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Examining Different Patterns of Children's Early Dual Language Development and Nonverbal Executive Functioning

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EXAMINING DIFFERENT PATTERNS OF CHILDREN'S EARLY DUAL

LANGUAGE DEVELOPMENT AND NONVERBAL

EXECUTIVE FUNCTIONING

by

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ABSTRACT

Examining Different Patterns of Early Dual Language Development
and Nonverbal Executive Functioning

by

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A quarter of children in the Head Start program come from homes where a language other than English is spoken. Previous research indicates that bilingualism has a positive cascading influence on executive functioning development. From this perspective, it is possible that children who experience different patterns of language learning may have different outcomes in terms of executive functioning. The purpose of this study was to explore patterns of receptive Spanish and English language development, identify subgroups of Head Start children with different language trajectories, and examine whether executive functioning skills differed by group membership. Extant data from the Family and Child Experiences Survey (FACES:2009) were analyzed. Children from Spanish-speaking households who were three years old when they participated in the study were selected for analyses. Data were collected at three time points spanning two full years of Head Start participation.

Parallel-process growth mixture modeling identified three patterns of dual

language development. The smallest group (Average English and Spanish) was characterized by standard scores of English and Spanish in the ‘Average’ range across time. The second group (Moderately Low Increasing to Average English; Stable Average Spanish) showed Spanish and English standard scores that were closely related across time. Standard scores for this group were on the cusp between the ‘Average’ and ‘Moderately Low’ ranges. The final, and largest, group (Increasing Extremely Low English; Stable Average Spanish) had Spanish standard scores in the ‘Average’ range across time and English standard scores that increased more than one standard deviation, to ‘Moderately Low,’ by Head Start exit. Effects of group membership on executive functioning scores at Head Start exit were tested. The second group, with similar standard scores in English and Spanish across time, performed statistically significantly better on the executive functioning task than children in the largest group.

Results suggest the positive relation between bilingualism and executive function may be due to cascading effects between overlapping processes. Implications for policy and practice discuss the positive implications for supporting the development of two languages for children who are from non-English-speaking homes. Limitations and future directions are also identified.

(111 pages)

PUBLIC ABSTRACT

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Children from non-English-speaking homes often lag behind their English-speaking peers academically. However, people who speak two languages often have better executive functioning skills than people who speak only one language. Executive functions are neurologically-based skills related to managing oneself to achieve a goal. The relation between bilingualism and executive function may be due to how two languages are processed in the brain. However, it is unclear if more balanced bilinguals experience larger gains in executive function than people who are less balanced.

Children from low-income homes are at a disadvantage as compared to children from homes with higher incomes. A quarter of children in the Head Start program, which serves children from low-income homes, come from homes that speak a language other than English which puts them at a double disadvantage. Longitudinal data from 3-year-old children enrolled in Head Start who were from Spanish-speaking households were used to investigate whether there were different patterns of dual language development and if those patterns related differently to executive function.

Results revealed three groups of dual language development. Groups were compared in terms of children's performance on a nonverbal executive functioning task. Results showed that children in the group that had the most similar proficiency between English and Spanish had the highest average executive functioning scores, even after

controlling for child age and gender. This indicates balanced bilingualism may enjoy additional benefits to executive functioning development as compared to individuals with relative imbalance between languages.

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CHAPTER I

INTRODUCTION

Over 25% of families served by Head Start report a language other than English as their primary home language. The largest portion of non-English speakers identified Spanish as their home language (Office of Head Start, 2014). Reports from nationally representative assessments of the Head Start program indicate that, at entrance to the program, average scores of both Spanish and English vocabularies are more than one standard deviation below the mean (Malone et al., 2013). This report is not surprising given the documented impact of poverty on monolingual children's language development (Hart & Risley, 1995). Children from low-income Spanish-speaking homes are at a compounded disadvantage as they may enter school understanding very few words in the dominant language of the classroom.

At a national level, children who are dual language learners (DLLs) have scores that consistently lag behind their peers who are not DLLs. This is true across grade levels (4^{th}, 8^{th}, and 12^{th}) and across subjects (math, science, and reading; NAEP, 2015). Despite targeted research initiatives and practice recommendations, these gaps have seen little change between 2003 and the most recent data collection effort in 2015 (NAEP, 2015). Children of immigrants are more likely to be bilingual because the language of their home country may not be the same as the majority language spoken in their host country. These children typically achieve lower scores on standardized reading and math assessments (Aud et al., 2012; Entorf & Minoiu, 2005; Fleischman, Hopstock, Pelczar, & Shelley, 2010) and are more likely to repeat a grade or drop out of high school (Child

Trends Data Bank, 2012, 2013). Historically, there have been two opposing policies to address this problem: English-only versus dual-language instruction. State-wide policies mandating one approach over the other vary across the U.S.

Supporters of policies mandating English-only instruction believe it is essential that children learn English in order to achieve academic success. From this perspective, providing dual-language instruction is a crutch that prevents children who are learning two languages from being able to graduate from high school with the necessary English language skills to succeed in college or get well-paying employment. Indeed, research does indicate that bilingualism slows English vocabulary acquisition in young children (Bialystok, Luk, Peets, & Yang, 2010; Fernandez, Pearson, Umbel, Oller, & Molinet-Monina, 1992). Some parents and teachers have expressed concern that providing instruction in two languages may confuse children and delay development of oral, reading, and writing skills (Sawyer, Manz, & Martin, 2017; Thomas, 2017). In addition, dual language classrooms can be more expensive than monolingual instruction due to the need for bilingual teachers who have additional skill and certification in dual language instruction. Some models of dual language instruction depend on having sufficient numbers of both children who are DLLs and children who are native English-speaking to ensure there are enough speakers of each language to provide ample volume of exposure. This requires parents of both groups to place value on bilingualism.

Research reports that a strong foundation in a home language promotes the development of English (August & Shanahan, 2006; Genesee, Lindholm-Leary, Saunders, & Christian, 2006; Tabors, 1997). In addition, as compared to people who are monolingual, people who are bilingual also appear to have an advantage in the

development of cognitive skills such as executive functioning (hereafter EF; Akhtar & Menjivar, 2012; Bialystok, 2001; Calvo & Bialystok, 2014; Carlson & Meltzoff, 2008; Mezzacappa, 2004). EF is essential to academic success in the areas of math, science, and reading (Best, Miller & Naglieri, 2011; Bierman, Torres, Domitrovich, Welsh, & Gest, 2009; Blair, 2002; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Bull, Espy & Wiebe, 2008; Smith-Donald, Raver, Hayes, & Richardson, 2007; Thorell & Wåhlstedt, 2006). EF is a set of processes that all have to do with managing oneself in order to achieve a goal (Miller & Cohen, 2001) and can be thought of as the neurological supervisory system responsible for planning, reasoning, and the integration of thought and action (Shallice, Burgess, & Robertson, 1996). Often, cognitive development research distills EF into smaller component parts that include: working memory, (holding information in mind while performing some operation), inhibitory control, (the inhibition of automatic responses or ability to ignore irrelevant information), and attention shifting, (the ability to shift concentration between separate but related aspects of a given task; Davidson, Amso, Anderson, & Diamond, 2006; Zelazo & Müller, 2002). Initial development of EF begins in infancy, and by 3 years of age children have been shown to be able to inhibit ‘‘instinctive’’ behaviors fairly well (Anderson, 2002; Diamond & Taylor, 1996; Espy, 1997). In previous research, the role of gender has been inconsistently reported as important only for specific areas of EF (e.g., girls outperform boys in verbal fluency, information processing, and spatial organization; Anderson, Anderson & Garth, 2001; Karapetsas & Vlachos, 1997; Levin et al., 1991).

Research indicates that the longer children who are learning two languages have lived in the U.S., the more likely they are to switch language preference from the home

language to English, thus possibly forfeiting associated increases in EF associated with bilingualism (Anderson, 2004; Jia & Aaronson, 2003; Kohnert, 2004; Kohnert & Bates, 2002; Portes & Schauffler, 1994). Rather than focusing solely on improving children who are DLLs English skills, it is critical that Head Start programs and teachers also support home languages. This will enable children who are learning two languages to engage in activities as soon as they enter the classroom without sacrificing the benefits associated with knowing two languages. Research has not yet addressed the long-term influence of first language loss. It is also unclear if varying levels of bilingual proficiency influences EF skill development. Understanding these unknowns may provide further evidence for how home languages can be a resource for students who are DLLS, especially for those who are enrolled in Head Start.

One of the biggest barriers to answering these questions may be the methods currently in use. The balance between languages is often ignored in research with bilingual populations. Criteria for participant inclusion often relies on qualitative self-report rather than quantitative measures of proficiency. The few studies that have used quantitative measures use methods that require a lot of resources and time. Thus, the results cannot feasibly be implemented on a large scale or on a tight budget. A method for identifying profiles of dual language change is needed to provide a way for programs to understand the developmental trajectories of students who are DLLs. At a larger level, understanding what types of dual language development patterns are currently most common among students who are exposed to both Spanish and English who are enrolled in Head Start programs may be informative to policymakers as they consider the critical importance of first languages maintenance. The Head Start performance standards have

recently been updated to highlight the importance of recognizing the unique needs of children who are learning two languages (U.S. Dept. of HHS, 2016).

CHAPTER II

REVIEW OF THE LITERATURE

This chapter will identify the theoretical perspective that will be used to guide this research and review literature relevant to the proposed research questions. First, the theoretical lens will be presented. Then, the relation between bilingualism and EF will be examined. Next, research outlining what is known about first language shift, loss, and attrition will be reviewed. Finally, research outlining methods for measuring bilingualism will be outlined and critiqued.

Theoretical Framework

The developmental cascades theoretical framework highlights the cumulative influence of early disparities on children's developmental and academic outcomes (Bornstein et al., 2006; Marchman & Fernald, 2008; Masten & Cicchetti, 2010; Smith & Thelen, 2003). According to this theory, children's early experiences have a cascading influence on development both across domains and over time. Theoretically, cascades may be direct and unidirectional, direct and bidirectional, or indirect through various pathways. Over time, concepts encapsulated in this theory have gone by different names, including chain reactions, snowball, amplification, spillover, and progressive effects (Cicchetti & Cannon, 1999; Dodge & Pettit, 2003; Hinshaw, 1992; Masten & Coatsworth, 1998; Patterson, Reid, & Dishion, 1992; Rutter, Kim-Cohen, & Maughan, 2006).

An example of an often-studied cascade is the influence of living in poverty on children's development. Living in poverty is often coupled with a decrease of parental responsiveness and an increase of psychological distress (Bradley, Corwyn, McAdoo, & Garcia-Coll, 2001; Guo & Harris, 2000). Distressed parents may have reduced involvement in cognitively stimulating activities (Santos, Yang, Docherty, White-Traut, & Holditch-Davis, 2016). The reduced interactions may have indirect negative influence on children's language development (Guo & Harris, 2000; Hart & Risley, 1995). Without adequate vocabulary to make meaning of the world, children may struggle academically (Carlisle, Beeman, Davis, & Spharim, 1999; Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2004; Raikes et al., 2006). This illustrates the cascading influence of disparity in a single domain having a wide-ranging influence on broader areas of development.

Cascading interactions observed in monolingual children between verbal abilities, reading, and writing skills, are also relevant for children learning two languages (Brisk & Harrington, 2007). Exposure to language through listening and reading build receptive language which, in turn, leads to developments in productive language: speaking and writing. Children with strong productive language skills elicit interactions with parents and teachers, which in turn provides additional opportunities to be exposed to a greater amount and variety of vocabulary (Hoff, 2006; Pearson, 2007; Tamis-LeMonda, Bornstein, & Baumwell, 2001). In this regard, children's contributions and their environments interact to provide successive springboards for later learning. Similarly, a dearth in any area of language may have a cascading influence on other forms of language production or exposure.

Later achievements are built upon foundational skills developed early in life. For example, early oral language supports later storytelling (Smith & Thelen, 2003), which contributes to later reading trajectories (Gardner-Neblett & Sideris, 2017). Young children who enter school with well-developed EF abilities are at an advantage in their ability to learn additional skills such as reading, writing, and mathematics (Bull et al., 2008). These foundational skills also shape other people's interactions with individual children, thus their development, or stagnation, may explain the noted impact on other domains (Sameroff & Fiese 2000).

Well-timed targeted interventions can be influential in interrupting negative, or promoting positive, cascades. If interventions can be targeted on domains that are likely to have cascading influence on other areas this increase the probability of improving overall outcomes (Cicchetti & Gunnar, 2008; Masten, Long, Kuo, McCormick, & Desjardins, 2009). Thus, seemingly small changes may have vast impacts on larger outcomes. For example, high quality preschool programs can have a profound influence on later achievement (Heckman, 2006; Reynolds & Temple, 2006). Children's early language skills grow rapidly through the accumulation of daily interactions. These foundational experiences set trajectories for later academic performance. Thus, the decisions to structure early learning environments in ways that support, or ignore, children's first languages may have long-term repercussions for the development of the two languages, the development of EF, and subsequent academic success.

Head Start programs have many essential target outcomes, for children and a limited number of resources available. With this in mind, it may be fruitful to identify "points of leverage" that will create positive cascades with relatively minimal additional

effort. First language maintenance has the potential to have far-reaching positive impacts on children’s development in many domains. Bilingualism is often approached as an “all or nothing” endeavor that discounts the potential value of maintaining even limited first language proficiency. Furthermore, it is unclear if there are long-term costs associated with first language loss. Understanding the impact of language loss, and the connections between varying degrees of bilingualism and EF, will provide a more nuanced understanding of dual language development highlighting how early experiences in one domain can have a cascading influence on other areas of development.

Bilingualism and Executive Functioning

Bilingual children typically outperform monolingual children in nonverbal EF tasks (Bialystok, 2001; Carlson & Meltzoff, 2008; Mezzacappa, 2004). The bilingual advantage for EF development is most pronounced in tasks that focus on inhibition, working memory, and interference control (Bialystok, Craik, Green, & Gollan, 2009). The Pencil Tapping Task (Blair, 2002; Diamond & Taylor, 1996; Smith-Donald et al., 2007) has been shown to be an objective assessment of children’s self-regulation, particularly inhibitory control (Blair & Razza, 2007; Espy et al., 2004; McClelland, Cameron, Wanless, & Murray, 2007). An outline of how the task is administered can be found in the methods section of this document. Here, it is sufficient to say that The Pencil Tapping Task requires the examinee to hold a rule in working memory that requires the child to inhibit their natural response. One study has found a bilingual advantage for 3- to 4.5-year-old middle-class Canadian children completing a similar tapping task (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010). It is also important to note that this is

a non-verbal task; it does not require the child to read or produce any language as a part of the task. This makes it a particularly well-suited assessment for children learning two languages.

