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From Bench to Classroom: Collaborating Within a Dual-Language Education Model

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ABSTRACT

We describe research results and lessons learned from a laboratory/classroom collaboration with a school system offering both traditional English-only education and a dual-language track (Spanish/English). Through this collaboration, we addressed basic research questions informing malleable factors that impact cognitive development. In a reciprocal manner, ongoing communication with the school system and community has directed the research questions to provide information the school system seeks for program evaluation and to maintain community support. In this report, we share results of the effects of participation in a dual-language model of education in the areas of executive functions, academic performance, and English-language development. Our research revealed no evidence of detrimental effects of participation in the dual-language education program compared with the traditional English-only instructional track in any of these areas. There was some evidence for emerging benefits to executive functions and academic performance for children participating in dual-language education. We also share the implications of the research for the way in which academic content is delivered in the dual-language education model. We conclude with lessons learned from collaborating with the school system that will direct our future research and might aid researchers interested in pursuing similar partnerships.

Introduction

Children across the United States are increasingly learning academic content through various forms of bilingual education (Lindholm-Leary, 2012). Dual-language education models, in which content is provided through two languages, are in demand and have grown from a handful of programs across the United States in the 1970s, to roughly 200 programs at the turn of the 21st century, to more than 500 programs as of this writing. Dual-language models initially were adopted in the United States as a way to ensure that minority language-speaking children (primarily Spanish) could keep up with academic content while acquiring English. The number of dual-language programs has grown in part due to increased immigration. In addition, the demand for dual-language instruction has increased among parents who speak English in the home who want their children to learn a second language; dual-language instruction is an excellent way to accomplish

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second-language fluency for both majority- and minority-language speakers (e.g., Burkhauser et al., 2016; García & Nájuez, 2011; Lindholm-Leary & Genesee, 2014). Yet the benefits of dual-language education are not universally recognized nor are they necessarily known to the populations the models are meant to serve. Additionally, initial research on bilingual education was confined to specific populations, and it has been unknown if the reported benefits generalize beyond them.

The work described in this report was a laboratory/elementary classroom collaboration on the impact of second-language acquisition on cognitive development, specifically in the areas of executive functions (EF), academic performance, and language acquisition. It also has had implications for the way in which academic content is delivered in the classroom. The laboratory/classroom collaboration, begun in 2010, has permitted us to address basic research questions that have informed the malleable factors that impact cognitive development and academic performance. In a reciprocal manner, the ongoing communication with the school board, teachers, principals, and parents involved in the dual-language program has directed the research questions in such a way as to provide information the school needs to evaluate its innovative programming and garner necessary community support to maintain this programming.

In this report, we share some of the findings and the lessons we have learned. We start with a brief overview of the school system. With the goal of explicating the bidirectional benefits of this ongoing research collaboration, we then move into research findings regarding EF, academic achievement, language development, and content delivery. The first two questions regarding EF and academic achievement have been addressed in previous publications (Esposito, 2018; Esposito & Baker-Ward, 2013); thus, we summarize the process and findings. Concerning the third question of language development, we present new data. Regarding content delivery, we present our ongoing research approach for addressing the question of how to best foster comprehension and academic achievement when content is presented through more than one language. We conclude with lessons learned from collaborating with the school system.

Participating schools and dual-language education

The collaborating school system is in the Southeastern United States. The school system is public (i.e., state funded) and composed of six centrally located schools serving kindergarten through Grade 12. For kindergarten through Grade 8, there is only one school option in the county. The early elementary students (K–1; ages 5–7 years) attend the primary school, Grades 2 to 3 (ages 7–9 years) attend the elementary school, Grades 4 to 5 (ages 9–11 years) attend the intermediate school, and Grades 6 to 8 attend the middle school. Students in Grades 9– through 12 have the option of attending high school or applying to the early college option. The schools are part of a continuous progression through the county grade school program such that until 9th grade, all students eventually attend the same schools.

The participating school system serves a rural, agricultural community characterized as low-income with racial, ethnic, and linguistic diversity. Approximately 87% of children in the community qualify for federally funded school lunch assistance (a proxy for poverty), and approximately 10% of the adult population has a college degree. The community is composed of an approximately equal number of Black, Non-Hispanic White, and

Hispanic White families. The majority of the families who identify as Hispanic are first-generation immigrants from Mexico and native Spanish speakers. Thus, across the community, approximately one third of the population enter school with limited mastery of the English language.

To address the needs of their community, the school system developed a dual-language two-way immersion program for kindergarten through fifth grade. Dual-language two-way immersion is one of several models of bilingual education. The nonprofit Center for Applied Linguistics (Washington, DC) has defined the model as including a) the integration of both majority and minority speakers within one class with approximately equal distribution, b) content and literacy instruction provided through both the majority and minority language with at least 50% of instruction through the minority language, and c) an offered duration of at least 5 years. Unlike remedial language programs, dual-language education is an enrichment program in which children gain proficiency in the second language as they continue to develop the skills of their home language (e.g., Alanís & Rodríguez, 2008). In addition, because at least 50% of instruction is through the minority language, minority-language children are provided with academic content through their home language, thus promoting academic achievement (e.g., Lindholm-Leary, 2001; Thomas & Collier, 1997, 2002). Compared with those in dual-language education, minority-language children who are instructed only through the school language do not reach similarly high levels of language proficiency; their academic performance frequently suffers, and they are at higher risk for dropout (e.g., Bialystok, 2001; Hakuta & Mostafapour, 1998). In the case of the participating school system, the dual-language two-way immersion model provided the opportunity for children whose home language is Spanish to maintain and continue to develop Spanish fluency while also learning English. The model also has the benefit of providing an opportunity for children whose home language is English to develop proficiency in Spanish while continuing their English education.

