EXPLORING THE ROLE OF CULTURE, LANGUAGE EXPERIENCE, AND EXECUTIVE FUNCTION ON CHILDREN'S BEHAVIORIAL OUTCOMES

A Dissertation

Presented to

The Faculty of the Department

of Psychology

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

By

Crystal Duc Tran

May 2015

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ABSTRACT

Executive Function (EF) is a complex cognitive construct encompassing a set of processes that monitor and control thought and action for goal-directed responses. Increasing research has demonstrated that certain environments (e.g., bilingualism, culture) may foster early development of EF. However, it is not clear if the cultural and bilingual cognitive advantages demonstrated on EF tasks may be a product of laboratory tasks or if the effect itself may be translated to real world situations, such as overall behavioral outcomes. Accordingly, the present study recognizes the need to understand the implications of language status, culture, and performance on EF tasks on children's behavioral outcomes. In doing so, the current study assessed 3-year-old preschool children from the U.S., Argentina, and Vietnam with different language learning backgrounds (i.e., monolingual, bilingual) and cultures (i.e., Western, Western-European, Eastern) longitudinally for 3 years on 4 common EF tasks, and related to parental ratings of child behavioral problems. Results demonstrate the role of culture on various aspects of behavioral problems, while specific EF tasks and language status have a differential role on behavior. The present study further sheds light on the potential role of culture and language status mediating the effect of EF on certain behavioral outcomes.

ACKNOWLEDGEMENTS

Special thanks are due to my committee chair and advisor, Dr. Hanako Yoshida, for her support and encouragement in this study and in my graduate career. You are the best mentor. Thank you for guiding my journey.

I would also like to extend my gratitude to Dr. Arturo E. Hernandez, Dr. Paul T. Cirino, and Dr. Ferenc Bunta for joining this committee and for their valuable feedback and support. All of my committee members are very dedicated researchers, teachers, and family members, so the time and effort that they set-aside for me is greatly appreciated.

Finally, I would like to thank all of the children and parents in the USA, Argentina, and Vietnam who participated in the present study, without whom this project would not have been possible.

Support for this research was provided in part by the National Institutes of Health grant (R01 HD058620), the Foundation for Child Development, the University of Houston's Enhance and Advance Research (GEAR) program, and the Graduate Research Assistant Stipend Program Award.

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DEDICATION

I would like to dedicate this dissertation to my family.

Hia Tài, Tâm, Martial, and Jayson, I wouldn't have been able to complete my graduate career without your unfaltering love and support over the years.

Introduction

The development of Executive Function (EF) has gained much attention across a number of fields. EF is a complex cognitive construct encompassing a wide range of different yet related processes that monitor and control thought and action in goal-directed responses to novel or difficult situations (Zelazo, Carter, Reznick, & Frye, 1997; Welsh, Pennington, & Groisser, 1991). For example, EF has been linked to self-control over thoughts, behaviors, and emotions that young children exhibit in the preschool period (for an overview, see Carlson, 2005; Kopp, 1982; Zelazo & Müller, 2002), and to the development for social competence (e.g., Hughes, Dunn, & White, 1998), moral conduct (e.g., Kochanska, Murray, & Harlan, 2000), and school readiness (e.g., Riggs, Blair, & Greenberg, 2003). Therefore, EF plays an integral role in many critical cognitive and everyday functions and has become one of the most studied constructs in psychology (Topalk, West, & Stanovich, 2013). Despite the seemingly solid predictive nature of EF, a growing body of research has demonstrated its vulnerability to experiences such as individuals' language-learning and cultural background.

One strong effect on EF, known as the bilingual cognitive advantage, indicates that learning and speaking multiple languages generate advantages in cognitive control (e.g., Bialystok, 1999; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Kovacs & Mehler, 2009; Yoshida, Tran, Benitez, & Kuwabara, 2011). This effect is thought to arise because bilingual individuals are required to inhibit one language and process another, while also switching between the two languages and contexts, which in turn trains cognitive flexibility (Bialystok, 1999, 2001). As such, this bilingual cognitive advantage has been shown in a number of task contexts and age groups (e.g., Bialystok, 1999; 2001;

Bialystok & Martin, 2004; Carlson & Meltzoff, 2008; Costa, Hernández, & Sebastián-Gallés, 2008; Kovacs & Mehler, 2009). However, recent studies have documented that different cultural background can also influence individual's EF (Oh & Lewis, 2008; Yang, Yang, & Lust, 2011). Specifically relevant to the present research, one study suggested that the *cultural effect* behaves similarly to the *bilingual cognitive advantage effect* (Yang, Yang, & Lust 2011). Here, the cultural effect demonstrates that children from certain cultures hold cognitive advantages over others, which has often been found in Eastern children relative to their Western counterparts. This is conceptually different from bilingual cognitive advantage given that the participants are only exposed to one language. For example, in the Yang et al. (2011) study, 3.5-year-old Korean monolinguals outperformed English monolinguals on attentional control—one of the major components of EF (Miyake et al., 2000; Diamond, 2006b; Garon, Bryson, & Smith, 2008), suggesting the potential role of culture on EF. This Korean advantage has been explained by the Eastern cultural practices/values on collectivism and parenting attitudes (e.g., Ahadi et al., 1993; Chao & Tseng, 2002; Chen et al., 1998; Vinden, 2001). Eastern (or collectivistic) cultures place emphasis on obedience to authority figures, interdependence, early maintenance of self-regulation/impulse control, strict academic training, and less on play (e.g., Tobin, Wu, & Davidson, 1989; Ho, 1994; Wu, 1996; Chen et al., 1998; Nisbett, Peng, Choi, & Norenzayan, 2001; Parmar, Harkness, & Super, 2004; Oh & Lewis, 2008), and this has been found to positively impact EF among children from Eastern cultures (Mezzacappa, 2004; Yang, 2004; Oh & Lewis, 2008; Yang, Yang, & Lust, 2011). As such, the present study further asks whether these bilingual and Eastern cultural effects are similar (or different) in predicting behavioral

outcomes. If these factors predict similar sets of behavioral outcomes, what might be the stronger predictor—language or culture? Further, if language and culture are differently related to behavioral outcomes, how are they different?