Previous research indicates that much of the improvement in EF may result from the repetitive experience of controlling two languages simultaneously and avoiding interference from the non-target language (Blumenfeld & Marian, 2007; Emmorey, Luk, Pyers, & Bialystok, 2008; Kroll, Bobb, & Hoshino, 2014; Rodriguez-Fornells, Rotte, Heinze, Nosselt, & Münte, 2002; Thierry & Wu, 2007). Psycholinguistic evidence suggests that both languages are constantly active during listening, speaking, or preparing to speak (Francis, 1999; Grainger, 1993; Kroll, Dussias, Bice, & Perrotti, 2015; Kroll, Dussias, Bogulski, & Valdes-Kroff, 2012; Marian & Spivey, 2003). Both languages have been shown to activate in a variety of tasks, including cross-language priming (Gollan Forster, & Frost, 1997), cross-language Stroop interference (Brauer, 1998; Chen & Ho, 1986), cross-language homograph recognition (Dijkstra, Grainger, & van Heuven, 1999) and cross-language picture naming (Hermans, Bongaerts, De Bot, & Schreuder, 1998). From a theoretical perspective, there may be a cognitive mechanism for language selection that guarantees fluent use of the target language for individuals who know more than one language. Think, for example, of an individual who is bilingual interacting in a monolingual environment. Although the nontarget language is unnecessary for comprehension during the interaction, the linguistic systems necessary for the unspoken language will still activate. However, because the production of an unknown foreign word would be met with surprise and confusion, a person who is bilingual must suppress the unrepresented language. Developmental cascade theory supports the possibility that

development of bilingualism may have a cross-domain influence on the development of EF.

The hypothesized mechanism for language selection may be part of a domain-general process for attention and inhibition. The constant engagement of this process for language selection may strengthen its abilities across domains to influence verbal and nonverbal abilities (Bialystok et al., 2009). Research suggests that neural regions associated with nonverbal attention switching overlap with those necessary for language selection, which lends support to the theory that bilingualism strengthens EF abilities through repetitive use of specific neural regions (Abutalebi & Green, 2007; De Baene, Duyck, Brass, & Carreiras, 2015; Luk, Green, Abutalebi, & Grady, 2012). A meta-analysis of 10 fMRI studies in which people who were bilingual performed a task that required them to switch between languages, supports this conclusion by indicating that the network that was activated during language switch was the domain-general EF network (Luk et al., 2012). Taken together, there is evidence for the interpretation that there is a cross-domain overlap in the attention processes used to control attention to languages and those used to control attention to nonverbal stimuli.

One of the most common critiques of research examining the relation between bilingualism and EF is the confounding influence of socioeconomic status (SES; Morton & Harper, 2007). Language proficiency outcomes for young children who are learning two languages have been found to be drastically different in higher- SES compared with lower-SES families (Fernald, Marchman, & Weisleder, 2013). Additionally, children from lower SES backgrounds who are monolingual show deficits in aspects of attention, including a reduced ability to ignore irrelevant information (Stevens, Lauinger, &

Neville, 2009). Children who are monolingual that live in materially disadvantaged circumstances are often, in turn, disadvantaged academically (Bradley & Corwyn, 2002). The combined influence of reduced quality and quantity of language (Hart & Risley, 1995; Hoff, 2003), reduced participation in learning activities (Bradley et al., 2001; Evans, 2004; Whitehurst et al., 1994), and reduced access to learning materials in the home due to less disposable income may be a part of the developmental cascade reflected in the associations between SES and cognitive outcomes (Guo & Harris, 2000; Hart & Risley, 1995).

Much of the literature describing differences between children who are monolingual and children who are bilingual has focused on higher-SES groups (e.g., Bialystok, 2010; Bialystok & Martin, 2004; Filippi et al., 2015; Yang, Yang, & Lust, 2011). Less is known about the influence of bilingualism for children who face challenges from lower SES and less stimulating home environments.

Several studies have justified comparisons between children who are monolingual and children who are bilingual from different SES profiles by using statistical procedures to control for the differences. For example, Carlson and Meltzoff (2008), controlled for SES in their analyses comparing EF outcomes in groups of 6-year-old children who were classified as either monolingual or bilingual. This method however, cannot fully consider the vast differences in experiences between high and low SES groups. Developmental cascades theory indicates that the consequences from early disparity irrevocably alter the course of development. Thus, statistically controlling for background variables is not equivalent to an experiment designed to compare groups with similar initial differences in experience. A better method to tease out the difference between effects attributed to

bilingualism or to SES would be to compare children who are bilingual and children who are monolingual with similar backgrounds. Four studies have reported such data.

Mezzacappa (2004) compared low SES Hispanic and African-American children's performance on a task measuring EF. Hispanic children performed significantly better on this measure of attention. However, bilingualism was not formally measured in the study. The authors did note that nearly 70% of the Hispanic children spoke Spanish at home.

A more sophisticated study compared 8-year-old children who were living in Portugal to age-matched children from families that had immigrated from Portugal to Luxembourg (Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012). Families who had immigrated to Luxembourg had moved from the region in Portugal where the children who were monolingual were tested. The study matched participants on many indices, including SES. Results indicated that children who were bilingual performed better than children who were monolingual on some EF tasks.

One study used a factorial design to compare 6-year-old children who were either monolingual or bilingual and from families that were classified as either middle-class or working-class (Calvo & Bialystok, 2014). Parental education was used to differentiate between middle and working-class families. Results indicated that regardless of SES, children who were bilingual outperformed children who were monolingual on EF tasks. Interestingly, there was no interaction between SES and bilingualism. The authors concluded that bilingualism and SES operate as independent influences on children's EF development. A more recent study replicated Calvo and Bialystok's (2014) results using a similar design but with an adolescent population (Krizman, Skoe, & Kraus, 2016).

Taken together, these studies show consistent associations of bilingualism with higher EF performance for populations from a wide range of SES backgrounds. This indicates that children from low-income homes who are learning two languages are likely capable of experiencing gains in EF that may be critical to their future academic success. What is unclear is the mechanism that explains the associations of bilingualism with EF. Recall that the theorized relation is that the increase in EF is a result of the ongoing experience of managing attention as a result of jointly activated languages. If that is true, then it follows that there should be dose related influences. For example, individuals who know many of the same words in two languages would experience many opportunities for the general executive function neurologic system to suppress unrepresented language. This, theoretically, would result in a greater increase in EF development as compared to a person with unbalanced proficiency between languages who would less frequently encounter opportunities for the neurological system to "practice" skills related to EF. Documenting this relation would give additional support to policies and practices that emphasize supporting children's first language skills in addition to English language development.

Language Loss, Shift, and Attrition

Factors describing the aspects of bilingualism, such as similarity between languages (Costa, Hernández, & Sebastián-Gallés, 2008) and age of acquisition (Tao, Marzecová, Taft, Asanowicz, & Wodniecka, 2011), influence the relation between bilingualism and EF. In order to fully understand the relation between bilingualism and

EF, we need to explore how specific aspects of the bilingual experience influence the development of EF (Kroll, 2009).

People who are bilingual can be classified as additive or subtractive depending on how learning a second language influences the retention of the first language (Lambert, 1974). Individuals who learn a second language without losing proficiency in their first are experiencing additive bilingualism. Whereas, learning a second language at the cost of first language skills is considered subtractive bilingualism. Subtractive bilingualism has been described in several different ways. Language *shift* occurs across generations and occurs gradually. Research indicates a complete loss of heritage language within a family is typically complete within two or three generations (Alba, Logan, Lutz, & Stults, 2002; Baker, 2001; Gordon, 1964; Veltman, 2000). Language *loss*, however, refers to a more rapid shift in which a person's first language use is reduced or diminished within an individual (Anderson, 1999a, 1999b; Butler & Hakuta, 2004; Wong-Fillmore, 1991). Although this pattern has been recorded in adults, it is more commonly seen in children. In this context, first language loss is evident in a reduction in first language linguistic skill relative to skill at a previous time. Alternatively, first language *attrition* is when there is not a noted loss in language ability, but there is also no improvement. In other words, language attrition refers to a stagnation of development in one language (Schiff-Myers, 1992). Language shift, loss, and attrition have been reported in many Latino communities in the U.S. (Anderson, 1999a, 1999b; Wong-Fillmore, 1991).

"Most often, L1 loss occurs in a context in which there is a minority-majority language dichotomy and in which different values are placed, either overtly or covertly, on each of these languages," (Anderson, 2004, p. 196). Language loss is common in

contexts where the dominant language is critical to academic and financial wellbeing (Petrovic, 1997). In these contexts, little value is placed on heritage languages and thus there are typically few supports in place for first language maintenance. Early exposure to English immersion (before age 5) may be especially influential on first language development or loss (Hammer, Lawrence, & Miccio, 2008; Wong-Fillmore, 1991). Often, the home environment is the only source of first language input (Chávez, 1993; Petrovic, 1997).

Demographic Context

Previous research indicates gender influences language development in both people who are monolingual and people who are bilingual. Studies of monolingual language development report female children tend to have a larger vocabulary than males of the same age (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Some studies indicate that in school, girls display English proficiency slightly sooner than boys (Greenberg-Motamedi, 2015; Grissom, 2004; Thompson, 2017; Uriarte et al., 2011). One common perception is that female Hispanic immigrants in the U.S. are more likely to learn two languages, whereas their male counterparts tend to learn primarily English. This assumes that women traditionally value maintaining family relationships, which requires knowledge of two languages to bridge the gap between family members with different levels of proficiency in each language. In addition, girls who stay at home with their mothers and other women in the family are immersed in Spanish. On the other hand, males are typically expected to gain employment and support families. As previously noted, for families in the U.S., proficiency in English is often perceived as critical to

academic and financial success (Petrovic, 1997). As a result, boys may be encouraged to spend time out of the home where they are removed from Spanish-dominant social networks (De Von Figueroa-Moseley, Ramey, Keltner, & Lanzi, 2006; Flannagan, Baker-Ward, & Graham, 1995; González, Umaña-Taylor, & Bámaca, 2006). However, a study of children enrolled in Head Start investigating the influence of child gender on bilingual language outcomes reports that child gender was not related to children's developing Spanish or English vocabulary (Hammer, Davison, Lawrence, & Miccio, 2009). The authors speculated that the experience in an English immersion Head Start classroom may "level the playing field" in terms of access to English input.

Family demographics are often related to bilingualism. For Latino populations, generational status and maternal education, are important family background variables to consider. Approximately two thirds of the Latino population are immigrants (Hernandez, 2006). Immigrants typically encounter dramatically different experiences than individuals who are U.S.-born. Thus, it is important to consider the amount of time that a family has resided in the U.S. rather than categorizing Latinos into a single homogenous group. To illustrate length of residence differences, one study showed differences between U.S.-born Dominican mothers and immigrant Mexican mothers. Over 5 years, the U.S.-born group showed greater increases in mothers' English language use with their children (Tamis-LeMonda, Kuchirko, & Song, 2014).

Maternal education level is typically low among Latino immigrant families (Hernandez, Denton, & Macartney, 2007). However, immigrant parents who have more years of schooling typically also have higher levels of English proficiency, which can influence children's English language learning (Bohman, Bedore, Peña, Mendez-Perez,

& Gillam, 2010). One study has reported that comparing generational status and maternal education, generational status is a better predictor of Spanish receptive vocabulary and maternal education is a better predictor of English receptive vocabulary (Hammer et al., 2009). Thus, both variables may be influential in understanding the co-development of Spanish and English.

Political Context

A variety of policies pressure schools to reclassify students who are DLLs as "fluent English proficient" as quickly as possible (Umansky & Reardon, 2014). For example, an Arizona state law passed in 2010 requires students who are DLLs to receive a minimum of four hours of structured English immersion each school day with the intent to speed students' transition out of dual language instruction (Gándara & Orfield, 2010). The transition to a fully immersive English classroom environment inherently reduces the amount and context of exposure to the first language. Restrictions on the frequency and contexts in which a language is heard and spoken contribute to language loss and attrition (Anderson, 2004).

In general, early education programs, including Head Start, do not improve Spanish vocabulary for children from Spanish-speaking homes (Pacini-Ketchabaw & Armstrong de Almeida, 2006; Puma et al., 2012). This may be due to inconsistent exposure to Spanish within the classroom environment, which may be attributable to constraints on the ability to provide bilingual personnel and resources (Halle, Hair, Wandner, McNamara, & Chien, 2008). There has been previous research about the nature and causes of language loss and attrition, however, there is surprisingly little research on

the associated outcomes. The potential short- and long-term influence of these patterns are not well understood. It is clear that there are potential cognitive benefits, such as EF, associated with bilingualism; however, it is unclear what amount of proficiency in two languages is necessary to strengthen EF or whether there are differences for children experiencing first language loss and attrition. Understanding these associations is critical to inform current teaching practices in regards to children enrolled in Head Start who are learning two languages. Answers to these questions could potentially highlight the critical need to develop teaching and family engagement practices that contribute to additive, rather than subtractive, bilingualism as a strengths-based mechanism to promote overall academic success.

Measuring Bilingualism

Bilingualism is not always clearly defined. Beardsmore (1986) indicated that bilingualism is best understood as being on a spectrum. At one end of the spectrum is the monolingual speaker with little or no exposure to any second language. At the other end is the individual who learned two languages in naturalistic contexts throughout childhood and is able to speak both languages with equal, native-like, fluency. To consider varying levels of abilities in two languages, imagine balanced bilingualism as being a point delicately balanced in the very center of a spectrum with monolingual individuals in their respective languages representing opposite ends of the spectrum. A perfectly balanced bilingual individual, whose abilities are equally matched in both languages, is hypothetical, and rarely seen in reality (Hakuta, 1987; Lyons, 1981). It is typical for people who are bilingual to have differing levels of proficiency in each language,

although these differences may not always be readily apparent (Kaushanskaya & Prior, 2015; Luk, 2015; Peal & Lambert, 1962).

Some researchers have argued for better control over the selection and classification of participants who are considered bilingual (e.g., Namazi & Thordardottir, 2010). Because bilingualism is a spectrum, rather than a discreet category, inclusion criteria for participants vary widely. Researchers noted, in a meta-analysis, that studies often do not give clear information on the type of bilingual skills represented in the study participants (Adesope, Lavin, Thompson, & Ungerleider, 2010).

Bilingual classification usually focuses on the context in which the individuals who are bilingual use each language. Studies focusing on children who are DLLs typically classify participants as bilingual or monolingual depending on parents' reports of children's use and exposure to each language. Questions typically elicit information about how often the child uses language in different contexts or with different individuals. Information about languages spoken by family members, how languages were learned, and exposure to other types of media such as television and books are also often included. Research has indicated that parent and teacher reports of child vocabulary are congruent with observed expressive language patterns (Gutiérrez-Clellen & Kreiter, 2003; Marchman & Martinez-Sussmann, 2002). However, these findings have not been replicated with receptive language, which develops before expressive language. There are indications that regular expression in each language does not necessarily imply equal proficiency in both languages (Grosjean & Li, 2003). This indicates that research methods must go beyond dichotomous classification of bilingual and monolingual individuals based on reports of expressive language.

Quantifying proficiency in two languages is not straightforward. Most often, Spanish and English vocabulary change scores are considered separately. This approach allows for straightforward interpretation of factors that influence the development of each language. However, results fail to account for the inter-relatedness of language development in two languages (see Table 1). This perpetuates the idea that the two languages are developing separately rather than interacting and influencing one another. Sometimes, the untested language is accounted for by being entered as a control variable. However, this strips the data of critical information in order to inspect the influence of other predictor variables.