In the participating school system, Spanish/English dual-language two-way immersion is one of two programs within the schools, with the other being single-language instruction through English. Entrance into the dual-language education program is by lottery at the time of registration for kindergarten. Roughly 30% of families join the lottery and 17% are placed. Those who do not apply or who are not admitted by lottery are placed in the single-language English instructional setting. The two programs are provided with the same school-level resources. Dual-language placement is a stable assignment from kindergarten to the completion of fifth grade. It is rare that a child is admitted to the dual-language program after kindergarten.

Motivating questions and the collaborative approach to their address

The expansion of bilingual education broadly and the dual-language model specifically led to questions regarding the impact of dual-language education on cognitive development and content delivery for this model of education. We approached the collaborating school system with questions regarding potential cognitive effects of the dual-language model based on research supporting a “bilingual advantage” in EF. The school system was eager to collaborate because they also questioned program impact, specifically regarding academic achievement and language development.

The collaboration has resulted in five waves of data collection since 2010. The first collaboration in 2010 was provisional on the part of the collaborating school system. We were granted access to three grade levels (kindergarten, Grade 2, and Grade 4) with a limit of 15 min per child. The collaboration has since expanded to include more time, grade levels, and student participants, as depicted in Table 1. The longitudinal portion of the study began with kindergarten through first grade in 2013. In 2015, the K–1 students from 2013 were in Grades 2 to 3. We also added a new cohort of K–1 students so that the 2015 data collection included children in kindergarten through Grade 3. The same group was then followed in 2016 (when in Grades 1–4), 2017 (in Grades 2–5), and 2018 (in Grades 3–5), so there were 4 years of continuous data from the four cohorts. The data from 2018 are not included in this report because they are still under analysis. The intention is to continue following these students through the conclusion of their elementary education.

Study 1: Dual-language education and executive functioning

The research collaboration began with an investigation of the development of EF in children with emerging bilingualism as a byproduct of dual-language education (Esposito & Baker-Ward, 2013). Executive functions refer to the top-down processes that are required for effortful cognition such as reasoning, problem solving, and planning (Diamond, 2013). It is generally accepted that these processes include three components: inhibition, working memory, and task switching (e.g., Miyake et al., 2000). As documented in an extensive literature, EF correlate with indices of academic performance (for review, see Serpell & Esposito, 2016), making this set of skills of particular interest for intervention studies aimed at improving school performance.

Executive functions are of special interest for children receiving their education through two languages because of the so-called “bilingual advantage” (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004; Costa, Hernández, & Sebastián-Gallés, 2008; Martin-Rhee & Bialystok, 2008). The bilingual advantage refers to higher performance by bilingual individuals compared with monolingual individuals in some areas of EF (for a review, see Valian, 2015). This advantage is thought to result from constant practice in managing two languages, which enhances mental flexibility and controlled attention (Green, 1998). The advantage has been found across the life span (from infancy to advanced adulthood; e.g., Bialystok et al. 2004; Kovács & Mehler, 2009; Martin-Rhee & Bialystok, 2008), across languages (global investigations include languages representing the majority of the 141 language families; e.g., Barac & Bialystok, 2012; Bialystok & Viswanathan, 2009; Prior & Gollan, 2011), and across geographic locations (e.g., Canada, Spain, the United States; Bialystok & Majumder, 1998; Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Esposito, Baker-Ward, & Mueller, 2013, respectively). However, the specific conditions under which a bilingual advantage is found and the conditions under which it is not found

Table 1. History of data collection with the participating school system.

Academic Year (AY) of data collection	AY 2009–2010	AY 2012–2013	AY 2014–2015	AY 2015–2016	AY 2016–2017
Participating Grades	K, 2, 4	K, 1, 4, 5	K, 1, 2, 3	1, 2, 3, 4	2, 3, 4, 5
Total <i>n</i>	120	280	476	647	612

Note. Bolded grades indicate contributing to the longitudinal sample. Participants were distributed approximately equally across grade levels. Shaded area indicates those contributing to Study 3 analyses.

have not been elucidated (e.g., Valian, 2015). Tasks more aligned to the cognitive demands of managing two languages are more likely to show an advantage; however, the tasks that fit these criteria may change across the life span (Blumenfeld & Marian, 2014). Although the primary goals of dual-language education are to develop second-language fluency and support academic achievement, there may be advantageous side effects to EF.

In the initial partnership with the participating schools in 2010, we investigated whether the “bilingual advantage” would be evident for children acquiring a second language through dual-language education. At the time, the only investigation of potential effects of dual-language education on EF showed no effect (Carlson & Meltzoff, 2008). However, the child participants had only participated in dual-language education for 6 months at the time of the test, and it was unclear if benefits would emerge if children were given more time to develop. Based on the more expansive literature reviewed earlier documenting an advantage in EF for children growing up bilingual, we expected to find benefits after several years of experience in the program. We found support for this hypothesis for children enrolled in dual-language education for more than 3 years compared with their English-only traditionally educated peers (Esposito & Baker-Ward, 2013). We examined EF performance through the Trail-Making Test (Bowie & Harvey, 2006) and the Sun/Moon (Archibald & Kerns, 1999) task in children in either the dual-language education model or a traditional English education model classroom in kindergarten, Grade 2, and Grade 4 ($n = 35$, $n = 43$, and $n = 42$, respectively). Children in the dual-language program in Grades 2 and 4, but not those in kindergarten, showed a performance advantage over their traditionally educated peers in the Trail-Making Task. Our findings were supported by two other studies that also showed no EF benefits associated with bilingual education for children enrolled for less than 2 years (Kaushanskaya, Gross, & Buec, 2014; Poarch & van Hell, 2012).