Another strong factor that influences EF is age. The development of EF is rather incremental, yet changes drastically over time (Senn, Espy, Kauffmann, 2004; Isquith, Gioia & Espy, 2004; Wiebe, Espy, Charak, 2008; Best & Miller, 2010). This makes studying the factors relevant to EF itself more challenging. For example, Carlson (2005) investigated the development of EF and found that EF performances drastically improve from age 3 to 5-years. Other studies also demonstrate age related influences on bilingual cognitive advantage, suggesting that bilinguals develop EF earlier and faster than their monolingual peers during the preschool years (Bialystok, 1999; Carlson & Meltzoff, 2008). In particular, recent developmental works demonstrate that the bilingual advantage peaks specifically at 3-years of age (Tran & Yoshida, 2011; Tran, Arredondo, & Yoshida, in review), indicating the early onset of the impact of language learning experiences (e.g., bilingualism, cultural practices) on EF development.

Collectively, present literature indicates the flexible nature of EF and strong influences of individuals' experiences on the development of EF, however, little is known about what exactly these *measurable differences* really mean for individual child's everyday experiences and learning outcome (Lawson, Hook, Hackman, & Farah, 2014). In this manner, are the following additive effects generated through bilingualism *and* cultural practices meaningful? As mentioned, early EF task performances are predictive of a number of cognitive milestones such as school adjustment and academic success (Bart, Gajami, & Bar-Haim, 2007; Duncan et al., 2007; Best, Miller, & Naglieri, 2011;

McClelland & Cameron, 2011), mathematical (Bull & Scerif, 2001; Waber et al., 2006; D'Amico & Passolunghi, 2009), reading (Brooks-Gunn & Furstenberg, 1993; Hughes, 1998; Waber et al., 2006), writing (Bull, Espy, & Wiebe, 2008; Cameron et al., 2012; Carlson, Rowe, & Curby, 2013), and language learning (Bialystok, 1999; Singer & Bashir, 1999; Carlson & Meltzoff, 2008). However, the advantages these learning environments generate-–through bilingualism and cultural practices—have not been linked to any tangible behavioral or learning outcome. The present study investigates specifically how these bilingual and cultural advantages may influence psychological outcomes. By doing so, the present study focuses on early adaptive behavior—a strong predictor of social cognitive development, which has been linked to EF development (Harms, Zayas, Meltzoff, & Carlson, 2014). In particular, Harms et al. (2014) suggest that EF in childhood serves as a biological marker for adaptive behaviors in early adolescence. In this study, Harms et al. (2014) define adaptive behaviors as having higher aspects in academic achievement and social adjustment (positive), with lower sensation-seeking (negative) behaviors. The present study further investigates whether or not this behavioral outcome is also predicted by children's language status (monolinguals vs. bilinguals) and cultural background (Eastern vs. Western). In this manner, the present study may indicate whether reported cognitive advantages in EF tasks are solely a product of laboratory assessments, or more importantly, whether it can be translated into individual's behavioral outcomes. The present study takes the developmental approach to further address how these potential relations may change over time.

The present research will provide the first evidence on how cognitive consequences, generated through learning experiences, feed back into individuals'

behavioral and learning outcome. The results may provide critical information for bilingual and immigrant education, cross-cultural background, language development, and cognitive impairments in general.

Behavioral Reports and EF

Recent literature suggests that parental reports on children's behavior are related to their EF ability, primarily through data linking mechanisms of EF to emotional regulation. Cohen, Henik, and Moyal (2012) indicate that cognitive processes such as emotional regulation and inhibition, aspects of EF, play an important role in decreasing negative effects for adaptive behavior. Further, research by Smith (2011) found that the Developmental Neuropsychological Assessment (NEPSY; Korkman, Kirk, & Kemp, 1998), a series of neuropsychological tests that assesses both basic and complex aspects of cognition critical to children's ability to learn in/out of school settings, are significantly related to general behavioral outcomes, as measured by the Behavior Assessment Systems for Children, Second edition (BASC-2; Reynolds & Kamphaus, 2004) scores.

The NEPSY includes six functional domains, which include attention and executive function, language and communication, sensorimotor, visuospatial, and learning and memory. Relations between the following attention and executive function subsets of the NEPSY and the BASC-2, therefore, highlight the potential link between basic behavioral outcomes and aspects critical to cognition, suggesting a two-way interaction between EF and behavioral outcomes.

Significance of Parental Reports

Behavioral rating scales have been found to capture patterns of EF in clinical and nonclinical populations, correlate with biological markers for adaptive behaviors, and provide evidence of relationships between EF and real-world outcomes (Smith, 2011; Cohen et al., 2012; Isquith, Roth, & Gioia, 2013; Harms et al., 2014). One of the most widely used parental reports in assessing early EF is the Behavior Rating Inventory of Executive Function-Preschool version (BRIEF-P; Gioia, Andrew, & Isquith, 2003; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF-P reliably measures various EF processes, such as Inhibit, Emotional Control, Shift, Working Memory, and Plan/Organize (Gioia et al., 2000). Recent research by Toplak, West, and Stanovich (2013) demonstrate that there was a weak correlation between the BRIEF-P and cognitive measures of EF in their meta-analysis of EF, suggesting the differing role of behavioral and cognitive measures of EF. In particular, Toplak et al. (2013) suggest that behavioral rating scales represent an individuals' goal pursuit in everyday settings, while cognitive measures represent an individuals' processing efficiency in a highly structured and standardized setting. In order to address the complexities of EF, the present study considers the use of BRIEF-P, as well as laboratory cognitive tasks, to provide a comprehensive understanding of children's EF. Therefore, central to the research aims, the present study specifically questions whether participants' EF (as measured by cognitive task performances *and* parental behavioral reports), culture, and language status may be indicative of general behavioral outcomes, as measured by the Behavior Assessment Systems for Children, Second edition (BASC-2; Reynolds & Kamphaus, 2004). The BASC-2 measures both positive (adaptive) and negative (problem) behaviors in the community and home setting for children as young as 2.5 years of age, which

includes four general behavioral indexes—Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Systems (Reynolds & Kamphaus, 2004). Relevant to concerns regarding the development of EF, the BASC-2 has also been shown to complement longitudinal designs (Reynolds & Kamphaus, 2003). As such, the BASC-2 is a great tool to not only address the positive and negative aspects of adaptive behavior as it relates to EF, culture, and language, but it also provides a means to encompass the developmental changes involved in a child's behavior over time for comparative analysis.