However, considering two vocabulary change scores simultaneously presents a problem. The two change scores cannot logically be added together to create a cumulative continuous variable. To illustrate the problem, consider two hypothetical children starting with the same level of Spanish and English proficiency. One achieves a 10-point increase in English from wave one to wave two, and a 2-point increase in

Table 1

Example Interpretation if Bilingual Development is Considered Separately or Summed

ID	Spanish Interpretation	Spanish Change	English Change	English Interpretation	Sum
A	Excellent	10	2	Little Improvement	12
B	Improvement	6	6	Improvement	12
C	Little Improvement	2	10	Improvement	12
D	Poor	-6	18	Excellent	12

Spanish over the same period of time; the other a 2-point increase in English and 10-point increase in Spanish. If Spanish and English scores were summed, both would receive the same score (see Table 1) This method would miss other obvious differences between participants. Even though the summed scores are the same, the participants have vastly different ability. One may be able to expertly navigate a conversation in Spanish and say a few words in English, whereas the other would be at home in a conversation with an English-speaker and flounder if asked to speak Spanish.

Previous studies have calculated translation equivalents as a measure of bilingualism (Crivello et al., 2016; Umbel, Pearson, Fernandez, & Oller, 1992). Translation equivalents are words that are known in both languages for the same object or concept. Translation equivalents are typically learned early during dual language development and they are directly related to the amount of second language exposure (Genesee & Nicoladis, 2007; Pearson, Fernandez, Lewedeg, & Oller, 1997). Additionally, an increase in translation equivalents has been shown to correlate with increases in EF (Crivello et al., 2016). However, translation equivalents are an incomplete representation of dual language proficiency because they ignore vocabulary understood in a single language. Using scores from tests of 105 first graders who were English-Spanish bilinguals, Umbel et al. (1992) calculated the number of translation equivalents, words unknown in both languages, and words known in only Spanish or only English. By comparing the actual results for this population to the expected ratio of the relative number of items that one would answer incorrectly, the authors concluded, “a portion of bilingual children’s lexical knowledge is distributed disjunctively between two languages” (Umbel et al., 1992, p.1018). Thus, it seems important to look beyond

translation equivalents, to develop a method that accounts for vocabulary more holistically.

Thomas-Sunesson, Hakuta, and Bialystok (2016) presented a method of calculating a bilingualism ratio using subtraction. First, the absolute difference between scores of receptive Spanish and English vocabulary was calculated. The output was multiplied by negative one (-1), to reverse the order of scores for interpretability. A constant of 100 was then added to that score. Thus, a score of 100 indicated perfect balance between vocabulary scores, whereas lower scores indicated less balanced proficiency. Even though this method accounts for both languages simultaneously, as noted by the example in Table 2, it is not capable of identifying individuals experiencing language loss or attrition.

Table 2

Example Bilingualism Ratio Score Calculation

ID	Spanish Change	English Change	Abs. Diff. * (-1)	Add 100
A	10	2	-8	92
B	6	6	0	100
C	2	10	-8	92
D	-6	18	-24	76

An alternative method is to plot the two variables on an X-Y plane. This allows both languages to be considered simultaneously and permits more meaningful interpretation (see Figure 1). From this view, it is easier to determine cases that would be similar to each other in their relative balance of Spanish and English proficiency.

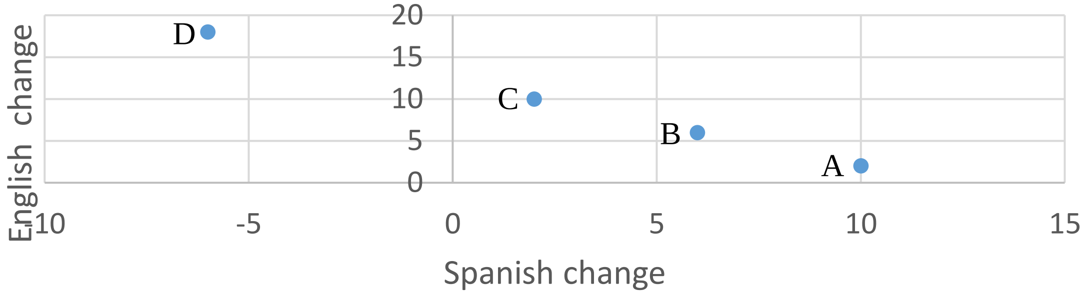

Figure 1. Example Plotting Change Scores to Consider Two Languages Simultaneously.

Note. Example data points plotted correspond with individual scores listed in Tables 1 and 2.

However, in this form, the information is a standalone graphic. In order to use the information to predict other outcomes it must be transformed into a meaningful numerical value. A traditional method would be to use cut-scores to force participants into predetermined groups regardless of whether the differences in scores are practically meaningful. Cut-scores assume that distinct subgroups exist. (e.g., which classroom a child is enrolled in).However, this may not be an appropriate method for identifying groups of children learning two languages. For example, imagine if a cut-score was placed at 100 on a vocabulary scale. The difference between a child who knew 99 words and one who knew 101 words would be indistinguishable in person, but due to the arbitrarily placed cut-point these two children would belong to separate groups. Group membership in this case clearly requires a more sophisticated approach to group formation. Growth mixture modeling is capable of identify unobserved subgroups while taking into account a wider range of characteristics.

Previous research indicates that unobserved subgroups of bilingual language development do exist. Research following a sample of immigrant Dominican and Mexican children from ages two to five identified four dual language profiles: (a) Spanish dominance, (b) Dual-language growth, (c) English dominance, (d) Change from Spanish to English dominance (see Figure 2; Escobar & Tamis-LeMonda, 2017).

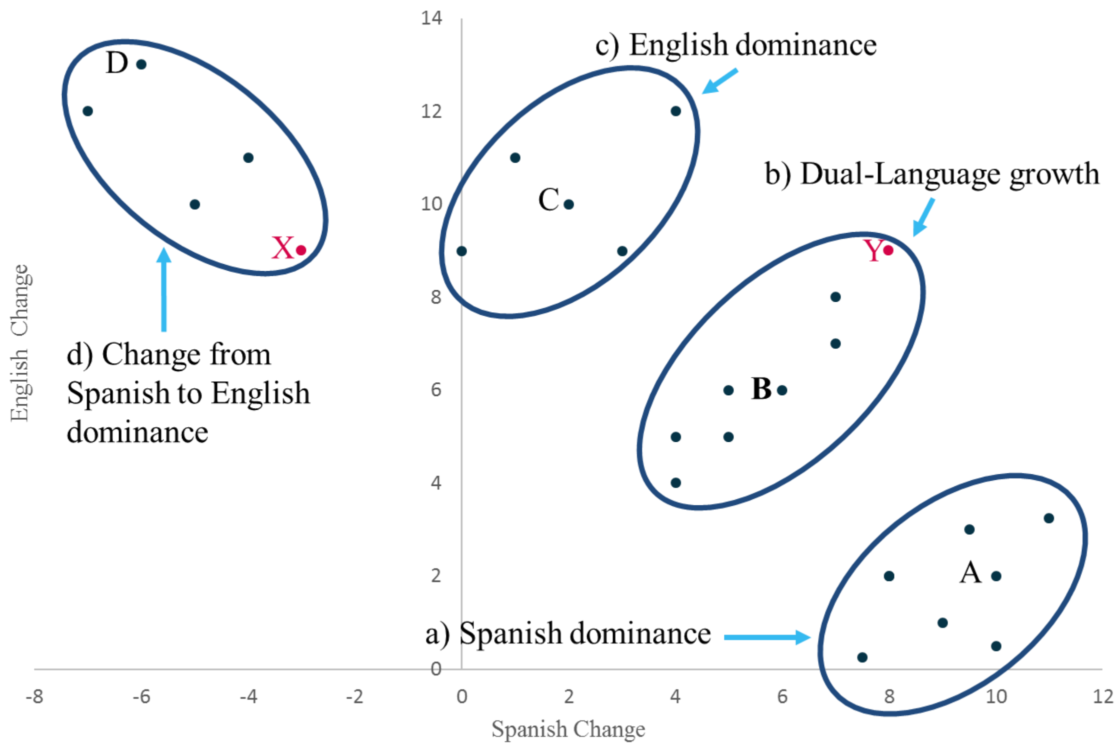

Figure 2. Group Labels Overlaid Example Change Scores.

Note. Groups identified by Escobar and Tamis-LeMonda (2017).

Children in the Spanish dominant groups produced uneven gains with a greater increase in Spanish scores as compared to English scores "most likely representing the types of language development seen in children of recently immigrated parents" (Escobar & Tamis-LeMonda, 2017, p. 96). Children in the dual-language growth group showed

relatively even gains in both languages “likely reflecting strong support for the use of English and Spanish in their home environments” (Escobar & Tamis-LeMonda, 2017, p. 96). Children experiencing English dominance showed uneven gains with a greater increase in English scores as compared to Spanish scores “likely reflecting predominantly English inputs at home, despite the immigrant status of their parents” (Escobar & Tamis-LeMonda, 2017, p. 96). The final group showed gains in English production and a reduction in words produced in Spanish, displaying first language loss. “This profile of change is likely to be most common for many children of immigrant parents as they are increasingly exposed to English in the host country, particularly at school” (Escobar & Tamis-LeMonda, 2017, p. 96).

Outcomes associated with these patterns have not yet been investigated. Little is known about the long-term influences of different language learning patterns. It may be that those individuals whose English vocabulary scores increase and Spanish scores decrease experience different outcomes than those whose vocabulary scores both show growth. For example, the points labeled X and Y in Figure 2 are experiencing the same amount of growth in English. However, participant X is making gains in English at the expense of Spanish vocabulary (subtractive bilingualism), whereas participant Y is making even gains (additive bilingualism). Based on previous literature, it is possible children in these separate groups would experience different outcomes in terms of EF. Furthermore, children experiencing dominance in a single vocabulary (groups A and C) may have different outcomes than those who are developing proficiency in both languages more evenly (group B: dual-language growth). Understanding these differences will enhance teachers’ understanding of developmental trajectories and

facilitate the development of strategies to improve the quality of service to children who are learning two languages.

Escobar and Tamis-LeMonda (2017) based their findings on the number of words produced in a naturalistic setting. Language preference shift is most commonly measured using either participant preference or counts of verbally expressed vocabulary. Recordings of naturally expressed vocabulary may be the most meaningful way of measuring language shift. However, it is not easy or cost-effective data to collect. This type of data collection requires observing families in their homes or in labs. This process requires significant amounts of participants' and researchers' time. After the interactions are recorded, utterances must be transcribed by someone fluent in both languages. Information must then be coded and counted for each language. This method has the advantage of being effective and meaningful. However, for early childhood programs interested in tracking bilingual language change across time, it is not feasible to collect this type of intensive data for large groups of children.

Standardized measures of receptive vocabulary are generally less invasive and less time consuming to collect and score. Their content also specifically tests knowledge of nouns and verbs, which are typically the first expressive word types to be reduced when an individual is experiencing language loss (Anderson, 1999a). However, it is unknown whether receptive vocabulary scores will show patterns of change similar to those found in expressive vocabulary. Receptive vocabulary must precede expressive; children typically do not produce words they do not know. A reduction in the need to access the lexicon may reduce an individual's ability to retrieve items quickly, or at all. This influences an individual's ability to mentally access their lexicon quickly and may

even result in the loss of vocabulary across time (Kravin, 1992). Research has indicated that lexical knowledge is particularly vulnerable to loss (Gal, 1989; Smith, 1989; Weltens & Grendel, 1993). If measures of receptive vocabulary could be similarly effective in identifying different dual language learning groups, this would be a viable method for assessing dual language growth in Head Start classrooms. Information gained from such assessments could enhance programs' and teachers' understanding of the developmental trajectories of children who are learning two languages. This would allow teachers to use information about current developmental needs and strengths to individualize materials and activities to move children along their developmental trajectory.

Summary

Developmental cascade theory indicates that experiences can have a pervasive influence on both multiple domains of development and developmental trajectories across time. This theory is especially relevant for children attending Head Start who are from low-income Spanish speaking families. For children who are DLLs, language development is influenced by the typical reduction in linguistic diversity common in the language environments of low-income families, and their inability to communicate with some students and teachers in English immersion Head Start classrooms. The cascading influence of these early experiences may contribute to future achievement gaps between students who are and are not DLLs. However, it is not necessarily the experience of learning two languages that specifically contributes to gaps in achievement. Rather, the experience of participating in English immersion classrooms where the home language may not be valued could be the more pervasive influence. Previous research has

identified a positive connection between bilingualism and EF. This connection suggests that a focus on providing support to develop bilingualism, by continuing to learn the first language while learning a second language, may provide benefits to these children across domains.

The role of language dominance and language loss in the development of EF is still unclear—it is not known to what extent various levels of language dominance might influence the cognitive benefits of bilingualism. Understanding the potential influence of language loss and attrition on EF development may influence policies to create environments that contribute to first language loss and attrition. Research that shows there are different increases in EF skill related to relative “amounts” of bilingualism would be useful on many levels. Theoretically it will lend further evidence to the theory identifying a domain-general mechanism for EF that is “strengthened” through repeated practice of being bilingual. Methodologically, it will provide evidence that there is a need to require a more thorough description of the proficiency levels of bilingual included in future research investigating other aspects of the EF-bilingualism connection. Practically, it may encourage those who interact with students who are DLLs to place renewed focus on developing more advanced levels of bilingualism in order to reap the potentially greater associated EF benefits. Thus, the current project will test the effectiveness of using receptive language scores to identify latent subgroups of children enrolled in the Head Start program who are classified as Spanish-English DLLs.

Research Questions

RQ 1. Will an analysis of the receptive vocabulary of children who are learning two languages detect the same number and nature of classes as has been observed using longitudinal expressive language counts?

RQ 2. Does latent class membership differentially predict EF?

Hypotheses

H 1. - Four classes will be identified that will be characterized similar to those reported by Escobar and Tamis-LeMonda (2017).

H 2. - Children who experience change from Spanish to English dominance will have reduced EF as compared to those in other groups. Children who experience dual-language growth will have higher EF scores relative to children experiencing English or Spanish dominance.

CHAPTER III

METHODS

The purpose of this study is to examine the influence of varying levels of proficiency in Spanish and English on EF skills for children who are DLLs enrolled in Head Start. The present study will use extant data from the Head Start Family and Child Experiences Survey (FACES): 2009.

Data Sources and Sample Selection

The FACES data set is a longitudinal study of Head Start classrooms, children, and families. Researchers followed 3-year-old children from the beginning of their first year in a Head Start classroom until the end of their second year in Head Start. Participants were selected using a multi-stage cluster sampling technique. This means that sampling was conducted in stages using progressively smaller sampling units at each stage. The sampling stages were program, center, classroom, and child. Although in previous years, centers that have been selected for previous waves of the FACES have been excluded, the 2009 data collection effort included all available centers during that stage of sampling. Probability proportional to size was used in the first three stages of sampling (programs, centers, and classrooms). In the final stage, equal numbers of children, with equivalent probability within classrooms, were selected in an effort to give each child equal chance of selection. Participation in FACES is historically high. The overall sample size for the 2009 data collection timeframe was 3,149 children.