One question raised by the findings from our first classroom–bench collaboration was the source of the observed advantage. In the scientific literature, there have been concerns that the “bilingual advantage” is actually a socioeconomic advantage (e.g., Morton & Harper, 2007; Paap & Greenberg, 2013). This question was also raised within the community, with many parents and teachers believing that despite lottery assignment, the dual-language students were a select group, and thus, any advantages found were reflective of the precocious nature of a select group of students rather than a result of the education model. To address this question, we conducted a follow-up study (Esposito, 2018). Reflecting our expanding collaboration, the school system allowed us more time with each child (expanded from 15 min for the initial study) and access to parents to complete a family questionnaire (not available for the initial study). These additions allowed us to examine group differences between education models that might have accounted for the differences in EF performance.

In this second investigation, we took into account the possibility of socioeconomic and other family-level variables by creating a yoked control of traditionally educated children who were matched to dual-language participants on parents’ level of education, child’s home language, English vocabulary, and nonverbal intelligence (Esposito, 2018). The yoked sample consisted of 80 early ($M_{\text{age}} = 6;9$) and 42 late ($M_{\text{age}} = 11;0$) elementary school children who completed three computerized measures of EF. No difference was found between groups on two of the tasks, but the dual-language children in upper elementary school outperformed the traditionally educated children in the Simon task of

inhibitory control (Simon, 1969). The EF advantage was not present at the early elementary level (K–1) but was present at the upper elementary level (Grades 4–5). The emerging advantage replicated the previous findings (Esposito & Baker-Ward, 2013). The results highlight the need for more information regarding the contexts and conditions under which an advantage is apparent and those under which it is not. Importantly, there were no differences found between education models on parent involvement or extracurricular opportunities. Given this finding and the yoked control, we concluded that the differences in EF performance could not be explained as a function of uncontrolled differences between the groups (Esposito, 2018).

The findings were of great interest to the community and support the possibility of emerging benefits associated with dual-language education. At the minimum, the findings showed no indication of harm resulting from enrollment in the dual-language education model. This news was encouraging for the school system, and it allowed them to set aside some concerns that the dual-language model might potentially negatively impact the very children they were attempting to help.

Study 2: Dual-language education and academic performance

A recurring concern in the community regarding the dual-language program is the effect on academic performance. Parents, teachers, and administrators were all uncertain as to whether receiving half of classroom instruction through Spanish would negatively impact long-term performance on literacy achievement and mandatory state testing (conducted in English). These “high-stakes” tests, beginning in third grade, determine grade promotion. Parents were often concerned about their children remaining in the dual-language program for third grade, regardless of academic progress made to that point, due to the pending tests. Regardless of whether home language was Spanish or English, parents were uncertain if their children were acquiring the necessary English literacy to perform well.

We helped address these concerns by conducting public forums in which we presented results from extant research on bilingual education outcomes. We shared with the community the absence of evidence that dual-language education is detrimental to academic performance, regardless of home language. We highlighted observations that contrary to this assumption, there is overwhelming support that children participating in dual-language education perform at or above the level of their peers in single-language education, and this result has been consistent for both majority- and minority-language speakers (see Greene, 1998; Rolstad, Mahoney, & Glass, 2008, for examples of meta-analyses). We explained that such programs have excellent outcomes for minority-language speakers, with children enrolled in dual-language two-way immersion programs outperforming peers in other forms of bilingual education such as transitional bilingual education (e.g., Lindholm-Leary & Block, 2010; Marian, Shook, & Schroeder, 2013). The parents, teachers, and community members listened to the research presentation and nodded their heads in understanding. When the forum concluded and questions were invited, one by one, they stood up and asked, “Yes, but what about *my* child/student/school?” The parents, teachers, and community members wanted to know how this program impacted school performance in their setting, using their program, and with their children. Thus, we examined just that.

To address community and school system concerns regarding academic achievement in their schools with their program, we initiated original data collection. Most pressing was the question of the generalizability of findings for the specific community as well as whether the findings had adequately taken into account demographic factors that might contribute to the academic performance of children participating in the dual-language program. The extant research did not have individual measures of socioeconomic status or child intelligence that could help control for what might be preexisting group differences. With these questions in mind and with cooperation from the school system for more time with each child and parent involvement in the research, we examined academic performance as part of the 2013 study.

As part of the previously discussed 2013 data collection effort (Esposito, 2018), the school shared specific measures of academic performance. This information permitted us to compare academic performance between education models with a yoked control matched on parents' level of education, child's home language, English vocabulary, and nonverbal intelligence. The results replicated those of previous studies showing either no differences or advantages in favor of the dual-language program. Specifically, no differences in academic performance between education models were found for children in the primary grades (K–1) or in state standardized tests for intermediate school students (Grades 4–5). Intermediate school students enrolled in the dual-language education model had higher academic performance as measured by classroom grades compared with their traditionally educated peers.