Hot and Cool EF

Although EF is often considered a domain-general cognitive function, a distinction has been made between "hot" and "cool" EF, and some research has associated these with the orbitofrontal versus dorsolateral prefrontal cortex regions, respectively (Zelazo and Müller, 2002).

Hot EF is a socio-affective executive skill that is considered necessary to perform in task situations involving affect or emotional regulation, such as when there is a reward or punishment associated with the task (Zelazo & Müller, 2002; Kerr & Zelazo, 2004; Allan & Lonigan, 2011). Children begin to develop and acquire "hot" EF skills early and gradually over childhood (Anderson, 1989; Anderson, Anderson, Jacobs, & Smith, 2007). Hot EF skills include emotional regulation, social/communication skills, self-awareness, moral judgment, and emotional/motivated decisions (Zelazo & Müller, 2002; Anderson, Anderson, Jacobs, & Smith, 2007). As such, hot EF has been considered to be more reflexive, emotional, and fast-acting (Bassett, Denham, Wyatt, & Warren-Khot, 2012), and is therefore not easily measured as it depends on the child's use of current input and

interaction with the environment (Zelazo & Müller, 2002). The key to measuring many hot EF skills is that they are affectively salient (Allan & Lonigan, 2011), with potential reward or punishment (Kerr & Zelazo, 2004). Examples of hot EF tasks include ToM, Iowa Gambling, and Delay of Gratification task. Those who have low hot EF skills have been found to exhibit more disruptive and aggressive behaviors, which may therefore affect their learning and relationship with others (Giancola, 1995; Hoaken, Shaughnessy, & Pihl, 2003; Raaijmakers et al., 2008), as well as associated with violence and antisocial behavior (De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013).

On the other hand, "cool" EF is considered an executive cognitive skill that is necessary to perform in decontextualized and abstract situations, where no proximal or specific reward or punishment are required for success in task performance (Metcalfe & Mischel, 1999; Zelazo & Müller, 2002; Anderson, Anderson, Jacobs, & Smith, 2007). In this manner, cool EF is affectively neutral, slower acting, less emotional, and involves cognitive processes such as attention, impulse control, planning and goal setting (Anderson, Anderson, Jacobs, & Smith, 2007; Allan & Lonigan, 2011). Children begin to develop cool EF early in childhood, although the development may be slower (Zelazo & Müller, 2002; Anderson, Anderson, Jacobs, & Smith, 2007). Examples of cool EF tasks include, but are not limited to, Letter-Number Sequencing, Tower of London, and the Dimension Change Card Sort (DCCS) task. Therefore, the difference between hot and cool EF lies in the extrinsic and proximal reward associated with task performances (e.g., Kerr & Zelazo, 2004; Hongwanishkul, Happaney, Lee, & Zelazo, 2005).

In sum, increasing research has demonstrated the facilitative nature of language and cultural experiences on the development of EF. Specifically, bilingual and Eastern

cultural advantages have been frequently cited in works surrounding EF development in young children. Recent findings further demonstrate that examination of EF at this age period is crucial given its role in predicting later adaptive behaviors. Research on this relation has been made through means of cognitive and behavioral measures of EF, with EF being further broken down to "hot" and "cool" aspects as it relates to behavior. Despite what we know about the cognitive consequences of bilingualism and culture on EF, as well as the implications of EF on behavior, there have been no systematic studies examining how culture and language may together or separately relate to behavioral outcomes.

Issues with EF

Beyond the influence of language status, culture, and the potential relationship between behavioral outcomes and EF, a participant's performance on one EF task may have little predictive value for performance on another test, and this may not predict performance in complex real world situations (Burgess, 1997; Burgess, Alderman, Emslie, Evans, Wilson, & Shallice, 1996; Burgess et al., 1998). Many tasks included in measures of EF also involve non-executive content, thus threatening the accuracy of the assessments (Miyake & Friedman, 2012; Toplak, West, & Stanovich, 2013). Furthermore, cognitive processes improve and change throughout development, which may complicate assessments of EF in young participants (Davidson, Amso, Anderson, & Diamond, 2006; Lamm, Zelazo, & Lewis, 2006). Finally, assessments of these issues is complicated by the fact that EF is an umbrella term used to describe a variety of cognitive processes, including inhibition, self-regulation, working memory, higher-order function, representation, and selective attention (Welsh, Pennington, & Groisser, 1991; Zelazo et

al., 1997; Dempster, 1992; Miyake et al., 2000; Chan, Shum, Toupoulou, & Chen, 2008; Garon, Bryson, & Smith, 2008). Therefore, the present study evaluates a broad range of these factors by incorporating both parental reports and laboratory assessments of EF to simultaneously consider their relative importance on behavioral outcomes over time in one model. Based on this model, we may begin to see what factors may be relevant to specific behavioral outcomes. In this manner, the present model selection is the first step to explore the potential relation between all factors considered on behavioral outcomes.