This data set is ideal for the current proposal because of its nationally representative sample of Head Start children, many of whom are Spanish-speaking. It offers a rich data set with many key variables available for analyses. The FACES dataset has a focus on answering questions about the population of Spanish-speaking children and thus includes measures of receptive Spanish language abilities. Children's receptive Spanish and English was tested at each wave. Although English expressive vocabulary was measured at each wave, there was not a corresponding expressive Spanish vocabulary assessment. There were some survey questions asked to teachers, program directors, and parents about the bilingual language environment. For example, respondents were asked how many adults and children were available in the classroom, or at home, to speak the child's home language. Parents were asked to estimate the amount of media (books, TV, etc.) available in their home in Spanish. There is no estimate of the amount of time spent speaking a particular language, but parents and teachers were asked to estimate their proficiency in understanding and speaking Spanish.

For many of the children included in this data set, Head Start may be their first English-immersion experience where they were expected to participate and learn. Past research has reported that early exposure to English immersion may influence dramatic first language loss (Wong-Fillmore, 1991). Thus, this environment is a critical context to investigate changes in both languages.

Three-year-old children who participated in the first wave of FACES data collection were included in analyses for the present study. For these children, data collection occurred three times before their exit from the Head Start program (see Figure 3). First, a baseline assessment was completed shortly after the beginning of the Head

Start school year in fall 2009. For this group of 3-year-olds, this would be the beginning of their first year of participation in the Head Start program. A second wave of assessments was completed at the end of that school year: between February and June of 2010. The third wave of data collection was completed the following year (between February and June of 2011). Thus, this third assessment wave was completed at the end two complete years of Head Start participation. Because of their early and extended exposure to English immersion, this group will be the most likely to experience language loss and attrition.

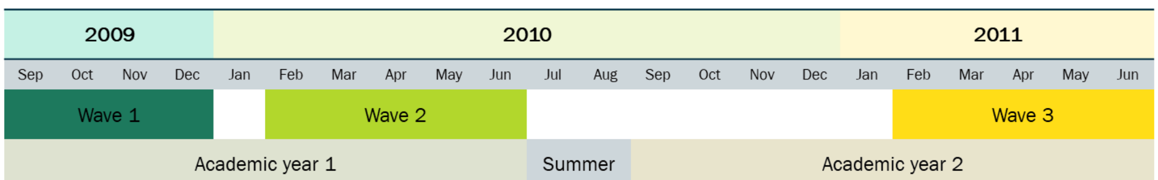

Figure 3. Timing of Longitudinal Assessment Collection

Note. Assessments were completed three times: at entrance to Head Start, at the end of the first year, and at the end of the second year of Head Start participation.

The sample size necessary for a particular study depends on many factors. The parameters of the model, distribution and reliability of individual variables, missing-ness in the data, and strength of the relations among variables all influence statistical power. A rule of thumb in the research community using growth mixture models, appears to favor sample sizes of at least 100 (Curran, Obeidat, & Losardo, 2010). However, growth models have been successfully fit with far fewer participants (e.g., Huttenlocher, Haight, Bryk, Seltzer, & Lyons; 1991; Ram & Grimm, 2009). The sample size for the proposed project meets this 100-participant requirement. Growth models also typically require at

least three waves of repeated measures (Curran et al., 2010). This requirement was also met by the data set.

Variables/Measures

Demographics

Maternal education, child's generational status, and gender, were collected from participating families via computer-assisted personal and telephone interviews. Interviews were conducted in Spanish and English. Parents' perceived proficiency in understanding, speaking, and reading English and Spanish (1 = *Not at all Well*, 4 = V*ery Well*) were used to describe the resulting language groups. Information about parental goals for socialization was also solicited by asking respondents to rate how important it is to them that the target child speaks English (1 = essential, 4 = not important at all). These descriptive variables provided context to findings. In addition, child age was calculated at the time of assessment at each wave.

Administration Order

A language screener was administered to decide which language testing should be used to conduct testing. Although the measures selected for analysis in this study do not require a verbal response, it is essential that children understand the explanation of the rules of the tasks. The FACES testing protocol dictates that all testing must begin with two English language screening measures from the Preschool Language Assessment Survey (*pre*LAS): Simon Says and Art Show (see Figure 4).

Parent indicated Spanish home language at Head Start enrollment	
Language Screener (Simon Says and Art Show)	
Fewer than five consecutive errors Testing Presented in English	Five consecutive errors Testing Presented in Spanish
Peabody Picture Vocabulary Test -4	
Test de Vocabulario en Imágenes Peabody	
Pencil Tapping Task	Pencil Tapping Task (Spanish translation)

Figure 4. Test Administration Order

Note. Children from Spanish-speaking homes, who did not pass the language screener were given instructions for subsequent tests in Spanish.

These two measures are child-appropriate screeners of receptive and expressive language respectively. Internal consistency reliability (alpha) coefficients for Simon Says range from 0.88 to 0.89 across forms and 0.88 to 0.90 for Art Show (Malone et al., 2013). Scores from these two assessments determined whether a child from a non-English-speaking home had the English language skills needed to understand the directions and questions on the assessments and to respond to the questions orally when required. Children whose home language was Spanish, and who made five consecutive errors on Simon Says and Art Show, received instructions in Spanish. Children who passed the screener received instructions for the assessments in English regardless of home language.

Vocabulary

Receptive English vocabulary was measured using the *Peabody Picture Vocabulary Test* (PPVT). This measure is in its fourth edition and is designed to assess receptive vocabulary of participants from age 2.5 years to adults (Dunn & Dunn, 2007). Participants are shown picture plates with four pictures and asked to point to the picture that best represents a stimulus word presented orally by the examiner. The items are presented in order of increasing difficulty. Testing is discontinued after participants have made eight or more errors in a set of 12 stimulus words. One point is awarded for each correct response, and the sum of the correct responses is used as the index of receptive vocabulary. Scores may be converted into standard scores, with a mean of 100 and a standard deviation of 15 (Dunn & Dunn, 2007). The administration manual notes the following about the PPVT's application to English language learners:

> The PPVT-4 instrument was normed exclusively on individuals who are proficient in English, and therefore it would not be best practice to report a normative score on this test for an individual who is not English proficient. As a criterion measure, however, the PPVT-4 scale is useful for assessing the extent and nature of a person's knowledge of standard American English words. The early item sets of each PPVT-4 form include high-frequency, commonly used words. These words can aid in screening individuals for whom English is not the primary language and in planning interventions for those who want to attain English proficiency. (Dunn & Dunn, 2007, p.3)

Split-half reliability and alpha coefficients are consistently high at all ages and grades (Dunn & Dunn, 2007). The FACES User Guide indicates that Cronbach's alpha for the PPVT scores gathered ranged from 0.91 to 0.97 across waves (Malone et al., 2013). Average test-retest reliability is reported to be .93 (Malone et al., 2013). The PPVT demonstrates convergent validity as it has been found to correlate with two established tests of expressive vocabulary: The Expressive Vocabulary Test, Second

Edition (.80 to .84), and the Comprehensive Assessment of Spoken Language (mid-.60s to high .70s; Dunn & Dunn, 2007). All children participating in FACES testing were administered the PPVT.

Receptive Spanish vocabulary was measured using the *Test de Vocabulario en Imágenes Peabody* (TVIP), which was designed to measure children's receptive vocabulary (Dunn, Padilla, Lugo, & Dunn, 1986). The TVIP was administered to all children whose parents indicated their primary home language was Spanish. Parents report their home language during enrollment into the Head Start program. Scoring and administration is similar to the PPVT. Split half reliabilities of the TVIP range from .80 to .94 (Dunn et al., 1986). The content validity of the measure with the Kauffman Assessment Battery for Children Spanish ranged from .25 to .56 and concurrent validity was .44 with the *Habilidad General Ability Test* (Dunn et al., 1986). The FACES User Guide indicates that the Cronbach's alpha for the TVIP ranged from 0.89 to 0.94 across all waves (Malone et al., 2013). The PPVT and TVIP have been used in previous studies to monitor language development of children who are bilingual attending Head Start (Hammer et al., 2008).

Dependent Variable

Executive Functioning was measured using The Pencil Tapping Task (Blair, 2002; Diamond & Taylor, 1996; Smith-Donald et al., 2007), a variation of the peg-tapping task used by Blair (2002) and Diamond and Taylor (1996). In the FACES data collection, this task was administered only to children age 4 and older at the time of the direct assessment. The task requires the child do the opposite of what the assessor does;

that is, tap one time when the assessor taps twice and tap two times when the assessor taps once. In essence, children are asked to inhibit their natural response to imitate the adult assessor exactly (or to tap repeatedly) and instead to keep in mind that the rule was to do the opposite of what the assessor did. It is also important to note that this is a nonverbal task; it does not require the child to read or produce any language as a part of the task making it well suited for children learning two languages. The target outcome variable is the number of correct taps out of 16 trials. Scores range from zero to 16, with higher scores indicating better skills on the task. This effectively measures the child's inhibitory control, working memory, and effortful attention.

The Pencil Tapping Task has been shown to be an objective assessment of children's self-regulation, particularly inhibitory control which is associated with young children's development in mathematics, vocabulary, and literacy (Blair & Razza, 2007; Espy et al., 2004; McClelland, Cameron, Wanless, & Murray, 2007). In a sample of low-income 3- to 4-year-old children, the peg-tapping task demonstrated a relation to later kindergarten outcomes in mathematics and literacy (Blair & Razza, 2007). The FACES User Guide indicates Cronbach's alpha for the Pencil Tapping Task of scores gathered ranged from 0.85 to 0.88 across waves (Malone et al., 2013). Previous research has found a bilingual advantage for 3- to 4.5-year-old middle-class Canadian children completing a similar tapping task (Bialystok, Barac, et al., 2010).

Analytic Plan

To examine the trajectories of English and Spanish language development parallel process latent growth models (LGM) were conducted to simultaneously estimate the

growth curves for English and Spanish. LGM is the covariance structural equation model (SEM) representation of the multilevel model (MLM) for change. LGM is capable of adjusted standard errors for data that is nested. This is important given the structure of the current study (i.e., time nested within individuals). LGM fits a growth model with fixed (i.e., average level) and random (i.e., variability around the average) effects and correctly estimates adjusted standard errors. In short, this is a flexible and powerful methodological approach capable of estimating growth curve models to test hypotheses about within-person change over time (i.e., intraindividual change) and between-person differences in change over time (i.e., interindividual change; Bollen, 2014; Ram & Grimm, 2007; Raudenbush & Bryk, 2002; Singer & Willett, 2003). In addition, results using these methods are robust to missing data. Due to attrition over time in the FACES dataset, not all cases are complete. The most typical method for handling incomplete (or missing) data is by using maximum likelihood estimation. This estimation method assumes repeated measures are continuous and normally distributed. Results from preliminary analyses indicate the selected data meet these assumptions.

LGM takes a multivariate approach to growth modeling. As such, the data is in a wide format. This means each row represents a single participant and each column corresponds to a variable's occasion of measurement. The wide format allows a LGM to estimate the sample's covariance matrix. This is needed to compare to the model predicted covariance matrix which will provide information that will determine if the hypothesized model fits the data (Willett, 2004). Within the wide format data structure, values associated with time (intraindividual change) are programmed into the LGM directly. Thus, they are specific, fixed parameters that correspond to a particular

measurement occasion so the growth function can be estimated. Given that the current study aimed to test linear growth models to identify change in English and Spanish vocabulary, models were estimated that included only a latent intercept (*I*) and latent linear slope (*S*) that capture the repeated, observed measures of English and Spanish vocabulary raw scores via fixed factor loadings that represent the passage of time (Figure 5). Because only three time points were selected for analyses, latent quadratic slope (non-linear trajectories) could not be tested.

As depicted in Figure 5, the latent intercept variable was identified by constant loadings of 1. The latent linear slope variable was identified by fixing factor loadings to 0, .6, and 1.8 to reflect three un-equally spaced measurement occasions occurring 6- and 18-months post-baseline. Time was fixed to 0 at the first measurement occasion so the intercept could be estimated at the beginning of the study when children were age three. The sample's average values on each aspect of intraindividual change (i.e., the means of the latent variables) are identified by the fixed effects (in Figure 5 intercept = μ_I, and linear slope = μ_S). Statistically significant fixed effects indicate that, on average, the sample's intercept and slope are different from zero.

In Figure 5, the residual variance factors ψ_I and ψ_S represent individual variation around the intercept and linear slope latent variables. These factors are similar to the random effects. They represent between-persons differences around the sample's average intercept and slope. Statistically significant differences in ψ_I indicate that individuals have higher or lower initial levels than the mean intercept. Similarly, statistically significant ψ_S indicate sample individuals have flatter or steeper slopes than the mean slope. Statistically significant random effects are necessary to proceed with introducing

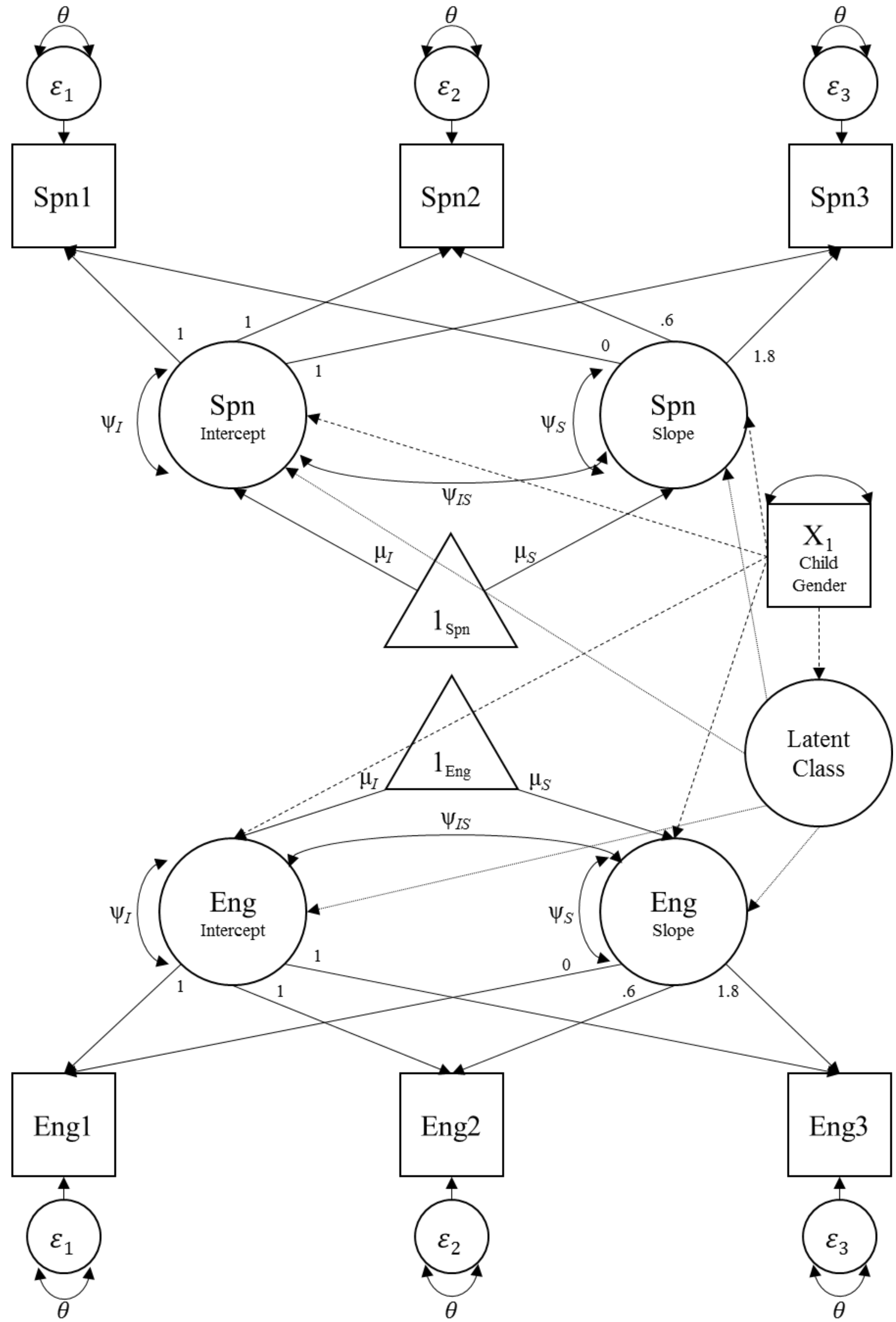

Figure 5. Parallel-process growth mixture model.

covariates into the model. The current study investigated the influence of time-invariant demographic covariates (e.g., child gender, maternal education, and maternal years in the U.S.) on the intercept and slope. Detecting statistically significant associations between covariates and the growth curve components would indicate that a particular covariate explains some of the variation in average scores around the sample's mean intercept and/or slope. In Figure 5, an example of a time-invariant covariate is represented by the observed independent variable X_1. To represent the linear regressions of the growth factors on the time-invariant covariate, there are arrows drawn from X_1 to the latent intercept and slope.