These findings were a relief to the school board and provided the answers they needed to help parents make decisions about initial enrollment and persistence in the dual-language model, especially after Grade 2 when state high-stakes testing begins. This information also served to reduce the assumption teachers held within the school system that those in the dual-language program represented a select group of students and thereby increased support for the program and participating teachers.

Study 3: Dual-language education and English-language growth

The findings reported in Studies 1 and 2 helped to ease concern about academic performance among parents, teachers, and school administrators. Yet they left open another question equally concerning to the community—namely, whether regardless of home language, children in dual-language instruction would fail to achieve comparable English language or literacy relative to children enrolled in the traditional English-only classroom. Fear of “linguistic confusion” is a recurring concern for care providers and parents raising bilingual children (Bialystok, 2012; Cummins, 1981). This concern was a common reason parents provided for not enrolling in the lottery for the dual-language program. The concern is not without foundation. Although children growing up bilingual do not show evidence of language confusion (see Guiberson, 2013, for a review), there is evidence that they have smaller vocabularies in each of their languages compared with the vocabulary size of monolingual speakers (e.g., Bialystok, 2009). To address questions about language development, we began measuring English-language proficiency in 2015. Here we present the first report of 3 years of data on vocabulary development.

Method

Participants

For this investigation, we included all children for whom we had English vocabulary information. Thus, participants were 712 children (380 female) enrolled in the traditional or dual-language education model in kindergarten through Grade 5 during 2015 to 2017 in the participating schools (see Table 1). Consent forms were sent home through parent communication folders (the typical means of communication between the school system and students' parents/guardians). Only the children whose parents/guardians returned signed consent forms were included in analyses (approximately 60% of the population). Reflecting the diversity of the community, based on parental report, the sample was 33% African American, 24% Caucasian Non-Hispanic, and 33% Caucasian Hispanic; 7% reported more than one racial group, and the racial/ethnic background of the remaining 3% was unknown. Approximately 87% of children in the community qualified for federally funded school lunch assistance. Of the 440 participants whose families reported caregiver education, 50% reported a high school education or less, 20% had some training beyond high school, 13% had a technical or associate degree, and 13% had a college bachelor's degree.

Measure

The Woodcock-Muñoz Language Survey®-Revised Normative Update English is a norm-referenced measure of language proficiency level and is appropriate for ages 2 years to 90 + years. We used English comprehension measures Verbal Comprehension Test 1, vocabulary, and Test 2, analogies. Raw scores within each subtest were recorded and summed to create a verbal comprehension measure.

Procedure

The English vocabulary measure was included as part of a larger longitudinal study. We included children who provided data during at least 1 of the 3 years the English vocabulary measure was given and who could have provided data for up to 3 years. Each year, children met with a research assistant in a quiet classroom within their school. Children provided assent before participating. They completed a battery of cognitive measures as part of an ongoing investigation prior to the English vocabulary measure. Research assistants were extensively trained and were monitored by the first author during data collection to ensure protocol fidelity.

Findings

We analyzed the longitudinal trajectories of English verbal comprehension and explored effects of the home language, education model, and the interaction of Home Language \times Education on children's levels and rates of change in this construct.

We fit unconditional and conditional quadratic latent growth curve models in MPlus (Comparative Fit Index = .95 and .96; root mean square error of approximation = .05 and .04; CI [0.03, 0.07] and CI [0.02, 0.05], respectively) with freely estimated variances (i.e., random effects) for the intercept and the linear slope but not the quadratic slope (preliminary analyses indicated this specification was the most appropriate). Results from the

unconditional model revealed a significant mean of the intercept and linear and quadratic slopes ($b = 33.11, 6.35, \text{ and } -0.59; SE = 0.68, 0.42, \text{ and } 0.07, \text{ respectively}; ps < .001$), which indicated average English comprehension in kindergarten was significantly different from 0 and showed significant growth over time, which slowed down toward the later years. There was also significant variability in the intercept ($b = 91.07, SE = 9.91, p < .001$) and linear slope ($b = 1.69, SE = 0.80, p < .034$), pointing to significant departures of individuals from the average starting point and linear trajectory in English verbal comprehension.

Results for the conditional model are depicted in [Figure 1](#). The conditional model pointed to significant effects of home language on both intercept ($b = -8.79, SE = 1.25, p < .001$) and linear slope ($b = 0.77, SE = 0.34, p = .024$). Kindergarten children who indicated speaking Spanish in the home had lower initial English comprehension performance compared with their peers who spoke English in the home. Second, children who indicated speaking Spanish in the home had a steeper linear slope of English acquisition compared with those who spoke English at home. There was no main effect or interaction with education model, indicating that neither initial English comprehension nor linear rate of change differed for students in the traditional English education model compared with the dual-language model.