Participant Selection: Developmental Issues and the Cultural Continuum

Developmental Issues

The idea here is that bilingual individuals are defined not entirely by the types of language one is learning, but also the culture to which they belong. Thus, the interaction between learning multiple languages and coming from multiple cultural backgrounds is a particular area that requires additional parsing to understand the magnitude of the bilingual and cultural advantage together and on its own. However, there are no systematic studies documenting how and when bilingual advantage and the Eastern cultural influence are related. Thus, there is little developmental basis for the contribution and collective evidence of language and cultural effects on EF. One recent attempt documented that the bilingual advantage effect does not persist throughout development (Tran & Yoshida, 2011). In this study, bilingual children's attentional control is optimized at 3 years of age, with the effect diminishing at age 5. Further, another attempt suggests that the Eastern cultural influence on EF tasks emerges early (at 3 year of age), yet its development is rather gradual (Tran, Arredondo, & Yoshida, in review). These previous studies suggest that the language effect and cultural influence may vary the

developmental relation, and that it is important to track broader periods of individuals' development to observe the effects. This, therefore, simply provides a snapshot of potential relation among these factors and may not fulfill the gap in the current literature. To systematically document and fully compare the influence of language and culture on behavioral outcomes, 3-year-old children who were at the earliest stage of participating in cognitive tasks (Yoshida et al., 2011; Tran, Arredondo, & Yoshida, in review) were selected and tested repeatedly until 5 years of age.

As such, the present longitudinal design provides a measure of the developmental relations among the tasks and behavioral outcomes, as well as a measure of possible different developmental trajectories in different groups of children. By utilizing a longitudinal design, we may begin to address concerns regarding the complexity of change of EF over development (Senn, Espy, Kauffmann, 2004; Isquith, Gioia & Espy, 2004; Wiebe, Espy, Charak, 2008) and understand key aspects of language status and behavioral outcomes at each specific time point.

Cultural Continuum

In order to document the range of potential cultural influences on task results, cultures are presently considered through strict scaling based on the tightness and looseness of societal structure for collectivism and individualism, an indicator that categorizes different cross-cultural dimensions (Hofstede, 1980, 2001, 2003). The participating children resided in three countries: the United States (U.S.), Vietnam, and Argentina. The cultural groups were chosen to span Western (U.S.), Western-European with Latin influences (Argentina), and Eastern (Vietnam) cultures that incorporate the proposed continuum from more individualistic to more collectivistic societies (Hofstede,

1980, 2001, 2003; Lytle, Brett, Barsness, Tinsley, & Janssens, 1995; Vuong, 1976; Hui, 1984; Cha, 1994; Ho & Chiu, 1994; see Table 1). Specifically, backgrounds of Argentinean and Vietnamese learners have seldom been studied in the framework of bilingual and cultural effect on cognitive development (Tang, 2006; Pham & Kohnert, 2008). From these cultural variations, there were two language groups generated: Monolingual (English, Vietnamese, and Spanish) and bilingual speaking (Vietnamese-English and Spanish-English.) The present study included U.S. resident bilingual children whose cultural backgrounds vary. Inclusion of the U.S. children with different cultural backgrounds were analyzed according to their non-U.S. cultural backgrounds, due to studies suggesting the significant influence of the native culture relevant to the study, even in everyday exposure to individualism found in Western cultural practices (Ahadi et al., 1993; Chao & Tseng, 2002; Parmar, Harkness, & Super, 2004; Farver & Lee-Shin, 2000; Oh & Lewis, 2008).

Research Aims

The present study aims to elucidate these issues by incorporating a longitudinal design to capture the change of EF in development, different language and cultural groups to understand the effect across time, and the inclusion of a variety of EF tasks and behavioral forms to systematically understand the relationships. In this manner, three key issues are addressed: 1) Whether bilingual and/or cultural advantages exists in EF tasks, and if so, if these factors together or separately play a role on overall behavior, 2) How specific laboratory tasks (EF tasks) and parental reports on EF (BRIEF-P) may relate to real-world behavioral outcomes, and 3) The developmental effects of culture, language status, and EF on overall behavioral outcomes over time.

To address these issues, (Hypothesis 1) the first hypothesis proposes that the relationship of EF and behavior may together and separately be mediated by language status and culture. In this manner, if differences exist on the EF tasks when comparing bilingual and monolinguals and Eastern and Western groups, these differences together may spill over to their scores on the BASC-2. In particular, previous research has shown differences among bilingual advantages in the DCCS, Day/Night, and Bear/Dragon tasks (all "cool" EF tasks), as well as cultural differences in the Day/Night, Bear/Dragon, and Gift Delay task ("cool" and "hot" EF tasks). The two overlapping tasks that have previously demonstrated bilingual and cultural cognitive advantages—that is, Day/Night and Bear/Dragon—may suggest the mediating effects of language *and* culture together on behavioral differences. However, in tasks where there is no overlap between bilingual and cultural advantage—that is, DCCS (considered a robust "cool" EF task) and Gift Delay (considered a robust "hot" EF task), there may be separate effects on behavioral outcomes. In this manner, there should be structural differences to specific sets of behavior that has previously demonstrated bilingual and cultural influences.

Second, to understand how the bilingual and cultural effects may change over time, (Hypothesis 2) the present study hypothesizes that differences in behavioral outcomes may be larger during the initial stages of development (i.e., age 3 vs. age 5). Recent developmental works demonstrate that bilingual and cultural advantages peak around the age of 3 (Tran & Yoshida, 2011; Tran, Arredondo, & Yoshida, in review), where EF is fast developing and emerging in the preschool years. Therefore, given the influence of language and culture on EF around the age of 3, behavioral differences between groups may be more pronounced in earlier development.

Finally, to further delineate the role of EF on general behavior, 4 different EF tasks that are categorized differently on the "hot" and "cool" aspect of EF are included. In this manner, (Hypothesis 3a) the second hypothesis suggest that "hot" EF tasks may be related to Externalizing Problems, given that behaviors associated with this index—Hyperactivity and Aggression—are affectively laden provided the influence of reward and punishment (Luman, Oosterlaan, & Sergeant, 2005; Seguin & Zelazo, 2005), more than "cool" EF. However, Internalizing Problems (i.e., Depression, Somatization) and Adaptive Systems (i.e., Adaptability, Social Skills, Activities of Daily Living, and Functional Communication) indexes may also be related given behaviors associated with hot EF aspects involved in emotion regulation, emotional/motivated decisions, self-awareness, ToM, moral judgment, and communication skills (Zelazo & Müller, 2002; Anderson, Anderson, Jacobs, & Smith, 2007). (Hypothesis 3b): Therefore, "cool" EF tasks may specifically relate to the Behavioral Symptoms Index of the BASC-2, particularly due to the subset involved in Attention Problems. This is based on the type of cognitive executive skills involved for cool EF, such as attention, inhibition, impulse control, planning, and goal setting. Further, the cognitive subscales included in the BRIEF-P results will highlight the specific underlying mechanisms involved in different behavioral outcomes.