Covariances between the residual variance factors of the latent intercept and slope is also estimated in the LGM (ψ_{IS}, in Figure 5). This indicates how interindividual differences in each factor of intraindividual change are associated with one another. For example, a positive ψ_{IS} indicates that individuals with higher intercepts are likely to have steeper linear slopes. Lastly, the ε_1 through ε_3 in Figure 5 represent time-specific error terms for each measurement occasion of the observed outcome variables. In the current study, residual variances were constrained to be equal over the four measurement occasions. An assumption of MLM is that time-dependent residuals have a mean of 0 and the same variance across time (i.e., homoscedasticity). Thus, the current study met this assumption by constraining residual variances for each outcome variable to be equal over the three measurement occasions (In Figure 5, represented by Θ for the repeated observed outcome variables, Y_1 - Y_3).

Research question one: Will an analysis of the receptive vocabulary of children who are learning two languages detect the same number and nature of

classes as has been observed using longitudinal expressive language counts? This question was addressed by conducting a parallel process growth mixture model (GMM) using receptive Spanish and English vocabulary raw scores. Child gender, maternal education and child's generational status were entered in the model as control variables.

As a first step to conduct a parallel process analysis, separate models were fitted to English and Spanish vocabulary raw scores, thus, all of the following steps were completed for English and Spanish separately. First, intercept-only first-order latent growth curve models (LGCM) were examined. In the baseline models, all cases were considered to have identical growth patterns, means, variances, and covariances. All parameters were constrained to be equivalent across groups. In essence, the model was forced to assume all students belong to a single-group.

Next, fit statistics for linear LGC models were compared to intercept-only models. Then, random effects of the linear models were inspected. In contrast to fixed-effects (i.e., the sample's mean value for intercept and slope) random effects indicate the amount of variability around the sample's mean value for intercept and slope. In order to proceed with investigating if time-invariant predictors explain variability in random effects, these values must be statistically significant. The addition of covariates is intended to explain the observed variability around the sample's mean intercept and slope.

Next, time-invariant covariates, including child gender, maternal education, and the number of years the mother lived in the U.S. (which were all measured only at the first wave), were entered on the slopes and intercepts of the two separate models. Covariates were set to their individual variances as a requirement of time-invariant

variables in LGCM. Statistically significant variables were retained in the final parallel process model.

The two resulting models were combined into a single parallel-process model. Residual variances for each outcome variable were constrained to be equal over the three measurement occasions. Syntax was also added to prompt the generation of data-driven groups based on students' Spanish and English language scores. To account for the possibility that there may be more or fewer unobserved groups than hypothesized, models were tested with 2, 3, 4, and 5 group solutions. Bayesian Information Criterion (BIC) was compared between models to determine the best-fitting model (Nylund, Asparouhov, & Muthén, 2007).

The number and nature of groups in the final best fitting model are described. Groups are descriptively compared in terms of child proficiency relative to norms (standard scores), length of participation in Head Start, and parents' feelings of how important it is for their children to speak English. This descriptive information provides context concerning the characteristics of children experiencing each pattern of dual language development.

Research question two: Does latent class membership differentially predict EF? As described previously, FACES used a multi-stage clustered sampling technique. Unlike simple random sampling, it is expected that observations are not independent because there are inherent clusters at each stage of sampling. Children in the same program, center, or classroom, are more likely to share similar characteristics due to being drawn from the same environment. An intraclass correlation was conducted at the program, center, and teacher level to describe how similar student's scores are at each

level. The intraclass correlation coefficients (ICCs), indicate the proportion of between-unit variance to total variance. A small amount of clustering will indicate that nesting is not required in further analyses at a specific level.

A regression analysis was selected to test the relation between latent language group and EF. Latent language group was dummy coded based on model generated assignment. Regression analysis was selected because it allows for covariates (i.e., child age and gender) to be entered into the model. The number of correct taps out of 16 trials on the pencil tapping task was used as the outcome measure of EF. Because this task was administered only to children age 4 and older at the time of the direct assessment, many students only have scores collected during assessments completed at wave three (i.e., the end of two full years of Head Start participation). As such, preliminary correlations were inspected to understand the relation between covariates and outcomes across waves. Statistically non-significant variables were trimmed from the final model for parsimony.

CHAPTER IV

RESULTS

In this chapter, results are reported to address the research questions. For these questions, a *p* value of .05 was used as a cut-off point to determine statistical significance. All analyses were conducted using Mplus 8 (Muthén & Muthén, 2017). Descriptive statistics and intercorrelations among children's language skills in English and Spanish and EF were examined first to detect any abnormality in the data that may need to be addressed to meet the assumptions for subsequent analyses. Next, a parallel-process GMM was conducted to answer research question one. Finally, to answer research question two, the groups identified in research question one were compared in terms of EF.

Description of the Sample

Children who were in the 3-year-old cohort, who had been coded as a Spanish speaker, and had at least one TVIP score at any assessment wave, were selected for analyses. From this subsample, 22 cases were identified as having a speech or language disorder at any assessment wave were removed from the analytic sample. A summary of the number of assessments completed at each wave is presented in Table 3.

The sample was relatively evenly distributed between girls (51.7%) and boys. On average, children were 43-months-old at the time of the first assessment (SD = 4.03). Average household income category was $15,001 - $20,000. A dichotomous indicator was used to categorize families as living in poverty or not. The majority of families

Table 3

Number of Participants Across Time and Assessment

	Wave 1 (Fall '09)	Wave 2 (Spring '10)	Wave 3 (Spring '11)
PPVT	392	363	304
TVIP	391	387	292
Pencil Tapping	46	246	305

(69.5%) lived in poverty, with most families being between 50% and 100% of the poverty threshold.

At wave one, average maternal age was 29.99 (*SD* = 6.12). Most (56.3%) mothers reported having less than a high school diploma (Table 4). The majority of mothers (82.4%) were born outside of the U.S. Of these, 71.6% were born in Mexico (Table 4). The majority (78.1%) of families were headed by two parents who had been born outside the U.S. Only 6% of families identified both parents as being born in the U.S. Of mothers born outside of the U.S., 40.8% of mothers had lived in the U.S. for more than 10 years, 39.2% for 6 to 10 years, and 20% five or fewer years. The majority (97.3%) of children were born in the U.S. This indicates that the majority of the children in the sample were second generation immigrants, which, past research indicates would be most likely to learn to speak both the heritage and mainstream language (Alba et al., 2002).

In addition, 65.2% of adult respondents indicated that it was 'Very Important' that the target child, enrolled in Head Start, knows English. More than one fourth (32.7%) rated English language learning as 'Essential', and only 2.1% rated it as 'Somewhat

Important' indicating that, in general, parents may perceive English to be the language of success in the U.S.

Table 4

Selected Detailed Maternal Demographics

	N	Percent
Maternal Education		
Less Than a High School Diploma	253	56.3%
High School Diploma or GED	106	23.6%
Vocational/Technical Degree, Associate's Degree, or Some College	62	13.8%
Bachelor's Degree or Higher	28	6.2%
Maternal Place of Birth if Born Outside the U.S.		
Mexico	265	71.6%
Central America	52	14.1%
South America	28	7.6%
Caribbean	25	6.8%

Description of Language

Descriptive vocabulary scores are presented in Table 5. On average, children's English standard scores were more than two and a half standard deviations below the mean at wave one. By wave three, average English standard scores had improved (from 63.71 to 78.59) but were still one and a half standard deviations below the mean. At wave one, average Spanish standard scores were barley within one standard deviation of the mean (87.72). As shown in Table 5, average Spanish standard scores were similar across all three time points.

Table 5

Spanish and English Standard Score Descriptive Statistics

	Mean	*SD*	Min	Max	*N*
English Wave 1	63.71	19.68	20	112	392
English Wave 2	72.11	15.28	28	116	363
English Wave 3	78.59	14.28	39	117	304
Spanish Wave 1	87.72	10.96	64	134	391
Spanish Wave 2	85.71	13.95	55	128	387
Spanish Wave 3	87.26	16.35	55	131	292

Language variables were inspected to ensure variables did not display an unacceptable level of skew. Skewness less than three is typically recognized as acceptable (Kline, 2015). Skewness for all language variables of interest were less than three.

Intercorrelations of children's vocabulary scores in both languages at all waves are presented in Table 6. As expected, English scores were highly correlated with each other, and Spanish scores were similarly highly correlated with Spanish scores at other waves. A statistically significant negative correlation between English scores at wave one and Spanish scores at wave three, $r(250) = -.17$, $p = .007$, suggests that students who have more English proficiency at Head Start entry have lower Spanish scores after two years of participation. Conversely, it may indicate that those with the least English proficiency at entry have greater Spanish scores at the end of two years of Head Start. A smaller, statistically significant positive correlation between English and Spanish wave

three scores, $r(288) = -.12$, $p = .046$, suggests students with higher scores in one language also have higher scores in the other language.

Table 6

Intercorrelation of Standard Scores in Both Languages at All Waves

Variables	1	2	3	4	5
English					
1. Wave 1	–				
2. Wave 2	$.71^{**}$	–			
3. Wave 3	$.54^{**}$	$.63^{**}$	–		
Spanish					
4. Wave 1	.05	.07	.04	–	
5. Wave 2	-.08	.01	.10	$.50^{**}$	–
6. Wave 3	$-.17^{**}$	-.07	$.12^{*}$	$.42^{**}$	$.53^{**}$

Correlations between standard scores in both languages and covariates are presented in Table 7. Maternal education and years in the U.S. were statistically significantly positively related to English standard scores at all three waves as well as children's Spanish standard scores at wave one. In addition, maternal years in the U.S. and Spanish skills at the final wave were statistically significantly negatively correlated. Child gender was only related to Spanish at wave two in indicating that males have higher Spanish standard scores than females after a single year of Head Start participation. Additionally, age at assessment was negatively related to Spanish standard scores at waves one and two indicating that older children were less likely to be keeping pace with their same-aged peers.

Table 7

Intercorrelation of Standard Scores in Both Languages and Covariates

Variables	Gender	Age W1	Age W2	Age W3	Mother Ed	Years in U.S.
English						
1. Wave 1	-.03	-.08			.14**	.26**
2. Wave 2	.05		-.09		.17**	.18**
3. Wave 3	-.02			-.02	.14*	.16**
Spanish						
4. Wave 1	-.05	-.30**			.14**	.01
5. Wave 2	-.13*		-.16**		.10	-.01
6. Wave 3	-.06			-.02	.03	-.15*

* = $p < .05$, ** = $p < .01$.

Intraclass Correlation Coefficients

ICC analyses inspected the proportion of between-unit variance to total variance for English and Spanish and, under typical circumstances would be used to determine whether further analyses needed to account for clustering. However, because LGM and GMM are capable of accounting for clustering, ICC analyses were conducted here primarily as a point of interest about how language development relates to a child's placement in a specific program, class, or with a particular teacher. Clustering was inspected at the child, teacher, center, and program level for each variable. Results (see Table 8) indicated that the nesting of time within individuals, and children within teachers appears to explain a statistically significant portion of score variance for both Spanish and English. Although statistically significant, when compared to the amount of variability accounted for at the individual level (English = 55.66%; Spanish = 43.82%) a

very small proportion of variability in scores was attributable to children being grouped in a specific teacher (English = 8.17%; Spanish = 5.99%). Scores do not appear to be statistically significantly nested at the center or program level.

Table 8

Percent of Score Variance Attributable to Subject Specific Differences

	English	*P*	Spanish	*P*
Child	55.66%	.000	43.82%	.000
Teacher	8.17%	.000	5.99%	.001
Center	0.00%	.199	0.00%	.072
Program	4.27%	.061	4.16%	.125

Research Question 1: Will an analysis of the receptive vocabulary of children who are learning two languages detect the same number and nature of classes as has been observed using longitudinal expressive language counts?

As described in the analytic plan, separate LGCMs were fitted to English and Spanish raw vocabulary scores. Results from the intercept-only models were rejected in favor of the better fitting linear models for both English and Spanish. Results indicated that p-values for random effects of the intercepts and slopes were statistically significant indicating that there was substantial variation in the starting values and slopes for both English and Spanish. This indicates that time-invariant covariates could be included and tested.

Child gender, maternal education, and the number of years the mother had lived in the U.S., which were all measured only at the first wave, were entered on the slopes and intercepts of the two separate models. Statistically significant variables were retained in the final parallel process model, namely, maternal years in the U.S. on English

intercept and Spanish slope, maternal education on English intercept, and child gender on Spanish slope.

Finally, the two resulting models, with all covariates described above, were combined into a single parallel-process model. Measures of model fit from models with two, three, four, and five group solutions were compared across models (see Table 9). Bayesian Information Criterion (BIC) was compared between models to determine the best-fitting model (Nylund et al., 2007). Of the tested models, a three-group solution had the lowest sample-size adjusted BIC value. Because a four-group solution was most desirable theoretically, additional attention was paid to the four-group solution. However, after graphical inspection of the four groups, it was clear that the patterns identified did not conform to similar groups previously described in work by Escobar and Tamis-LeMonda (2017). Thus, the three-group, data driven solution was selected as best fitting based on sample-size adjusted BIC values.