Language Development by Education Program and Home Language

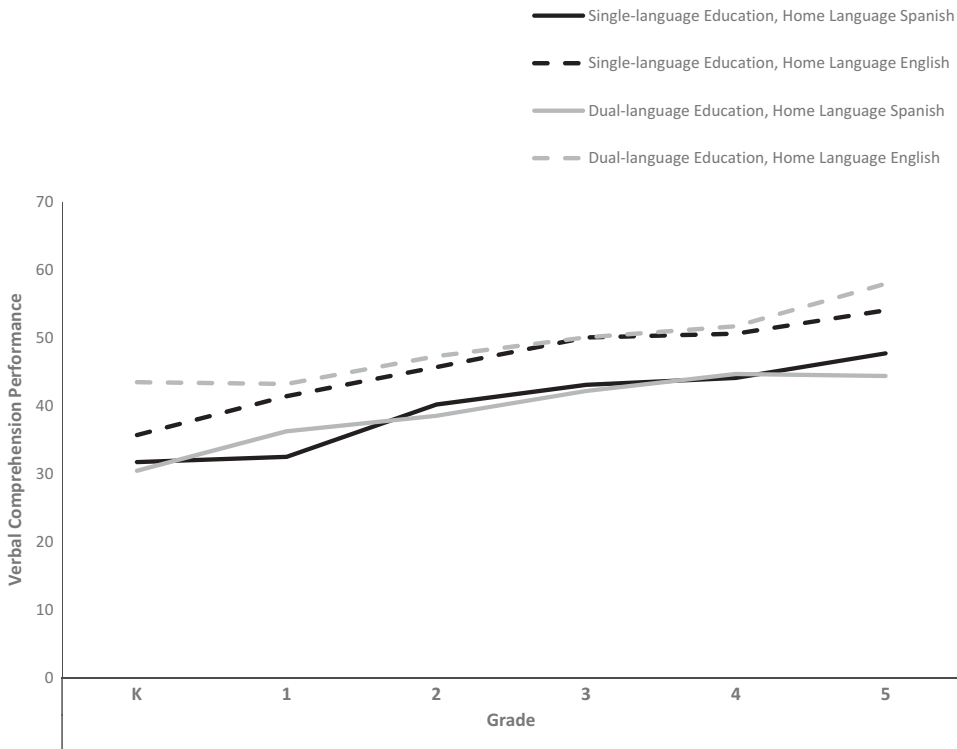


Figure 1. English verbal comprehension scores for children in traditional English education and dual-language education, presented for native Spanish and native English speakers.

The analyses reported are encouraging, as the results showed no evidence of harm. Children who spoke Spanish at home started kindergarten with lower English verbal comprehension than that of children who spoke English at home. Similarly, children who spoke Spanish at home showed more improvement in English growth over time than did children who spoke English at home as they rapidly acquired English once instruction began in the school setting. Of great importance to the collaborating school system and to policymakers regarding support for dual-language education, there were no significant effects or interactions with the educational model. In short, children in the dual-language model acquired as much English as students in the English-only education model, regardless of home language.

Study 4: Ongoing research on the implications for content delivery in the dual-language environment

Teachers and administrators involved in dual-language education, including those in the participating schools, are interested not only in achievement, but also in how best to foster it. Specifically, they are interested in best practices for delivery of content. In the world of dual-language two-way immersion, there are several different models for content presentation. One model presents different subjects through different languages, but within a subject, a consistent language is used (e.g., science in Spanish and math in English). Another model alternates days of instruction (such that math is taught through English on Monday, Spanish is taught on Tuesday, etc.) without repeating lessons. Although both models require integration across subject areas, the latter model also requires extensive integration of lessons within a subject area as children build content each day onto the lesson from the previous day that was presented in the alternate language. The participating school system uses the alternating day model, but administrators questioned whether the cost of integration across languages was too high, indicating they should switch to the one-language, one-subject model.

The underlying issue in regard to how to best present content in dual-language models is the question of how children accumulate and integrate content across different languages and language environments. We have been investigating this question in the laboratory through a paradigm that informs how well children integrate separate learning episodes under different conditions, including across languages (e.g., Bauer & San Souci, 2010). In this paradigm, children are prompted to self-derive new information through the integration of separate episodes of new learning. For example, children are presented with a story with the embedded fact, “Golden apple seeds taste like almonds” (Episode 1, Stem Fact 1). After a delay, they are presented with another story containing the fact, “Apricots are also called golden apples” (Episode 2, Stem Fact 2). If they successfully integrate the two related episodes, they are more likely to produce an answer to the integration question, “What do apricot seeds taste like?” (almonds)—a fact that was never stated. Performance on this paradigm has predicted academic performance in both reading and math (Esposito & Bauer, 2017). Laboratory research has revealed that performance suffered when the separate episodes of learning did not share characteristics (e.g., different characters featured in the related stories) compared with when characteristics were overlapping (e.g., the same character featured in the related stories; Bauer, King, Larkina, Varga, & White, 2012). This finding suggests to us that performance may also suffer when separate episodes are presented through different languages.

We examined cross-language integration in the dual-language classrooms by presenting related lessons in an English-only condition and a Spanish/English condition (Esposito & Bauer, 2018). We expected to see lower performance in the cross-language condition compared with the English-only condition. Surprisingly, this hypothesis was only partially supported. In the early grades (Grades 1–2), when children were provided the facts through richly illustrated and contextualized stories (see Bauer & San Souci, 2010, for examples), performance did not differ between the English-only control and the cross-language Spanish/English condition. The contextual support appears to aid integration and self-derivation even for children early in their second-language acquisition. In the middle grades (Grades 3–4), we utilized a single-sentence paradigm that provided little contextual support. Under these conditions, 3rd graders performed significantly better in the English-only condition compared with the cross-language condition, in which performance did not differ from chance. Cross-language performance recovered in 4th grade, when it no longer differed from English-only performance. The results suggest that contextual support can mitigate the difficulties of cross-language integration and subsequent self-derivation.

