children outperformed the French bilingual children on all three measures (receptive vocabulary, grammatical knowledge, and metalinguistic awareness) and the Chinese bilinguals on two of them (receptive vocabulary and metalinguistic awareness). Importantly, the Spanish bilinguals were not different from the other two bilingual groups in terms of the amount of language exposure and language production at home. The Spanish bilinguals and Chinese bilinguals were both being educated in English, but English metalinguistic performance was only better for the Spanish children, possibly because of greater similarity between Spanish and English. This pattern is consistent with results reported by Bialystok et al. (2003, Study 3) showing an interaction between language similarity and bilingualism to determine verbal outcomes. In another study (Bialystok et al., 2005), Spanish and Hebrew bilinguals showed more advanced performance in learning to read in English than English monolinguals, with the Chinese bilinguals at an intermediate level between these groups. These results were interpreted to suggest both general and specific effects of bilingualism such that speaking two languages boosts general knowledge related to print, but this facilitation is greater when the two languages share the same writing system.

Taken together, these studies suggest that both language similarity and language of schooling contribute to performance on linguistic and metalinguistic tasks by bilingual children. For the linguistic assessments of English receptive vocabulary and grammatical structure, the Spanish-English bilingual children obtained scores comparable to monolinguals; French-English children spoke a language with some relation to English and Chinese-English children were being educated in English, but each of these groups lacked one of the essential experiences that characterized the Spanish-English bilinguals and consequently obtained lower scores than the Spanish-English bilingual and monolingual groups. However, the results are different for the metalinguistic task. Unlike measures of linguistic knowledge, metalinguistic awareness has been shown to develop earlier in bilingual children. The present results suggest that the metalinguistic advantage for bilingual children depends on these linguistic measures (i.e., receptive vocabulary and grammatical knowledge). Specifically, the metalinguistic task was solved relatively better by the French-English and Chinese-English bilinguals than were the linguistic tasks in that they performed as well as the monolinguals instead of more poorly. Yet, the Spanish-English bilinguals, whose linguistic basis was equivalent to monolinguals performed better than monolinguals on the metalinguistic task. Thus, all three bilingual groups showed an advantage in the metalinguistic task relative to their performance in the linguistic measures, with the French and Chinese groups reaching the level of monolinguals and the Spanish group surpassing them. This pattern provides support for the idea that the nature of that advantage depended on the relation between the languages and their experiences in schooling. It is important to note that the majority of the literature reporting metalinguistic advantages in bilingual children has compared monolingual and bilingual children being educated in the same language with somewhat equivalent linguistic ability in that language, as was the case for the Spanish bilinguals.

The present study provides evidence for the distinction between the linguistic and cognitive outcomes of bilingualism. The results endorse the conclusion that bilingualism itself is responsible for the increased levels of executive control previously reported. Bilingual children were better able than monolinguals to maintain a task set across a mixed block, an advantage found equally in all three bilingual groups. In contrast, performance on the linguistic tasks varied with educational experience and similarity between the two languages. Although cultural background and language similarity are correlated for the Chinese group, their effects are separable. The Chinese-English bilinguals were only different from the other bilinguals on the language measures, and since it is hard to imagine how cultural influences would be responsible, we attribute those effects to degree of language similarity. In contrast, there were no differences among any of the bilingual groups on the nonverbal measure, ruling out both language similarity and cultural background as contributors to that performance. These results refine our understanding of how experience in general, and bilingualism in particular, shape development.