As such, the following study may address concerns regarding the validity of laboratory tasks when assessing early EF abilities among children, whether advantages found in EF tasks is solely a product of laboratory assessments, and if previous reported cognitive benefits of bilingualism and culture may play a role in real world settings of children's behavioral outcomes. This may allow a window of understanding into how

cognitive consequences, generated through learning experiences, may feed back into individuals' behavioral outcome.

Method

Participants

Eighty-one 3-year-old (M_{age} = 38.78 months) monolingual and bilingual children from three countries (the United States, Argentina, and Vietnam) participated in the present longitudinal study. Children participated in the EF tasks for a total of 5 time points, with each session being 6 months apart (M_{ages} = 45.35, 51.20, 57.52, and 63.35 months at Time 2, 3, 4, and 5, respectively). See Table 2 for sample characteristics. Children were recruited from communities in Houston, Texas, United States; Salta, Metán, and San Miguel de Tucumán in Argentina; and Đồng Nai, Việt Nam. As can be seen in Table 3, both monolingual and comparative simultaneous bilingual children (i.e., Argentinean Spanish-English, Vietnamese-English) were recruited in the United States. Ethnic background information were collected to ensure that the Spanish-English children were strictly from Argentinean descent and exposed to Argentinean Spanish. All children were attending preschool at the time of testing and came from middle-class backgrounds.

Children's demographic assessments were conducted using the John D. and Catherine T. MacArthur Foundation Research Network on Socioeconomic Status and Health, a parent questionnaire consisting of 16 questions on SES and the child's health. Parental reports on children's behavior were also assessed, which included the Behavior Rating Inventory of Executive Function—Preschool (BRIEF-P) version and the Behavior Assessment Systems for Children, Second Edition (BASC-2). Children's productive

vocabularies were also assessed in order to provide a rough screening for developmental delays in children across the various language groups. Parents were also asked to complete the MacArthur Communicative Developmental Inventory (MCDI, toddler form; Fenson et al., 1993). The English and Spanish checklists were independently developed and normalized (Fenson et al., 1993). Due to the lack of a Vietnamese vocabulary checklist, the Vietnamese version was adapted from the Chinese and Japanese MCDIs (Ogura & Watamaki, 1997; also Ogura, Yamashita, Murase, & Dale, 1993), with additional replacements of items native to the Vietnamese culture (i.e., food, drinks, etc.). Parents of bilingual children were asked to fill out two vocabulary checklists that correspond to the languages their child were exposed to. In the present sample, only children whose total vocabulary fell above the 20th percentile were included. Demographic measures (health background, language questionnaire, SES, and vocabulary reports) were collected to ensure all participating children were typically developing in terms of intelligence, cognition, and speech and language production.

The children who participated in the present study were selected to fall within the 50 percentile, middle SES range starting in the year data were collected (2008-2009), that was defined for each country (based on national statistics for total household income) as followed: $50,000 to $74,999 for the U.S. (John D. & Catherine T. MacArthur Foundation Research Network on Socioeconomic Status and Health), 15.500 to 21.499 pesos for Argentina (Development Economics LDB database), and 10,400,000 to 13,199,999 Đồng for Vietnam (Development Economics LDB database). Furthermore, the middle SES status was also considered in terms of parental education, which has been suggested to play a more vital role on children's cognitive task performances and

academic achievement (e.g., Smith, Brooks-Gunn, & Klebanov, 1997; Bradley & Corwyn, 2002; Davis-Kean, 2005; Biedinger, 2011). See Table 3 for more details on the SES scores for each cultural and language groups.

Procedure

For each visit prior to the children completing the EF tasks, parents completed the John D. and Catherine T. MacArthur SES, BRIEF-P, BASC-2, and the MCDI forms. All of the sessions were conducted in a quiet room, where children were instructed to sit on a small chair across from the experimenter. A mobile camera was set up at the corner of the room to record each experimental session for future behavioral analysis. The order of the tasks were counterbalanced for each assessment and randomized across children. Measures were collected at all 5 time points. For bilinguals, the EF tasks were administered in their dominant language. The dominant language was determined by parental reports on child's language exposure—number of hours in a day, how many days in a week, with whom, and since what age—for each language.

Measures

Executive Function Measures:

<u>Cognitive Measures (Laboratory EF Tasks)</u>

Stimulus Materials

Both the DCCS and the Day/Night tasks were administered through the use of a set of cards. Examples of these cards are shown in Figure 1a and b, respectively. For the DCCS, the stimuli were similar to those used in the original study by Zelazo, Müller, Frye, & Marcovitch, (2003; adapted from Frye, Zelazo, & Palfai, 1995 and Zelazo, Frye, & Rapus, 1996). There were two shapes (rabbit, boat) and two colors (pink, blue) used to

generate four types of cards (pink rabbit, pink boat, blue rabbit, blue boat). There were a total of 32 cards (16 shape-matched, but different color; 16 color-matched, but different shape). In the Day/Night task, there were two cards depicting a sun and a moon, which represented day and night, respectively. The Bear/Dragon task, however, was administered with the use of puppets. Pictures of the puppets used in the present study are shown in Figure 1c. For the Bear/Dragon task, there were 10 motor commands that children were instructed to perform, of which 5 were inhibited movements. Finally, as shown in Figure 1d, the Gift Delay task included the use of an incentive (e.g., a stuffed animal), a gift bag, and a stopwatch (for timed session).