Table 9

Comparing Model Fit Statistics Across Number of Classes

	2 Class	3 Class	4 Class	5 Class
Free Parameters	36	44	52	60
Loglikelihood H_0 Value	-9513.37	-9482.95	-9457.95	-9267.40
AIC	19098.75	19053.91	19019.89	18654.79
BIC	19246.60	19234.61	19233.46	18901.21
Sample-Size Adjusted BIC	19132.35	19094.98	19098.43	19710.80
Classification Entropy	.85	.89	.87	1.00

Nature of Groups

Final model estimated parameters are presented in Table 10. Values reported indicate the model derived using raw vocabulary scores. and controlling for maternal years in the U.S., maternal education, and child gender. To better understand average group proficiencies, standard scores were plotted and inspected in the remainder of the study.

Table 10

Group Intercept and Slopes

	Group 1 - (Average English and Spanish)		Group 2 - (Moderately Low Increasing to Average English; Consistent Average Spanish)		Group 3 - (Increasing Extremely Low English; Consistent Average Spanish)	
English						
Intercept	61.68 ***	(2.61)	9.80***	(0.53)	32.39***	(1.31)
Slope	15.73***	(4.07)	19.29***	(0.67)	22.93***	(1.39)
Spanish						
Intercept	16.52***	(2.65)	8.12***	(0.45)	7.76***	(0.93)
Slope	9.12**	(2.99)	8.60***	(0.45)	8.67***	(0.95)
Control						
Child Gender	0.19	(0.14)	-0.00	(0.03)	-0.01	(0.56)
Mom Yrs. U.S.	-0.31	(0.26)	-0.01	(0.05)	0.16	(0.11)
Mom Ed.	0.59*	(0.28)	-0.05	(0.05)	0.09	(0.12)

Note. Model based on raw Spanish and English vocabulary scores. Control variables were as follows: maternal years in the U.S. on English intercept and Spanish slope, maternal education on English intercept, and child gender on Spanish slope. Numbers in parentheses are standard errors.
* $p < .05$, ** $p < .01$, *** $p < .001$.

Inspection of standard score trends revealed that across groups, average English standard scores increased over time. This indicates that, on average, children were

learning English vocabulary at a rate that was bringing them closer to proficiency as compared to their same-aged peers. Spanish standard scores, across groups, remained the same or decreased across time indicating that although some students were learning enough words to keep pace with same-aged peers in the same proficiency range, others were not. Average child age and family income were similar across groups at each wave.

Group 1 - Average English and Spanish

Group 1 was the smallest group with only 13 cases. Inspection of Spanish and English standard scores revealed that students in this group scored in the average range in both languages at all three waves with higher English than Spanish standard scores (see Figure 6). The majority (69.2%) of children in this group were male. Mothers in Group 1, as compared to Groups 2 and 3, were the most educated with overall 61.5% completing high school or more, and of that 23% achieving a Bachelor degree or higher. Mother's average age was 31.85 (*SD* = 6.67). The primary caregivers of the children in this group reported over half (63.6%) of children in this group learned Spanish first, however most (45.5%) speak English most at home. All primary caregivers of children in this group selected 'Well' or 'Very well' in response to question about how well they feel they speak and understand their home language Spanish. The majority (63.7%) selected 'Well' or 'Very well' when questioned about both speaking and understanding English.

Group 2 - Moderately Low Increasing to Average English; Consistent Average Spanish

The average English standard score in Group 2 (*N* = 89) at wave one was just barely in the moderately low range (*M* = 83), but was in the average range by wave three exactly the same (*M* = 85) on the very edge of the average range. It is also worth noting

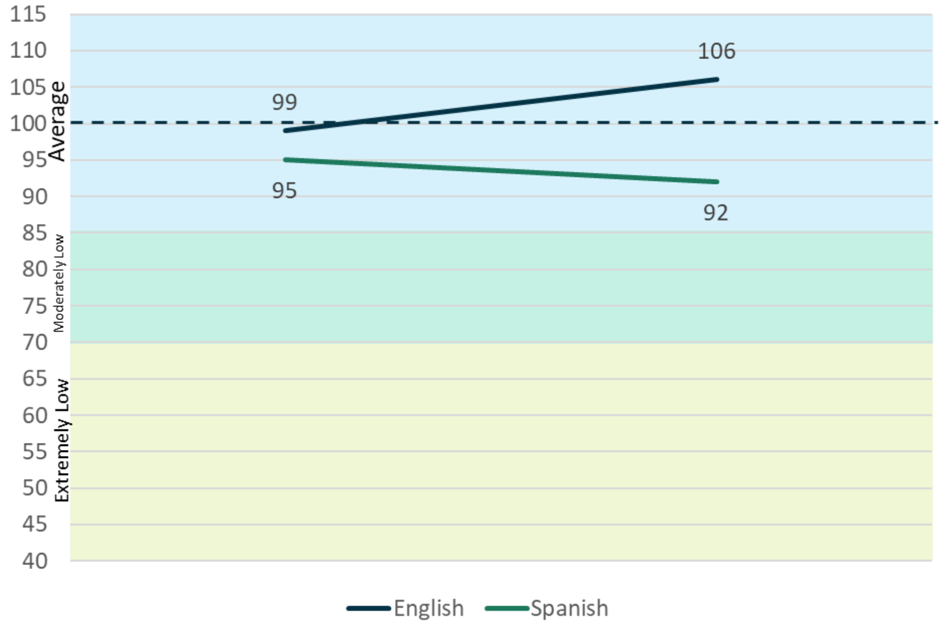

Figure 6. Group 1 (Average English and Spanish) average standard scores for Spanish and English across time.

that this group had language scores that were the most similar across languages. Indeed, graphically, they were the only group where the two lines representing language proficiency cross one another (see Figure 7). While the children in Group 1 (Average English and Spanish) have the highest average proficiency, children in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) appear to have the most similar proficiency across languages.

Gender was relatively evenly distributed (52.8% female). The majority (52.8%) of mothers of children in Group 2 had less than a high school diploma. Mothers' average age was 30.19 (*SD* = 5.33). The primary caregivers of the children in this group reported that the majority (85.5%) of children in this group learned Spanish first. However, the division among the language categories reflecting the language the child speaks most at

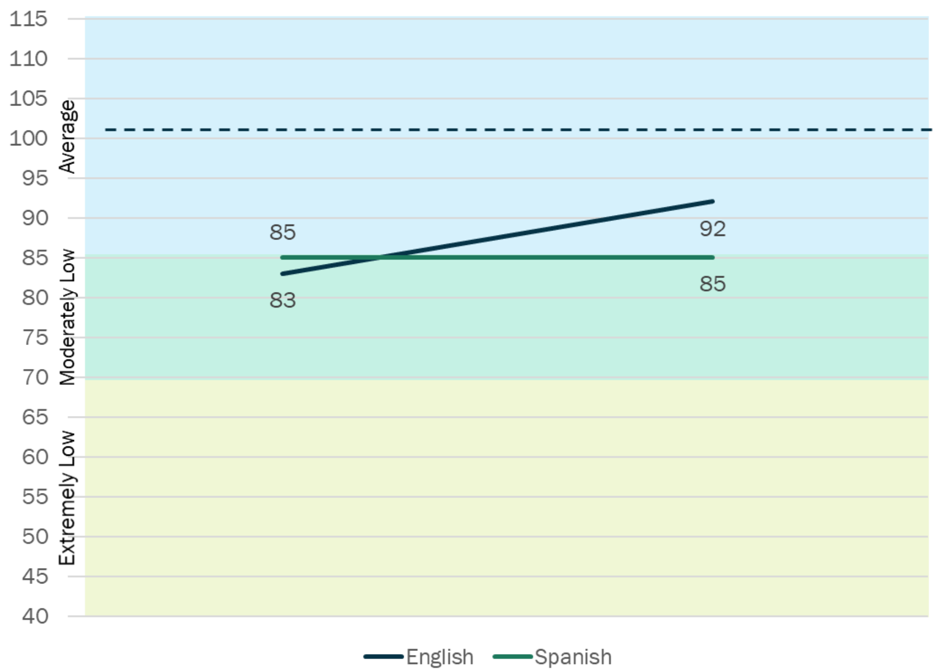

Figure 7. Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) average standard scores for Spanish and English across time.

home was fairly evenly split among English (33.9%), Spanish (38.7%) and English and Spanish equally (27.4%). The primary caregivers of the children in this group, on average, appear to not feel they speak or understand English well, but more than 'Not at All,' while they do rate themselves as understanding their home language very well.

Group 3 - Extremely Low Increasing English; Consistent Average Spanish

The largest group (*N* = 347) displayed the most dramatic increase in English vocabulary. At wave one, the average standard score was in the Extremely Low range (*M* = 56). At wave three, the average score had risen to the Moderately Low range (*M* = 75). Meanwhile, average Spanish standard scores, while in the average range, remained relatively the stable over time (see Figure 8).

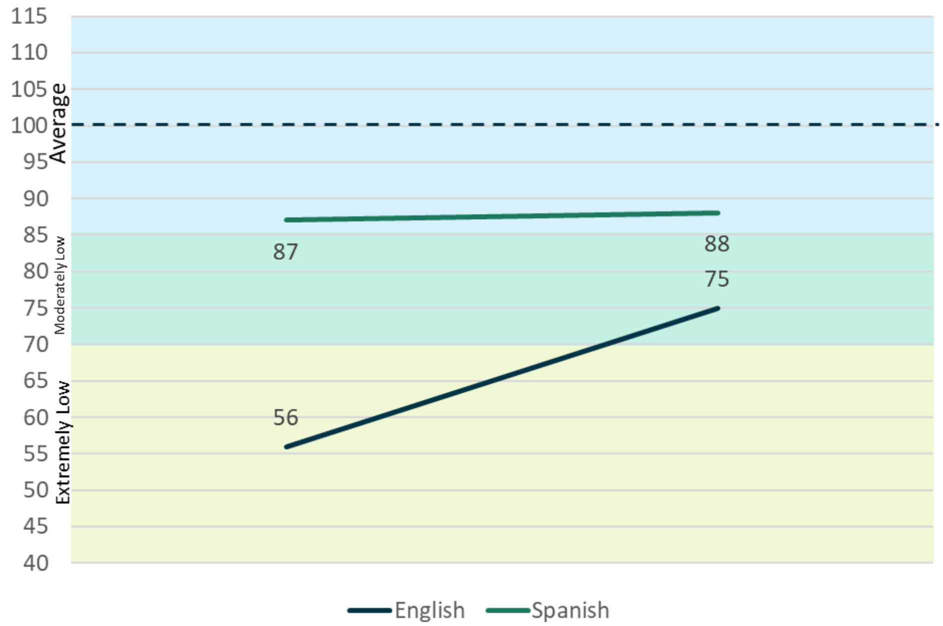

Figure 8. Group 3 (Extremely Low Increasing English; Consistent Average Spanish) average standard scores for Spanish and English across time.

Gender distribution for this group was the same percentages as in Group 2 (52.8% female). Of the three groups, this group had the highest percentage of children with mothers who had not completed high school (57.9%). Mothers' average age was 29.89 (*SD* = 6.29). Nearly all (95.7%) of children in this group learned Spanish first, and the majority (74.9%) continue to speak mostly Spanish at home. More than half of the primary caregivers of the children in this group rated themselves as speaking and understanding English 'Not Well' or 'Not At All,' but of the three groups this group had the smallest percentage of caregivers that rated themselves as speaking (9.6%) and understanding (13%) Spanish 'Very Well.'

Research Question 2: Does latent class membership differentially predict EF?

Descriptive analyses of the EF outcome measure were first inspected to ensure the distribution of scores met assumptions (see Table 11). As expected, children's correct number of taps on the pencil tapping task increased over time. Only children who were at least four years old at the time of testing were administered this task. Recall, children who were apart of the three-year-old cohort were selected for analyses. However, some children who were in the three-year-old cohort, and thus eligible for two full years of participation in the Head Start program, may have had birthdays late in the year, meaning that they would actually be four-years-old at the time of testing. As such, 46 children were administered this task at wave one. Approximately six months later, at wave two, 246 children were administered the task. On average, they tapped correctly 5.84 times out of 16 trials. By wave three, 305 children completed the task. The average correct response at wave three was 10.13 out of 16 trials. In addition, skew was inspected to ensure variables were not beyond acceptable levels. The largest skew was 1.79 at wave one. Because skewness less than three is typically recognized as acceptable, this indicates that skewness for variables of interest were within an acceptable range (Kline, 2015).

Table 11

EF, Correct Number of Taps on Pencil Tapping Task, Descriptive Statistics

	Mean	*SD*	Skew	*N*
EF Wave 1	3.28	3.66	1.79	46
EF Wave 2	5.84	4.93	.63	246
EF Wave 3	10.13	5.62	-.53	305

Correlations between all primary variables were inspected (see Table 12). Child gender was statistically significantly negatively related to EF scores at wave three. Because females were coded as zero in this dataset, this indicates that females produced higher scores than males. Child age at assessment at waves two and three were statistically significantly positively related to EF scores indicating that older children scored higher on the pencil tapping task. Language group was statistically significantly negatively related to EF only at wave three. Because language group was a categorical "dummy" variable, interpretation of this correlation was tricky. It appears that an increase in group (from group 1 to 2 and 2 to 3) was associated with lower EF scores. Regression results will indicate if there were specific group effects for EF.

Intercorrelations of children's EF and vocabulary scores in both languages at all waves are also presented in Table 12. EF scores at the end of the first year of participation in the Head Start program were positively statistically significantly related to English at the end of two years of participation, and Spanish at all three waves. Wave three EF scores were statistically significantly related to English and Spanish at all three waves in a positive direction. In addition, EF scores at the end of the first year and the end of the second year were positively statistically significantly related.

Intraclass Correlation Coefficients

ICC analyses to inspect the proportion of between-unit variance to total variance were conducted for EF. As with Spanish and English, clustering was inspected at the child, teacher, center, and program level. Results indicate that only the nesting of time within individuals appears to explain a noteworthy portion of score variance. As shown

Table 12

Correlation Matrix of All Primary Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
English Standard Scores															
1. W1	-														
2. W2	.71**	-													
3. W3	.54**	.63**	-												
Spanish Standard Scores															
4. W1	.05	.07	.04	-											
5. W2	-.08	.01	.10	.50**	-										
6. W3	-.17**	-.07	.12*	.42**	.53**	-									
EF															
7. W1	-.05	.05	-.21	.03	-.01	-.24	-								
8. W2	.11	.10	.18*	.17*	.23**	.19*	.20	-							
9. W3	.12*	.22**	.27**	.17**	.18**	.31**	.16	.39**	-						
Child Age															
10. W1	-.08	-.08	.00	-.30**	-.17**	.00	-.03	.15*	.17**	-					
11. W2	-.06	-.09	.00	-.29**	-.16**	-.03	.10	.13*	.15**	.87**	-				
12. W3	-.08	-.15*	-.02	-.29**	-.19**	-.02	.15	.14	.15**	.84**	.98**	-			
13. Child Gender	-.02	.05	-.02	-.05	-.13*	-.06	-.09	-.09	-.13*	.01	-.01	.02	-		
14. Mom Yrs. U.S.	.26**	.18**	.16**	.01	-.01	-.15*	-.03	.03	.02	-.11*	-.09	-.02	-.08	-	
15. Mom Ed.	.14**	.17**	.14*	.14**	.09	.03	.43**	.10	.08	-.09	-.12*	-.10	-.02	.01	-
16. Language Group	-.65**	-.68**	-.52**	.03	.01	.04	.06	-.11	-.22**	-.19**	-.22**	-.18**	-.04	-.02	-.13**

* = *p* < .05, ** = *p* < .01.

on Table 13, a very small proportion of variability in EF scores was attributable to children being grouped in a specific program, center, or with a specific teacher. ANOVA comparisons of models sequentially adding additional variables did not indicate any level contributed a statistically significant amount of nesting. Thus, all further analyses do not specifically account for clustering at these levels.