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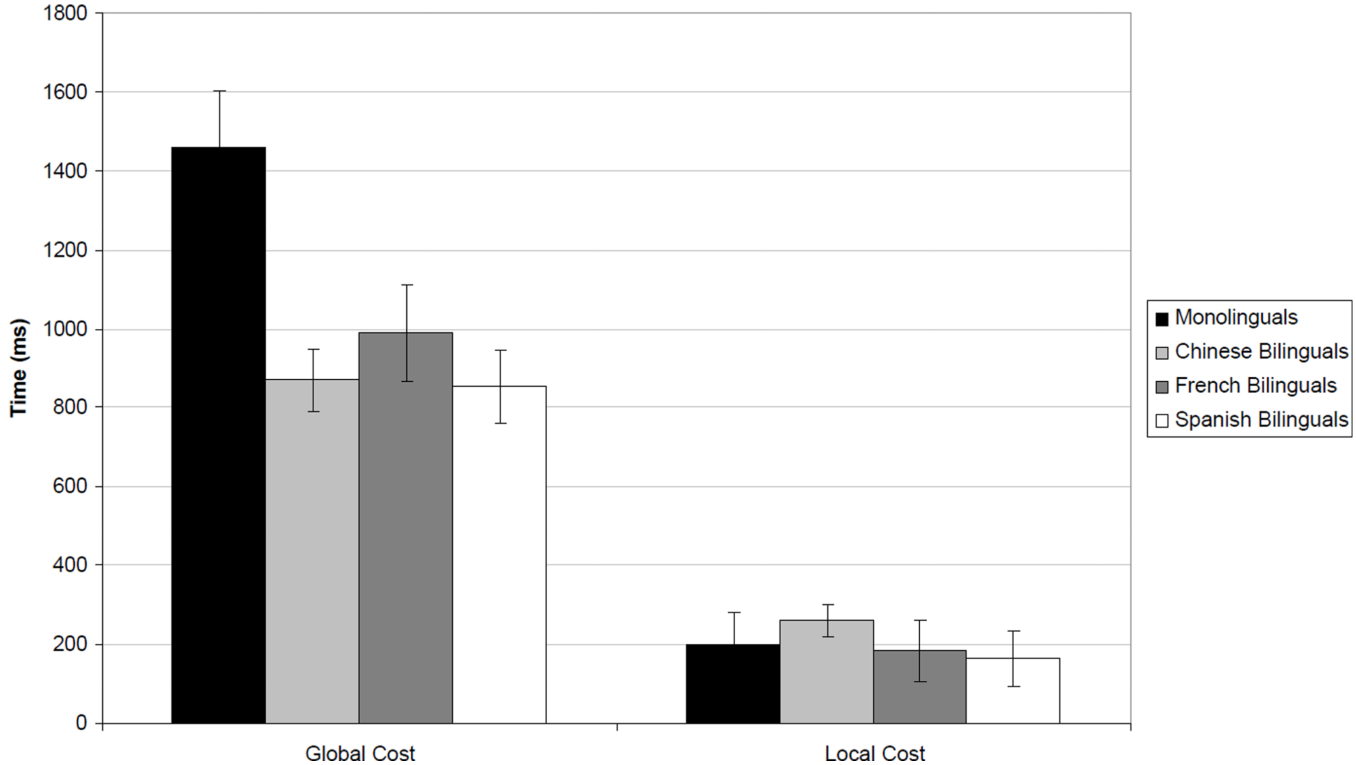

Figure 1.

Mean reaction time (RT) and standard error for local and global switch cost in the color-shape task switching by language group (N = 103).

Table 1

Mean and Standard Deviation for Background Measures: Home language spoken to child, home language spoken by the child, SES, KBIT-2 and Box Completion Speed by Language Group

Group	Home language spoken by parents	Home language spoken by child	SES[2]	KBIT-2	Box Completion Speed[3] (sec)
English Monolingual	1.3[1] (0.5)	1.2 (0.4)	0.8 (0.2)	106.6 (12.3)	45.7 (12.3)
Chinese Bilingual	3.9* (0.9)	2.9 (0.9)	0.8 (0.2)	108.5 (15.5)	44.4 (11.8)
French Bilingual	3.2 (0.9)	3.0 (1.0)	0.8 (0.1)	104.7 (10.8)	44.8 (9.6)
Spanish Bilingual	3.5* (1.0)	2.7 (0.9)	0.8 (0.2)	108.6 (14.9)	42.1 (14.2)

[1] Scores for home language use for English monolinguals were not further analyzed.

[2] Because of an error in administration, the scale for number of years of education for three of the groups was out of 5 but for the fourth group was out of 7. Therefore, all scores were converted to proportions.

[3] One monolingual child could not complete the box task for medical reasons. The child had broken her thumb and could not hold the pencil properly to complete the task.

* Score differs significantly from the balanced mean of 3.0 indicating more use of the non-English language.

Table 2

Mean and Standard Deviation for Receptive Vocabulary (PPVT – III), Standardized Score (out of 19) for the CELF Task and Number of Correct Responses (out of 33) on the Wugs Test by Language Group (N =104)

Group	PPVT	CELF	Wugs
English Monolingual	111.7 (10.5)	13.5 (2.4)	18.1 (7.6)
Chinese Bilingual	100.0 (10.2)	12.6 (2.5)	14.8 (5.1)
French Bilingual	100.9 (12.8)	11.5 (2.2)	15.1 (5.6)
Spanish Bilingual	111.5 (11.9)	13.4 (2.1)	22.2 (5.1)

Table 3

Mean and Standard Deviation for Accuracy and Reaction Times for the Color-Shape Task Switching by Language Group and Condition (N = 103)

	Accuracy		Reaction Times	
Group	**Non-switch blocks**	**Switch blocks**	**Non-switch blocks**	**Switch blocks**
English Monolingual	0.96 (0.04)	0.89 (0.09)	1227 (210)	2786 (785)
Chinese Bilingual	0.95 (0.04)	0.89 (0.10)	1180 (257)	2180 (515)
French Bilingual	0.94 (0.05)	0.88 (0.11)	1144 (217)	2226 (703)
Spanish Bilingual	0.94 (0.05)	0.88 (0.07)	1107 (187)	2043 (459)