"Hot" EF Task

Gift Delay task (Konchaska, Murray, & Harlan, 1996). Children were told that they did a good job and that they will be receiving a gift for their participation. However, the experimenter "forgot" to wrap the gift. To make it a surprise, children were instructed to turn around in their seat while the experimenter wrapped the gift. The experimenter then rifled with the wrapper (gift bag) noisily for 60 seconds. Peeking behaviors were recorded. This task involves simple motor response inhibition (i.e., self-control/regulation). The number of seconds spent peeking (from 60 seconds) was recorded. Proportions of non-peeking time were recorded as "correct" responses.

"Cool" EF Tasks

Dimension Change Card Sort task (DCCS; Zelazo et al., 2003). The DCCS task has two phases: pre-switch and post-switch. There were a total of 32 trials, of which 16 were pre-switching trials. The order of the dimensions (shape first/color first) were determined by the child's response when the child was first presented with a card (e.g., a

pink rabbit) and asked to tell the experimenter what they saw. If the child mentioned the shape (rabbit), then the child was asked to sort the cards by shape (and vice versa for color response). Immediately after this sorting (pre-switching trials), children were instructed to sort a stack of 16 cards by the opposite dimension (post-switching trials) as quickly as possible. Table 4 provides the script that was used during the pre-switching and post-switching trials. In order to measure whether children can switch when instructed to sort the cards by a new dimension, it was critical that they sorted the first dimension successfully in the pre-switching trials. Accordingly, children were encouraged and supported on the pre-switch phase to ensure that they sorted at least 10 cards (62.5 %) correctly during the pre-switching trials. The post-switch scores were considered to measure children's ability to switch. In contrast to the typical sorting of children's responses into either mostly correct or mostly incorrect, we implemented a continuous variable (proportion of successful switches) in the present analysis to maintain variability among the groups (e.g., Perner, Lang, & Kloo, 2002).

Day/Night task (Gerstadt, Hong, & Diamond, 1994). The experimenter engaged children in a conversation about when the sun comes up (i.e., during the day) and when the moon comes out (i.e., during the night). Children were then presented with a white card with a yellow sun and a black card with a white moon (see Figure 1b), and were instructed to respond "night" when shown the sun card and "day" when shown the moon card. After children were able to verbally assert the correct answer, children proceeded with the 16 follow-up test trials. Children's responses were either day or night. The number of correct responses was recorded. The orders of the cards were fixed, as

presented in the standard task (Gerstadt, Hong, & Diamond, 1994). The order of the cards and script used for the task are provided in Table 5.

Bear/Dragon task (Reed, Pien, & Rothbart, 1984). Similar to the Simon task, children were instructed to perform a variety of motor commands. Participants were introduced to "Mr. Bear" (in an excited tone of voice) and "Mr. Dragon" (in a deep voice), see Figure 1d. The objective of the task is for the children to perform the correct motor movements when Mr. Bear instructs, while successfully inhibiting motor movements when Mr. Dragon instructs. After training, participants were then presented with 10 trials of different motor commands from the bear and dragon in alternating order. This task involves complex motor response inhibition (i.e., selectively attending to correct motor command, while inhibiting prepotent motor responses). Therefore, the number of correct motor actions performed and inhibited was recorded. Instructions and script of the task used in the present study are included in Table 6.

Behavioral Rating Measures (Parental Reports)

Behavior Rating Inventory of Executive Function– Preschool version (BRIEF-P; Gioia et al., 2000). The BRIEF-P is a standardized rating scale developed to provide a window into everyday behaviors associated with specific domains of EF in preschool children aged 2 to 5 years. The BRIEF-P can serve as a screening tool for possible EF difficulties and as an index of the ecological validity of laboratory and clinic-based assessments. Specifically, it is a useful tool in assessing preschool-aged children with medical, acquired neurological, and developmental conditions as prematurity, emerging learning disabilities and attention disorders, language disorders, traumatic brain injuries, lead exposure, and pervasive developmental disorders/autism. Normative data on the

BRIEF-P are based on child ratings from 460 parents and 302 teachers from urban, suburban, and rural areas, reflecting 1999 U.S. Census estimates for race/ethnicity, gender, socioeconomic status, and age. Moreover, the BRIEF-P demonstrates convergent and discriminant validity with other measures of inattention, hyperactivity-impulsivity, depression, atypicality, anxiety, and somatic complaints. The BRIEF-P has been shown to have high internal consistency and reliability (.80-.95 for the parent sample) and moderate test-retest reliability (.78-.90 for the parent sample). The parent form of this measure was chosen for the purpose of capturing behavior at home and in the community as it relates to the child's everyday behavior.

The BRIEF-P consists of a single rating form that is designed to be completed by parents or other caregivers in 10-15 minutes, with the inclusion of 63 items in five non-overlapping scales. The scales form a Global Executive Composite (GEC) and three overlapping summary indexes each with two scales based on theoretical and statistical considerations. The Inhibitory Self-Control Index (ISCI) is composed of the Inhibit and Emotional Control scales, the Flexibility Index (FI) is composed of the Shift and Emotional Control scales, and the Emergent Metacognition Index (EMI) is composed of the Working Memory and Plan/Organize scales. There also are two Validity scales: Negativity and Inconsistency. Items are scored on a 1, 2, 3 scale with 1 indicating that the behavior has never been a problem, 2 indicating that the behavior is sometimes problem and 3 indicating that the behavior is often a problem. The item responses are totaled and converted to T-scores to compare against a normative sample. However, central to the present study's aims in understanding the underlying processes involved for individual behavioral outcomes, individual t-scores for each of the subscales (not indexes) will be

considered in the model—Inhibit, Emotional Control (EC), Shift, Working Memory (WM), and Plan/Organize (PO).