Table 13

Percent of Score Variance Attributable to Subject Specific Differences

	EF	*p*
Child/Time	33.61%	.000
Teacher	2.19%	.126
Center	4.22%	.056
Program	1.35%	.918

Multiple Regression

Multiple regression analyses were used to test whether latent language development group predicted EF as measured by the correct number of taps. To ease interpretability, child age was mean centered at all three waves. Mplus allows for multiple dependent variables to be tested in a single model. Thus, the first model tested the relation of child age at all three assessment points, child gender, and latent group on executive function at all three waves. Review of output revealed no statistically significant effects of any predictor variables on EF at waves one and two. These two variables were dropped from the model along with the children's age at waves one and two. It is important to note that wave three had the largest number of cases with responses on the outcome variable available for analysis (Group 1 $N = 4$; Group 2 $N = 62$;

Group 3 N = 239). Only four cases in Group 1 (Average English and Spanish) had EF scores at wave three. Given the small sample size, it was unlikely that a statistically significant difference would be detected. Thus, to simplify interpretation participants in Group 1 (Average English and Spanish) were removed from the analysis to transform latent group membership into a dichotomous variable. The final model tested membership in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) and Group 3 (Increasing Extremely Low English; Consistent Average Spanish) while controlling for child age and gender on pencil tapping task performance at the end of two years of Head Start participation.

The results of the final regression model predicting EF at wave three are shown in Table 14. The regression analysis yielded a statistically significant equation $F(3, 297)$ = 8.64, p = .000. The effect size (R^2 = .08) was found to exceed Cohen's (1988) convention small effect (R^2 = .02) but not large enough to be classified as a medium effect (R^2 = .25). All three predictor variables were statistically significant in predicting EF at spring before kindergarten entrance. Age at assessment had a positive effect on EF performance indicating that controlling for latent language development group membership and gender, every one month increase from the group average age there was a 0.19 increase in the number of correct taps (p = .030). Gender also had a statistically significant influence on EF. Because females were coded as zero in this dataset, this indicates that controlling for latent language development group membership and age, females had 1.45 more correct taps than males (p = .022). Finally, latent language development group membership had a negative influence on EF such that, controlling for age and gender, children in Group 2 (Moderately Low Increasing to Average English; Consistent Average

Spanish) had 2.84 more correct taps than in Group 3 (Increasing Extremely Low English; Consistent Average Spanish; p = .000).

Table 14

Language Group Predicting EF Controlling for Child Age and Gender

	EF at Wave 3			
Variable	*B*	SE *B*	β	95% CI
Constant	18.01	2.21		[13.66, 22.37]
Language Group	-2.84**	.78	-.20	[-4.38, -1.29]
Child Age W3	.19*	.09	.12	[.02, .36]
Child Gender	-1.45*	.63	-.13	[-2.68, -.21]
R^2	.08			
F	8.64**			

Note. N = 301: Group 2 = 62, Group 3 = 239. CI = confidence interval.
* = $p < .05$, ** = $p < .01$.

CHAPTER V

DISCUSSION

The first purpose of the current study was to use a nationally representative sample of children attending Head Start to examine trajectories of children's Spanish and English receptive language and determine if latent subgroups exist. Previous research has identified groups of dual-language development using expressive language counts (Escobar & Tamis-LeMonda, 2017). The current study sought to extend previous research to receptive vocabular scores. In addition, this study was unique as it focused on young Spanish-speaking children who were learning English in the Head Start program which serves primarily low-income families.

The second purpose of this study was to inspect whether the resulting groups experienced differences in EF. Many previous studies have described the difference in EF skills by comparing individuals who are bilingual to individuals who are monolingual (Akhtar & Menjivar, 2012; Bialystok, 2001; Calvo & Bialystok, 2014; Carlson & Meltzoff, 2008; Mezzacappa, 2004). This study was different from previous research in that it compared the EF skills among children who were of varying bilingual proficiencies among themselves without a monolingual comparison group. This approach was intended to identify the impact of varying patterns of bilingual proficiency.

Presence of Clustering in Variables of Interest

The largest amount of clustering for Spanish and English was within individuals across time. In addition, English scores were highly correlated over time. Similarly,

Spanish scores were also highly correlated over time. These findings were reasonable in light of previous research indicating that children with strong language skills may elicit a greater amount and variety of vocabulary than children who do not have strong language skills (Hoff , 2006; Pearson, 2007; Tamis-LeMonda et al., 2001). The current study did not explicitly focus on language elicitation. However, the pattern seen here where children who had high initial vocabulary continued to increase their vocabulary across time indicates that a similar relation between children and their environment may be at work. The current study demonstrates that this pattern of "the rich get richer" is true for both Spanish and English. Additionally, there may be reason to further investigate the influence children have on the languages represented in classrooms.

It was somewhat surprising that clustering at the program and center level for both language variables was not present in the ICC analyses conducted with this sample. It was expected that children in the same location would experience similar outcomes. However, in terms of language, results indicated nesting across time and within teachers was most influential and geographic clustering (i.e., program and center) variables were fairly inconsequential. However, clustering within teachers was statistically significant indicating that an assignment to a specific teacher may influence a child's Spanish or English language development. This reflects past research which indicates the amount and variety of language provided in an environment is predictive of a child's vocabulary size (Hart & Risley, 1995). One of the purposes of the Head Start program is to provide rich vocabulary environments for children from low-income families. However, as noted through assessments of Head Start classrooms, the language environment varies from class to class (Office of Head Start, 2018). It is important to note that while the clustering

at the teacher level was statistically significant, the portion of scores attributable to the clustering was only 8.17% for English and 5.99% for Spanish. The clustering at the teacher level seems relatively small in comparison to the proportion of variability attributable to scores across time (English = 55.66%, Spanish = 43.82%). This indicates that while teacher assignment may be important, the child's individual experience across time in each language explains a greater amount of variability in language-specific development.

In contrast to language, investigation of clustering for the EF variable revealed no statistically significant clustering of scores at the program, center, or teacher level. While surprising, this finding may be of comfort to families and Head Start programs within this sample. Because EF was not clustered by a specific teacher, center, or program, it appears to be less important that a child be assigned to the "best" teacher, or get into a specific program in order to experience what the Head Start program offers in terms of EF development. However, due to the age/sample size limitations of the EF measure, the current project did not investigate development of EF skills over time, or the influence of the Head Start program. Given that past research indicates EF is essential to academic success in the areas of math, science, and reading (Best et al., 2011; Bierman et al., 2009; Blair, 2002; Brock et al., 2009; Bull et al., 2008; Smith-Donald et al., 2007; Thorell & Wåhlstedt, 2006) it may be fruitful for future research to investigate the contribution of Head Start environments to the development of EF not just for dual language learners, but also for monolingual children. The current study suggests that there were no differences in EF for children who were Spanish-English DLLs when compared by teacher, center, or program.

Dual Language Development

Previous research indicates that exposure to English immersion before age 5 may be especially influential in first language loss (Anderson, 2004; Hammer et al., 2008; Wong-Fillmore, 1991). In addition, parents in this sample appear to perceive English to be the language of success in the U.S. The majority of adult respondents indicated that it was ‘Very Important’ that the target child, enrolled in Head Start, knows English. Perceiving that one language is critical to academic and financial success is often associated with subtractive bilingualism (Petrovic, 1997). However, inspection of group averages did not clearly identify a pattern of first language loss in any of the three groups defined by the model. While it is probable that there were individual students in the sample experiencing language loss, it was clear that as a whole this was not a typical experience for children in this sample. This may indicate that efforts to value home languages have been successful in reducing subtractive language environments described in past research.

There was little improvement in average Spanish standard scores across the three waves. Because standard scores are relative to same-aged peers, no growth in standard scores across time indicates children were continuing to learn Spanish at the same pace as their initial levels of proficiency. Thus, this trend cannot accurately be described as attrition because children were clearly continuing to learn new Spanish vocabulary. However, average standard scores were relatively low for two out of the three groups. Longitudinal data that continued to track the dual language development of this population would shed light on whether the trend seen here was a temporary focus on

"gaining ground" in English with a return to more balanced language proficiency in the future.

Identifying Latent Classes of Dual Language Learners

Based on previous research (Escobar & Tamis-LeMonda, 2017) it was expected that four groups of dual language learners would be identified in a Head Start population using the FACES dataset. Contrary to expectations, only three distinct groups were identified. The difference in the number of identified groups may be attributable to the different ages of the children in the two samples. Escobar and Tamis-LeMonda's sample started a year earlier (24 months) than the current sample and tracked children until age 5. It was also unclear from Escobar and Tamis-LeMonda's (2017) description of the sample whether families were similar in terms of maternal age and education. Their description does indicate families were low-income and Spanish-English-speaking immigrants. Unlike the present study, which focused on receptive language scores, Escobar and Tamis-LeMonda (2017) examined expressive language counts from children who were learning two languages.

Children of all ages who are learning two languages are typically able to understand a second language before they are able to express themselves in that language. Thus, receptive vocabulary represents some indication of what children are being exposed to, but more importantly, also what they are paying attention to. From the current results, it was clear that children in this sample were hearing, and paying attention to the English language. On average the children experienced growth in English across time. In addition, stable Spanish standard scores indicate children's raw scores increased;

they continued to learn Spanish vocabulary at the same rate as they were when they entered the Head Start program.

Differences in Executive Function by DLL Group

The results of the regression testing the influence of group on EF scores indicated that children in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) had statistically significant higher EF scores at wave three than children in Group 3 (Increasing Extremely Low English; Consistent Average Spanish). This finding appears to support the theory that children with more matched growth between languages may experience a cascading increase in EF skills. In other words, there may be a cross-domain overlap between the attention processes used to control attention to languages and those attention processes used to control attention to nonverbal stimuli. The students in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) had English and Spanish language scores that were very similar across time. On the other hand, children in Group 3 (Increasing Extremely Low English; Consistent Average Spanish) consistently had Spanish scores that were much higher than English scores with dramatic improvements in English scores across time. Because of their similar proficiency across languages, it is conceivable that the children in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) may have known many more words across languages than those in Group 3 (Increasing Extremely Low English; Consistent Average Spanish). For example, the children in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) may have known both ‘cat’ and ‘gato’ whereas it is more likely that those in

Group 3 (Increasing Extremely Low English; Consistent Average Spanish) knew the majority of words in a single language. If true, then the children in Group 2 (Moderately Low Increasing to Average English; Consistent Average Spanish) would encounter more frequent opportunities to "practice" neurological suppression of words known across languages but not currently represented in a specific interaction. Consistent with the language selection mechanism theory, and cascading developmental trajectories theory, this increased engagement of a neurological mechanism for language appears to be having a positive cascading influence on nonverbal EF development.

Alternatively, it is possible that children who already had an internal propensity for increased executive function are more adept at learning two languages. However, the difference between groups was not observed until the final wave, indicating that children were experiencing a specific pattern of language development before the difference in EF was noted. Unfortunately, this may be an artifact of the data collected. As noted in the results section, wave three had the largest group of participants who completed the EF measure. Because the EF task was only administered to children who were four years old or older at the time of testing the third wave was the time when the most children in this cohort were eligible for testing. Thus, it may be that if there were more cases at the other waves a difference may be evident earlier. To the same point, it may be that Group 1, which had the highest overall language scores may have also had differences in comparison to the other groups if there had been more children in that group. However, only four cases were included in analyses testing the influence of group membership on EF. Such a small sample size may not have provided sufficient power to detect a difference. This is a complex problem to solve given that group membership was a latent

variable. It would be difficult, to say the least, to purposefully select a sample with a more even distribution of children across groups.

In addition, this study's finding that the pattern of dual language development predicts later EF skills adds support to the developmental cascades theory. According to the developmental cascades theoretical framework, children's early experiences influence development both across domains and over time (Cicchetti & Cannon, 1999; Dodge & Pettit, 2003; Hinshaw, 1992; Masten & Coatsworth, 1998; Patterson et al., 1992; Rutter et al., 2006). It appears that for those children experiencing a specific pattern of dual language development, there was a cascading positive influence on EF skills. These findings also support the theorized mechanism of this cascading influence. Recall that psycholinguistic evidence suggests that both languages are neurologically constantly active (Francis, 1999; Grainger, 1993; Kroll et al., 2012; Kroll et al., 2015; Marian & Spivey, 2003). The results presented here indicating that children with more closely related dual language proficiency do have higher EF scores than children with more disparate language abilities. This adds evidence to the hypothesis that a neurological mechanism for language selection that is part of a larger domain-general process for attention and inhibition, may exist. This was evidenced by the reasoning that increased engagement of the language selection process, which would be true for people who know more words across languages, may strengthen its abilities across domains such as the effects on EF noted in this project (Bialystok et al., 2009).

Limitations and Future Directions

The contributions of this study should be considered in light of its limitations. Given differences in state policies regarding English-only instruction vs. dual language instruction and also possible trends for Spanish speakers to be more populous in particular areas, geographic region is an important factor to consider. It was regrettable to note that a geographic location variable was not available for inclusion in analyses. In response to requests for such a variable, the administrative entity for FACES:2009 was very clear that due to possible violation of participant confidentiality not even a general indicator of broad geographic location was available for this dataset. Future research would benefit from the inclusion of a regional variable to better understand how the larger societal context may influence language learning patterns for children who are learning two languages.

Another important variable to consider in future research is the role of siblings in dual language development. Previous research indicates that older siblings can be an important source of English for younger siblings (Ellis, Johnson, & Shin, 2002; Ortiz, Innocenti, & Roggman, 2004, Wong-Fillmore, 1991). As older siblings learn more of the dominant language, usually in English immersion schools, they become an additional source of English in the home (Wong-Fillmore, 1991). Research using an earlier iteration of the FACES data set reported siblings have a different influence for primarily Spanish-speaking and primarily English-speaking Latino children (Ortiz, 2009). The influence of siblings on dual language developmental patterns should be investigated in-depth in future research.