These results indicate benefits to contextual support but are not yet informative to educational policy. In addition to tests for replication, there are several next steps to help inform dual-language best practices. An important first step is to examine how same-language self-derivation in the *minority* language compares to English-only and cross-language performance (to date, we have only compared cross-language performance to same-language self-derivation in the *majority* language). There are two equally logical possibilities. Cross-language integration could be more difficult than single-language integration because it requires children to integrate and build a knowledge base across two languages that lack the surface similarity upon which young children often depend to recognize that material is related and can be integrated (see Bauer & Larkina, 2017, for discussion). Alternatively, single-language integration through the emerging second language could be more difficult because children may not comprehend the individual facts well enough to create a conceptual representation. With cross-language self-derivation, at least one fact is presented through the home language and can serve as a foundation on which the second fact can build. Our ongoing collaboration with the school system will address this question.

From bench to classroom and back again

In this section, we review the scientific lessons learned through our bench–classroom collaboration. We then discuss some of the costs and benefits of such collaborations, followed by some suggestions for ways to initiate collaborations between bench scientists and educational practitioners.

Scientific lessons learned

Our research with the participating schools has resulted in new knowledge both for basic science and the school system itself. Through our ongoing partnership, we have found some evidence of benefits of dual-language education that extend beyond second-language development. Specifically, there is support for an emerging advantage in the areas of EF

and academic performance that will be further informed by the examination of the longitudinal data currently under way. Additionally, the alliance has provided needed information to help guide future research on dual-language content presentation, particularly in the area of contextual support, which may mitigate the difficulties of integration across languages. Importantly, we found no evidence of harm for children participating in the dual-language program in the areas of EF, academic achievement, and English-language development.

Under typical publication guidelines, the absence of group differences found in this research might eliminate a report from consideration for publication in a peer-reviewed outlet, especially one with a strong impact factor. Yet in the present case, the absence of group differences was informative to the school system and meaningful as a guide in making programming decisions. Frequently, research on bilingualism or bilingual education hypothesizes an *advantage* in cognitive functioning. In our experience, the school system was less concerned about specific areas of cognition and was more interested in the impact of educational intervention on the language and academic goals of the school system. Specifically, they questioned whether the programming was leading to lower academic or English-language development. Through our collaboration with the school system, we framed our research questions in terms of potential harm, rather than in terms of potential benefit. The resulting “null effect” was vitally important information to the schools. We appreciate this opportunity to share this information more broadly, and we hope it may inform other school systems using dual-language two-way immersion models.

Costs and benefits of collaboration

Through our bench–school collaboration, we have also learned lessons for working with schools that may be of relevance to others considering such a collaboration. Some lessons are obvious, whereas others may be less so. First and foremost, researchers need to consider whether their questions are suited to the unique limitations and benefits of school data collection. One such limitation is lack of experimental control. Ecological validity and tightly controlled experimental conditions often operate on a continuum, and research in classrooms slides us away from the tightly controlled conditions of the laboratory. To put it bluntly, school data collection is messy. A perennial issue is missing data. One source of missing data is child absence. Given time constraints imposed by the school system, we could not reschedule data collection or return for children who were absent during planned data collection. These limitations are especially concerning for longitudinal studies. Moreover, children sometimes are called out of class in the middle of data collection, which results in “spotty” data collection, such that some portions are complete and others are missing. Researchers need to go in with a-priori goals for data collection and need to be prepared to make decisions regarding how to aggregate data when portions are missing.

Amid these challenges, there are also benefits. Laboratory samples are limited to those participants who have the means to come to the laboratory. By bringing the research to the children, we are able to work with a much wider demographic that is more representative of the entire population of children. Classroom work also provides more ecological validity relative to many laboratory paradigms. If we want to study how children learn, it is beneficial to study learning within the institution designed to educate

children. It also allows for the examination of academic performance with the measures that are actually used for grade promotion and entrance to institutions of higher education. Together, these benefits are substantial compensation for the challenges associated with school-based data collection. .

Suggestion for 'how to' get started in school-based research

For those who determine research in the schools is the right choice for their work, we offer some guidance to establish and maintain a mutually beneficial relationship. Although there is no exact recipe that will work in all populations, our recommendations are likely to be useful across communities. Here, we outline an attitude of generosity, respect, and transparency that has been the foundation for all our work in schools, including the relationship described in this report.

An attitude that is foundational for success is one that is generous, such that it weights the needs of the collaborating school more heavily than the needs of the researcher. This attitude entails asking the question of how we can give back. We approach school systems by first explaining what we study and why we are interested in their population and then by asking what supports we might be able to provide that would address some of their current needs to ensure they can benefit from our involvement. Examples include establishing a tutoring program, analyses of school data (such as attendance), or providing open research forums for teachers or parents. The school may also be interested in exposing their students to science and scientists. Our own research team is diverse. The school system values exposing students to role-model scientists who represent gender, racial, ethnic, and linguistic diversity. There are many ways we as scientists can give back, and a true collaboration requires that we find them.

A second recommendation is to respect the classroom objectives. Although as researchers, we understand that our work is contributing to science broadly, we do not often focus on direct benefits for the participants. However, the schools have a very immediate goal of educating the children in their care. When we pursue a partnership with a school system, we must be aware of the pressure administrators are under for each student to perform. We limit what we ask of teachers to only those tasks that only they can do (scheduling a time for participation) and take over all other tasks (managing consent, distribution of gift cards). We choose the shortest available valid measures and, whenever possible, align our stimuli to the curriculum. We capitalize on existing school organizational systems for parent communication. Coopting these procedures reduces the organizational load on the school system and participating families. We express gratitude to the community for their investment in our research, both in communications and in tokens of appreciation. We remember at all times that we are guests in their school and that our agenda is secondary to the mission of educating the children. Thus, if things come up last minute that require our flexibility, we adjust with a smile. Respecting their objectives strengthens our alliance.