Behavioral Outcomes:

Behavior Assessment Systems for Children, Second edition (BASC-2; Reynolds & Kamphaus, 2004). The BASC-2 is a general assessment that measures both positive (adaptive) and negative (problem behaviors) in the community and home setting for children and adolescents between the ages of 2.5 and 18. This tool has also been shown to complement longitudinal designs. The BASC has been used in several longitudinal studies exploring: 1) risk, onset, course, and progression of behavioral problems and psychopathology, 2) the predictive validity of early temperament, 3) the identification of adolescents who may benefit from residential treatment centers, and 4) the resulting effects of school violence prevention programs (Reynolds & Kamphaus, 2003). Normative data are based on the U.S. Census data with regard to gender, race/ethnicity, clinical or special education classification (Reynolds & Kamphaus, 2004). The BASC-2 also has moderate to good reliability and validity, where scales and composites have high internal consistency and test-retest reliability.

The BASC-2 contains 134 item behavioral rating scales that are completed by parents or caregivers. Within the measure, there are 12 subscales: Hyperactivity, Aggression, Anxiety, Depression, Somatization, Atypicality, Withdrawal, Attention Problems, Adaptability, Social Skills, Activities of Daily Living, and Functional Communication. The subscales are combined to make up four commonly used broad indexes for general behavior: Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Systems. Items are scored on a four-point response

format—N for Never, S for Sometimes, O for Often, and A for Almost Always, which correspond respectively to 0, 1, 2, and 3 points. The adding of the points provides a raw score, which is then converted into a normative T-score. The T-score delegates the distance of a raw score from the norm-group mean and will be used as the dependent measure for this study. In the current study, parents or caregivers completed the forms at the preschool age level (i.e., ages 2 to 5), which takes about 10-20 minutes. Validity and response set indexes (i.e., F-score, Response Pattern, and Consistency) are also used to help judge the quality and consistency of completed forms.

Due to the lack of Vietnamese and Spanish versions of the BASC-2 and BRIEF-P, direct translations of the English forms were made in the respective language for parents in Vietnam and Argentina. Although the measures may not be culturally relevant to children from Argentina and Vietnam, T-scores for the following children were examined as a first step to understand how they may be rated compared to the standardized norm.

Analysis

The main question is how culture, language status, and performance on EF (laboratory tasks and parental reports) independently or together influence behavioral outcomes. Following the longitudinal data analysis literature (e.g., Singer & Willett, 2003), linear mixed model analyses were chosen for the present analyses. In the following analyses, the Dependent Variables (DVs) include T-scores of the 4 broad behavioral indexes as measured by the BASC-2—Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Systems. Here, the Independent Variables (IVs) are 2 language statuses (monolingual, bilingual), 3 cultural groups (Western, Western-European with Latin Influences, Eastern), 4 EF laboratory task

performances (DCCS, Day/Night, Bear/Dragon, and Gift Delay), and the BRIEF-P cognitive subscales (Emotional Control, Inhibit, Plan/Organize, Shift, Working Memory, and the combination of these cognitive processes).

General effects with combined models. To specifically address general effect of language, culture, and EF performances (measured by laboratory tasks and the parental report BRIEF-P) on behavioral outcomes—the first step was to conduct ANOVAs on the combined mixed models that includes all 4 predicting factors. For this analysis, the effect of time (1, 2, 3, 4, and 5; random factor), language status (bilingual and monolingual; fixed factor), culture (Western, Western-European with Latin Influences, Eastern; fixed factor), BRIEF-P (Emotional Control, Inhibit, Plan/Organize, Shift, and Working Memory; fixed factor), and EF tasks (DCCS, Day/Night, Bear/Dragon, and Gift Delay; fixed factor) were used to predict each of the behavioral outcome scores—Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Systems. In this manner, there are a total of 4 behavioral models that includes *all* of the predicting factors in each model to understand how they may compete for prediction of specific behavioral outcomes. This analysis provides an overview regarding the general effects of each factor on task performances over time.

Specific effects with separate models. If significant effects are yielded from the general combined model, further analyses will be done in separate models to examine the effect of each factor individually. This will highlight the specific effects of Language Status, Culture, EF tasks, and BRIEF-P on BASC-2, the following mixed models were analyzed separately. First, 4 separate ANOVAs were conducted on each EF task model (i.e., analyzing task performances on the DCCS, Day/Night, Bear/Dragon, and Gift Delay

as predictors separately) to analyze the effects of each EF task on the 4 behavioral outcomes. Finally, a separate ANOVA was conducted with BRIEF-P as a predictor on the BASC-2 scores.

Parameter Estimates. Finally, to further understand the magnitude of each factor (effect size) on task performances over time, parameter estimates were examined for each model. In particular, the magnitude of the differences was examined for each individual effect size when all other factor effect sizes were controlled at 0. This allows us to understand the sole magnitude of specific factors on the behavioral outcomes. The parameter estimates were standardized by taking the difference of the performance scores of each individual from the grand mean of each task at time 1, where scores are further calculated over the standard deviation of performance score for each individual and then considered in terms of proportion (with a maximum effect size of 50.0). All analyses were conducted using the script-based statistical computing software, R (R Core Team, 2013).

Results

Descriptive Statistics: EF Task Performances and BASC-2 Parental Reports

As can be seen in Figures 2 and 3, general averages of EF task performances (DCCS, Day/Night, Bear/Dragon, Gift Delay) and parental rating scores on the BASC-2 (Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, Adaptive Systems) for different language groups over 5 time points are reported, respectively. For the 4 BASC-2 indexes in Figures 3a-c, T-scores above 60 are considered at-risk for Externalizing Problems, Internalizing Problems, and the Behavioral Symptoms Index, while T-scores below 40 indicate caution for the Adaptive Systems, see Figure 3d. In all

cases, the norm T-score for the 4 behavioral indexes is 50. However, central to the study aims, relationships between EF task performances and BASC-2 were analyzed.

General Effects (combined model)

To understand the general effects of each factor on behavioral outcomes, all predicting factors were included in each of the 4 broad behavioral models (Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Systems; 1 model for each BASC-2 variable).