A further limitation of this study, and the majority of research concerning children who are learning two languages, is the measurement of Spanish and English languages separately. The most common assessments of Spanish and English measure each language without considering the other. This essentially treats individuals who are bilingual as if they are two monolingual individuals in the same body, which can lead to a misunderstanding of a bilingual person's abilities (Grosjean, 1989, 1992, 1998, 2001). Future research using more comprehensive bilingual assessments, many of which are in production, will be better equipped to comprehensively answer this question.

In addition, the pencil tapping task used as the measure of EF in this study may be considered a narrow assessment of EF skills. As noted earlier, The Pencil Tapping Task has been shown to be an objective assessment of children's self-regulation, particularly inhibitory control which, is associated with young children's vocabulary development (Blair & Razza, 2007; Espy et al., 2004; McClelland et al., 2007). Additionally, the pencil-tapping task has been used successfully in previous research with bilingual populations (Bialystok, Barac, Blaye, & Poulin-Dubois, 2010). However, measurement of only children who were age 4 or older dramatically influenced sample size at the first and second waves of data collection. This impeded efforts to identify the relation between language development and EF. Additionally, a more comprehensive battery of EF assessments would allow future research to identify nuanced cascades between the development of two languages and the many facets of EF.

The current study was also limited by the use of three time points. If a fourth time point had been included in analyses non-linear patterns could have been inspected. However, as is, the analysis was limited to testing linear trajectories which may not have

captured the full range of change in both languages. In addition, replication of the current groups is necessary to confirm that the groups described here are reliably represented. The FACES data is from an on-going research program collecting data at regular intervals using many of the same measures from year to year. Future research could use these new datasets to confirm or dispute the findings reported here.

Policy Implications

The current study shows that children who have relatively equal vocabularies in two languages experience higher EF as compared to those with a clearly dominant language. This finding is similar to other reports that indicate balanced bilingualism has benefits beyond the practical ability to speak two languages. However, few nation-wide policies reflect systemic support for first languages.

The Head Start program has many policies that are intended to require programs to value home languages. However, pressure to ensure children are “school-ready” for fully immersive English classrooms may supersede desires to support first language growth in Head Start. It may be that in order for early childhood programs to truly be given the freedom to support home languages in a meaningful way, policies would need to be implemented to allow for more languages to be represented in kindergarten and grade schools. Without continued support for home languages throughout children’s school experiences, English proficiency may continue to supersede efforts to truly value first language skills.

A potentially untapped resource are the parents of the children who are DLLs in Head Start classrooms. Parents of children who are enrolled in Head Start are required to

provide volunteer hours to the programs serving their children. In light of results presented here, it may be important to consider the potential contribution of parents who speak a language other than English. It may be beneficial to encourage programs and teachers to facilitate opportunities for parents who are proficient in a non-English language to add to the classroom language environment in a meaningful way as a part of their regular volunteer opportunities.

Practical Application

Some Head Start families may not realize their important role as the primary source of home language input. Furthermore, families may be depending on children to learn language through indirect exposure to speech. However, previous research indicates that language simply overheard by toddlers is not related to growth in vocabulary or other aspects of language development (Ramírez-Esparza, García-Sierra, & Kuhl, 2014; Rowe, 2012; Weisleder & Fernald, 2013). Infants and toddlers learn best during one-on-one interactions, when talk is directed to them. It may be important to highlight this finding to families who may otherwise expect children to continue to develop home language skills after entering English immersion classrooms. Family language interventions may be useful in raising families' awareness and intentionally increasing the amount of home language spoken (Kohnert, Yim, Nett, Kan, & Duran, 2005; Tamis-LeMonda & Escobar, 2018).

Many parents may feel pressure to teach their children English. However, research indicates that if parents do not have sufficient proficiency in English, limiting interactions with their children to English-only can compromise children's native

language development without producing meaningful gains in English (Hammer et al., 2009; McCabe et al., 2013). Results presented here indicate that benefits associated with children knowing both English and Spanish equally may contribute to EF. There are also other benefits of supporting two languages, such as setting the stage for more growth in English vocabulary and literacy in the future (Leacox & Jackson, 2014; Prevoo et al., 2016; Rinaldi & Páez, 2008; Tamis-LeMonda, Song, Luo, Kuchirko, Kahana-Kalman, Yoshikawa, & Raufman, 2014). Thus, for children learning two languages it may be advantageous to consider building first language skills in a focused and intentional way in hopes of setting the stage for the development of children with more balanced bilingualism.

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Yang, S., Yang, H., & Lust, B. (2011). Early childhood bilingualism leads to advances in executive attention: Dissociating culture and language. *Bilingualism: Language and Cognition*, *14*, 412-422. doi: 10.1017/S1366728910000611

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CURRICULUM VITAE

Audrey C. Juhasz, Ph.D.
(January 2019)

EDUCATION

2019 **Ph.D., Family and Human Development** Utah State University

Dissertation Title: *Examining Different Patterns of Early Dual Language Development and Non-Verbal Executive Functioning*

Co-chairs and committee members: Lisa K. Boyce, Ph.D., Aryn M. Dotterer, Ph.D., Lori A. Roggman, Ph.D., Ronald B. Gillam, Ph.D., E. Helen Barry, Ph.D.

Human development emphasis

2013 **M.S., Family, Consumer, and Human Development** Utah State University

Thesis Title: *Maintaining Spanish in an English-Speaking World*

Chair and committee members: Lisa K. Boyce, Ph.D., Linda Skogrand, Ph.D., Kaelin M. Olsen, M.S.

Infancy and childhood emphasis

2011 **B.S., Family, Consumer, and Human Development** Utah State University

Magna Cum Laude

Community service emphasis

RESEARCH AND PROFESSIONAL EXPERIENCE

2018- Present **Program Evaluation Specialist**
The Family Place Supervisor: Esterlee Molyneux, M.S.

The Family Place is a 501(c)3 nonprofit organization striving to achieve its mission of Strengthening Families and Protecting Children in Cache and Rich Counties through 24-hour emergency/respite nursery care, education, and counseling services.

- Develop evaluation portion of all large grants
- Ensure high quality services are delivered and outcomes are demonstrated
- Work with department heads to:
    - Improve effectiveness and efficiency of programs
    - Assure compliance with contract and/or donation requirements
    - Oversee continuous quality improvement
    - Select and develop outcome-based evaluation measures
    - Implement standards and testing to measure and document effectiveness

2014- 2018 **Project Coordinator: CCAMPIS Federal Grant Program**.
Utah State University Principal Investigator: Dr. Lisa Boyce

The Child Care Access Means Parents in School (CCAMPIS) program is a $1,440,000 grant funded by the U.S. Dept. of Ed. It provides subsidies to offset the cost of childcare for college students.

- Co-author of currently funded grant program primarily development of project objectives and evaluation section of grant proposal
- Primary point of contact for all program related services
- Interface with evaluation team to conduct program evaluation
  - Applied data collection from parents, children, and teachers
  - Train and supervise all undergraduate and graduate students when hired.
  - Coordinate workflow within project; track task progress and ensure that deadlines are met on time and within budget.
- Design, produce, and present results of on-going program evaluation at professional conferences and through peer-reviewed publications
- Create strong partnerships with program administrators across campus to ensure comprehensive services are provided to meet needs of student-parents

INDEPENDENT EVALUATION CONSULTANT (2011- Present)

Accretio Consulting: Adolescent residential treatment center - Ongoing evaluation.
- Curate data files according to requesters specifications
- Involved in measure selection and evaluation design
- Input, process, extract, and analyze incoming data (electronic and hardcopy)
- Conduct analyses and prepare reports, including data dashboards and customized visualizations (graphs, charts, tables), for stakeholders
- Design, author, and distribute technical reports and executive summaries

Sarana Education: Multi-year Head Start evaluation to track program effectiveness and inform teaching practices. Pre-test/Post-test. Child, parent, and teacher level data.
- On-site supervisor and trainer for a team of 3-5 assessors collecting data from approximately 130 children twice a year across 15 sites (42 classrooms)
- Monitored quality of assessments and provided feedback to specific assessors
- Elicited feedback from teachers to improve testing and reduce classroom disruptions
- Co-presented findings to supervisors and teachers in large and small groups

Logan City School District: CLASS PreK observations for High Quality School Readiness grant.
- Applied the CLASS observation framework to code teacher-child interactions
- Provided written observation-based feedback to teachers including specific examples of strengths and areas for improvement
- Met with program coordinator to discuss observation report, review recommendations, and provide information and resources

ASSISTANTSHIPS AND PRACTICA

- Methodologist for the Partnership for Arts Learning program, a project aimed at researching the influence of arts education in preschool programs
    - Selected measures, advised data collection procedures including video recording and direct child assessment
    - Interfaced weekly with team to plan, prioritize, and set goals based on project objectives and timeline
- Mentored undergraduate students in standardized child assessment administration, double data entry, and basic statistical analyses

PUBLICATIONS

Juhasz, A. C., & Bradford, K. (2016). Mobile Phone Use in Romantic Relationships. *Marriage and Family Review*, 1-15.

Dotterer, A. M., Hall, K., **Juhasz, A. C.**, Park, S. J., & Boyce, L. K. (under review). Examining Stress Among College Student Parents: A Mixed Methods Study.

PRESENTATIONS

Juhasz, A. C., Dotterer, A.M., & Boyce, L. K. (2019, March). *Differences in executive functioning outcomes for Spanish-English dual language learners: Does bilingual proficiency matter?* Poster presented at the biennial meeting of the Society for Research in Child Development, Baltimore, MD.

Dotterer, A.M., **Juhasz, A. C.,** Hall, K., Park, S. J., & Boyce, L. K. (2018, November). *Examining stress among low-income college student parents: A mixed methods study*. Poster presented at the annual meeting of the National Council on Family Relations, San Diego, CA.

Hall, K., **Juhasz, A. C.,** Dotterer, A., Park, S. J., & Boyce, L. K. (2018, October). *A qualitative investigation of how student parents cope with multiple roles*. Poster presented at the Inclusive Excellence Symposium at Utah State University, Logan, UT.

Juhasz, A. C., & Boyce, L. K. (2018, June). *Describing latent classes of Spanish-English dual language learning students in head start*. Poster presented at Administration for Children and Families' annual meeting of the National Research Conference on Early Childhood, Washington, D.C.

Juhasz, A. C., & Boyce, L. K. (2018, May). *Parental coping as a potential buffer of stress on children's internalizing behaviors for student parents*. Poster presented at the annual meeting of the World Association for Infant Mental Health, Rome, Italy.

Juhasz, A. C., Hall, K., Dotterer, A., Park, S. J., & Boyce, L. K. (2018, March). *Student-parent fathers experience more stress-spillover than mothers*. Poster

presented at the annual meeting of the Utah Council on Family Relations, Provo, UT.

Juhasz, A. C. (2018, February). *Leveraging home languages to promote executive functioning*. Presentation at the annual meeting of the Child Care and Early Education Policy Research Consortium Annual Meeting, Washington, D.C.

Juhasz, A. C., & Boyce, L. K. (2016, October). *Making data meaningful: One program's use of data placemats to engage and serve stakeholders*. Poster presented at the annual meeting of the *American Evaluation Association*, Atlanta, GA.

Juhasz, A. C., & Boyce, L. K. (2015, March). *Child-level predictors of receptive Spanish language retention in the context of the pre-k classroom*. Poster presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, PA.

Juhasz, A. C., & Boyce, L. K. (2014, November). *Promoting parent-child home language use*. Poster presented at the annual meeting of the National Association for the Education of Young Children, Dallas, TX.

Boyce, L. K., & **Juhasz, A. C.** (2013, October). *Evaluating preschool classroom quality: Fluctuations and implications for impacts*. Poster presented at the annual meeting of the American Evaluation Association, Washington, D.C.

Juhasz, A. C., Boyce, L. K., & Ortiz, E. (2013, April). *Predicting Spanish language at 36 months: How does home language and literacy environment influence Spanish language vocabulary?* Poster presented at the biennial meeting of the Society for Research in Child Development, Seattle, WA.

Juhasz, A. C., Boyce, L. K., & Ortiz, E. (2013, March). *Growing-up bilingual: Home and early care influences*. Poster presented at the annual meeting of the Utah Association for the Education of Young Children, Murray, UT.

Cook, G. A., Boyce, L. K., & **Juhasz, A. C.** (2012, August). *Using assessment data to improve practice in head start classrooms*. Training provided to Ogden Weber Community Action Partnership Head Start Staff, Ogden, UT.

GRANTS

FUNDED

Agency/Title of Grant: U.S. Department of Health and Human Services: Administration for Children and Families/*Leveraging Home Languages to Promote Executive Functioning*
Duration of funding: One (1) year 2017-2018
Total amount of award: $24,995
Role: Scholar

Agency/Title of Grant: U.S. Department of Education/*Child Care Access Means Parents in School*
Duration of funding: Four (4) years 2017-2021
Total amount of award: $1,496,632
Role: Student Co-author and Project Coordinator

NOT FUNDED

Agency/Title of Grant: National Science Foundation/ *Using Legends to Develop Scientists among Native Hawaiian and American Indian Preschoolers: An Exploratory Study*
Duration of funding: Three (3) years 2017-2020
Total amount of award: $449,993
Role: Student Co-author
Scored: Excellent

Agency/Title of Grant: W.K. Kellogg Foundation/ *Ka'ike o ka 'Ohana (The Knowledge of the Family)*
Duration of funding: Three (3) years 2014-2016
Total amount of award: $500,000
Role: Student Co-author
Scored: Competitive

INSTRUCTIONAL EXPERIENCE

Instructor
FCHD 2660-Online: Parenting and Child Guidance, Fall 2014, Fall 2015, Spring 2016

Teaching Assistant
PSYCH/EDUC 6010: Introduction to Program Evaluation, Fall 2018

FCHD 3520: Middle Childhood, Fall 2012

FCHD 4900: Pre-Practicum Skills, Spring 2012

FCHD 2610/2660-Online: Parenting and Child Guidance, Fall 2011, Fall 2013

PROFESSIONAL AFFILIATIONS

American Evaluation Association (AEA)	2016 - Present
Society for Research in Child Development (SRCD)	2012 - Present
National Association for the Education of Young Children (NAEYC)	2012 - 2018
Utah Association for the Education of Young Children (UAEYC)	2012 - 2018
National Coalition for Campus Children's Centers	2018 - 2019

REFEREE/REVIEWER

Utah State University Graduate Enhancement Award
American Educational Research Association

AWARDS

Seeley-Hinckley Scholarship (2 semesters tuition and fees; 37 recipients)	2010, 2011
Leah D. Widtsoe Scholarship ($1,000)	2013, 2014
Rick Q. Lawson Scholarship ($3,333)	2013, 2104
Research and Graduate Studies Travel Award ($700) Seattle, WA	March 2013
Research and Graduate Studies Travel Award ($800) Philadelphia, PA	March 2015
Research and Graduate Studies Travel Award ($800) Atlanta, GA	October 2016
Research and Graduate Studies Travel Award ($1,150) Rome, Italy	May 2018
Stella Young Griffiths Scholarship ($2,000)	2017-2018
Graduate Enhancement award ($4,000; 20 recipients/227 applicants)	April 2018
Soc. Sci. & Ed. Dept, Graduate Poster Presentation; (22 recip./217 partic.)	April 2018