A third recommended pillar for a successful partnership is transparency. We lay out our objectives and the school's logistical involvement clearly from the beginning, and we communicate both the extant research and the findings from the collaboration. We originally started the partnership with the assumption that the school system was familiar with research to date regarding educational programming in general and dual-language education in particular. Yet through communication, we found that some of our

established scientific practices presented impediments to interpreting and understanding our results, even among educational professionals. For example, educational professionals are not necessarily conversant with p values and effect sizes. As a result, findings and relations that we regard as well established were not necessarily accepted by the community, which guided our approach to communication. Through regular meetings with all personnel and the community, we had opportunities to learn of their concerns and to share our findings and those from the larger research enterprise in ways that fostered understanding and thus furthered the collaboration.

Conclusions

Collaborating with school systems has its own challenges and rewards. The partnership described here has been mutually beneficial in addressing the needs of the school community and in pursuit of our research interests. Our collaboration produced results relevant to our initial research questions regarding cognitive development and second-language acquisition as well as to the community questions regarding academic performance and English-language development. Across these questions, we have found no evidence of detrimental effects of dual-language instruction, and when differences have emerged, they have indicated some benefits to participating children. We were also able to begin to examine content presentation in the dual-language environment, an area we will continue to develop with promise for informing educational policy. In true collaborative spirit, the questions we addressed informed basic science and simultaneously provided immediate and tangible service to the participating community.

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References

- Alanís, I., & Rodriguez, M. A. (2008). Sustaining a dual language immersion program: Features of success. *Journal of Latinos and Education*, 7(4), 305–319. doi:10.1080/15348430802143378
- Archibald, S. J., & Kerns, K. A. (1999). Identification and description of new tests of executive functioning in children. *Child Neuropsychology*, 5, 115–129. doi:10.1076/chin.5.2.115.3167

- Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development, 83*(2), 413–422.
- Bauer, P. J., King, J. E., Larkina, M., Varga, N. L., & White, E. A. (2012). Characters and clues: Factors affecting children's extension of knowledge through integration of separate episodes. *Journal of Experimental Child Psychology, 111*(4), 681–694. doi:10.1016/j.jecp.2011.10.005
- Bauer, P. J., & Larkina, M. (2017). Realizing relevance: The influence of domain-specific information on generation of new knowledge through integration in 4- to 8-year-old children. *Child Development, 88*(1), 247–262. doi:10.1111/cdev.2017.88.issue-1
- Bauer, P. J., & San Souci, P. (2010). Going beyond the facts: Young children extend knowledge by integrating episodes. *Journal of Experimental Child Psychology, 107*(4), 452–465. doi:10.1016/j.jecp.2010.05.012
- Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition*. Cambridge, UK: Cambridge University Press.
- Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language and Cognition, 12*(1), 3–11. doi:10.1017/S1366728908003477
- Bialystok, E. (2012). *The impact of bilingualism on language and literacy development* (Second ed., pp. 624–648). Hoboken, NJ: The Handbook of Bilingualism and Multilingualism.
- Bialystok, E., Craik, F. I., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19*(2), 290. doi:10.1037/0882-7974.19.2.290
- Bialystok, E., & Majumder, S. (1998). The relationship between bilingualism and the development of cognitive processes in problem solving. *Applied Psycholinguistics, 19*(1), 69–85. doi:10.1017/S0142716400010584
- Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition, 112*(3), 494–500. doi:10.1016/j.cognition.2009.06.014
- Blumenfeld, H. K., & Marian, V. (2014). Cognitive control in bilinguals: Advantages in Stimulus–Stimulus inhibition. *Bilingualism: Language and Cognition, 17*(3), 610–629. doi:10.1017/S1366728913000564
- Bowie, C. R., & Harvey, P. D. (2006). Administration and interpretation of the Trail Making Test. *Nature Protocols, 1*(5), 2277.
- Burkhauser, S., Steele, J. L., Li, J., Slater, R. O., Bacon, M., & Miller, T. (2016). Partner-Language Learning Trajectories in Dual-Language Immersion: Evidence From an Urban District. *Foreign Language Annals, 49*(3), 415–433. doi:10.1111/flan.v49.3
- Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11*(2), 282–298. doi:10.1111/j.1467-7687.2008.00675.x
- Costa, A., Hernández, M., Costa-Faidella, J., & Sebastián-Gallés, N. (2009). On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition, 113*(2), 135–149. doi:10.1016/j.cognition.2009.08.001
- Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition, 106*(1), 59–86. doi:10.1016/j.cognition.2006.12.013
- Cummins, J. (1981). Four misconceptions about language proficiency in bilingual education. *Nabe Journal, 5*(3), 31–45. doi:10.1080/08855072.1981.10668409
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135–168. doi:10.1146/annurev-psych-113011-143750
- Esposito, A. G. (2018). *Advantages of dual-language education: Executive function and academic performance among rural, low-income children*. Manuscript submitted for publication.
- Esposito, A. G., & Baker-Ward, L. (2013). Dual-language education for low-income children: Preliminary evidence of benefits for executive function. *Bilingual Research Journal, 36*(3), 295–310. doi:10.1080/15235882.2013.837848
- Esposito, A. G., Baker-Ward, L., & Mueller, S. T. (2013). Interference suppression vs. response inhibition: An explanation for the absence of a bilingual advantage in preschoolers' Stroop task performance. *Cognitive Development, 28*(4), 354–363. doi:10.1016/j.cogdev.2013.09.002

- Esposito, A. G., & Bauer, P. J. (2017). Going beyond the lesson: Self-generating new factual knowledge in the classroom. *Journal of Experimental Child Psychology*, 153, 110–125. doi:10.1016/j.jecp.2016.09.003
- Esposito, A. G., & Bauer, P. J. (2018). Building a knowledge base across languages: Self-generating new factual knowledge in a dual-language classroom. Manuscript submitted for publication.
- García, E. E., & Nanez, J. E., Sr. (2011). *Bilingualism and cognition: Informing research, pedagogy, and policy*. Washington, DC, US: American Psychological Association.
- Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, 1(2), 67–81. doi: 10.1017/S1366728998000133. ISSN 1469–1841.
- Greene, J. P. (1998). *A meta-analysis of the effectiveness of bilingual education*. Claremont, CA: Tomas Rivera Policy Institute.
- Guiberson, M. (2013). Bilingual myth-busters series language confusion in bilingual children. *Perspectives on Communication Disorders and Sciences in Culturally and Linguistically Diverse Populations*, 20(1), 5–14. doi:10.1044/cds20.1.5
- Hakuta, K., & Mostafapour, E. F. (1998). Perspectives from the history and the politics of bilingualism and bilingual education in the United States. In I. Parasnis (Ed.), *Culture and language diversity and the deaf experience* (pp. 38–50). Cambridge, UK: Cambridge University Press.
- Kaushanskaya, M., Gross, M., & Buac, M. (2014). Effects of classroom bilingualism on task-shifting, verbal memory, and word learning in children. *Developmental Science*, 17(4), 564–583. doi:10.1111/desc.2014.17.issue-4
- Kovács, Á. M., & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. *Proceedings of the National Academy of Sciences*, 106(16), 6556–6560. doi:10.1073/pnas.0811323106
- Lindholm-Leary, K. (2012). Success and challenges in dual language education. *Theory Into Practice*, 51(4), 256–262. doi:10.1080/00405841.2012.726053
- Lindholm-Leary, K., & Block, N. (2010). Achievement in predominantly low SES/Hispanic dual language schools. *International Journal of Bilingual Education and Bilingualism*, 13(1), 43–60. doi:10.1080/13670050902777546
- Lindholm-Leary, K., & Genesee, F. (2014). Student outcomes in one-way, two-way, and indigenous language immersion education. *Journal of Immersion and Content-Based Language Education*, 2(2), 165–180. doi:10.1075/jicb.2.2.01lin
- Lindholm-Leary, K. J. (2001). *Dual language education* (Vol. 28). Avon, England: Multilingual Matters.
- Marian, V., Shook, A., & Schroeder, S. R. (2013). Bilingual two-way immersion programs benefit academic achievement. *Bilingual Research Journal*, 36(2), 167–186. doi:10.1080/15235882.2013.818075
- Martin-Rhee, M. M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition*, 11, 01. doi:10.1017/s1366728907003227
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49–100. doi:10.1006/cogp.1999.0734
- Morton, J. B., & Harper, S. N. (2007). What did Simon say? Revisiting the bilingual advantage. *Developmental Science*, 10(6), 719–726. doi:10.1111/desc.2007.10.issue-6
- Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology*, 66(2), 232–258. doi:10.1016/j.cogpsych.2012.12.002
- Poarch, G. J., & van Hell, J. G. (2012). Executive functions and inhibitory control in multilingual children: Evidence from second-language learners, bilinguals, and trilinguals. *Journal of Experimental Child Psychology*, 113(4), 535–551. doi:10.1016/j.jecp.2012.06.013
- Prior, A., & Gollan, T. H. (2011). Good language-switchers are good task-switchers: Evidence from Spanish–English and Mandarin–English bilinguals. *Journal of the International Neuropsychological Society*, 17(4), 682–691. doi:10.1017/S1355617711000580

- Rolstad, K., Mahoney, K., & Glass, G. V. (2008). The big picture in bilingual education: A meta-analysis corrected for gersten's coding error. *Journal of Educational Research & Policy Studies*, 8(2), 1–15.
- Serpell, Z. N., & Esposito, A. G. (2016). Development of executive functions: Implications for educational policy and practice. *Policy Insights from the Behavioral and Brain Sciences*, 3(2), 203–210. doi:[10.1177/2372732216654718](https://doi.org/10.1177/2372732216654718)
- Simon, J. R. (1969). Reactions toward the source of stimulation. *Journal of Experimental Psychology*, 81(1), 174. doi:[10.1037/h0027448](https://doi.org/10.1037/h0027448)
- Thomas, W. P., & Collier, V. (1997). School effectiveness for language minority students. NCBE Resource Collection Series, No. 9.
- Thomas, W. P., & Collier, V. P. (2002). A national study of school effectiveness for language minority students' long-term academic achievement.
- Valian, V. (2015). Bilingualism and cognition. *Bilingualism: Language and Cognition*, 18(1), 3–24. doi:[10.1017/S1366728914000522](https://doi.org/10.1017/S1366728914000522)