*Effects of E*F *Task Performances, BRIE*F*-P, Language Status, and Culture on BASC-2*

Language Status. Analyses conducted via an ANOVA on the *combined* model revealed no significant relationship between language status (monolingual, bilingual) on general behavioral outcomes ($p>.1$). This demonstrates that when all factors are considered in the same model, the language status effect plays little role on the BASC-2 results (as can be seen in Figure 4; values closer to "0" indicates small effect on the predicted behavioral outcome).

Culture. Interestingly, analyses conducted via an ANOVA on the combined model revealed that Culture was significantly predictive of general behavioral outcomes. In particular, there were significant main effects of culture on Externalizing Problems, Internalizing Problems, Behavioral Systems Index, and Adaptive Systems, $F(2,79)=3.12$, $p<.01$, $F(2,83)=9.46$, $p<.001$, $F(2,73)=10.02$, $p<.001$, $F(1,78)=8.69$, $p<.001$, respectively. Specific parameter estimate comparisons further demonstrate that parental rating scores on the BASC-2 are largely influenced by the Eastern culture for Externalizing Problems (3.33 out of 50.0, SE=1.80; $p<.05$), Internalizing Problems (7.35 out of 50.0, SE=2.08; $p<.001$), Behavioral Systems Index (8.40 out of 50.0, SE=1.92; $p<.001$), and Adaptive

Systems (-7.02 out of 50.0, SE=2.31; p<.001). This indicates that when all cultures are considered, parents of Eastern children rated them significantly worse than the norm on the BASC-2, see Figure 4a-4d. Significant positive values of parameter estimates for Externalizing Problems, Internalizing Problems, and Behavioral Symptoms Index suggest that Eastern parents rated their children highly on negative aspects of the BASC-2. Similarly, a significant negative value of the parameter estimate score for Adaptive Systems indicate that parents rated their children the lowest on positive aspects of behavioral outcomes. See Figure 3.

EF Task Performances. However, when 4 EF tasks were considered, there were significant main effects of the Bear/Dragon task only on Internalizing Problems and Adaptive Systems, $F(1,322)=3.32$, $p<.05$, $F(1,303)=3.19$, $p<.05$, respectively. Specifically, parameter estimate comparisons further reveal a significant effect size of the Bear/Dragon task on Internalizing Problems and Adaptive Systems with a magnitude of --3.16 out of 50.0, SE=1.74 ($p<.05$) and -2.74 out of 50.0, SE=1.54 ($p<.05$), respectively. Moreover, there was only a significant main effect of the Day/Night task on Internalizing Problems, $F(1,302)=2.74$, $p<.05$, with a significant magnitude effect size of -1.99 out of 50.0, SE=1.21 ($p<.05$). However, there were no significant effects of the DCCS and Gift Delay on the 4 behavioral BASC-2 indexes. See Figure 4a-4d.

BRIEF-P. When specific cognitive subscales were considered, an ANOVA on the combined model revealed that Externalizing Problems was significantly predictive by Inhibit, Plan/Organize, and Working Memory, $F(1,336)=5.11$, $p<.01$, $F(1,343)=5.55$, $p<.01$, $F(1,322)=10.73$, $p<.001$, respectively. Although smaller in effect sizes compared to the magnitude of culture and EF Tasks on the BASC-2, parameter estimates were

significant for the Inhibit (0.35 out of 50.0, SE=0.15; p<.01), Plan/Organize (0.17 out of 50.0, SE=0.07; p<.01), and Working Memory (0.28 out of 50.0, SE=0.09; p<.001) subscales. For Internalizing Problems, there were significant main effects of Emotional Control and Working Memory, F(1,327)=6.24, p<.01, F(1,307)=14.90, p<.001, respectively. Parameter estimates reveal significant magnitude of 0.38 out of 50.0, SE=0.15 (p<.01) and 0.34 out of 50.0, SE=0.09 (p<.001) for Emotional Control and Working Memory, respectively. Finally, for the Behavioral Symptoms Index, there were significant main effects of Plan/Organize and Working Memory, F(1,338)=5.49, p<.01, F(1,308)=13.65, p<.001, respectively, with significant magnitude effect size of 0.17 out of 50.0, SE=0.07 (p<.01) and 0.31 out of 50.0, SE=0.08 (p<.001). However, there were no significant main effects of any of the cognitive subscales on Adaptive Systems, as well as Shift on any of the broad behavioral indexes of the BASC-2. See Figure 4 for complete magnitude effect size for each parameter estimates in the combined model.

Specific Effects (separate models)

Next, to further understand specific effects of each factor, the DVs and IVs were analyzed in *separate* models—1 Language Status and Culture, 4 EF Task Performances, and 1 BRIEF-P models—to examine its relation to each of the 4 broad indexes of the BASC-2.

Language Status. Although there were no significant relations between language status and behavioral outcomes in the general combined model, language status was separately analyzed to examine whether it may possibly play a role when all other parameters are excluded in the separate model. When language status was considered as a predictor of BASC-2 results, there was a main effect of language status on Externalizing

Problems and Internalizing Problems, $F(1,82)= 4.27$, $p<.01$, $F(1,84)=2.82$, $p<.05$, respectively. The following results suggest that when language factors are analyzed separately, bilingualism may buffer negative aspects associated with hyperactivity, aggression, anxiety, depression, and somatization. As can be seen in Figure 3a and 3b, bilinguals (in red) were rated near or below the norm for Externalizing and Internalizing Problems, which indicates that parents of bilingual children rated them highly on negative behavioral outcomes. There were no significant effects of language status, however, on the Behavioral Symptoms Index and Adaptive Systems.

Finally, separate analyses on Culture, EF-Tasks, and BRIEF-P and its effect on behavioral outcomes demonstrate similar findings from the general combined model. In particular, significant main effects of culture were found on all 4 broad indexes, with significant main effects of the Day/Night and Bear/Dragon tasks for Adaptive Systems and for Internalizing Problems. Finally, Behavioral Systems Index and Externalizing Problems were significantly predicted by processes involved in Plan/Organize and Working Memory, while Internalizing Problems was significantly predicted by Emotional Control, Inhibit, and Working Memory.

General Discussion

The present results demonstrate that language status, culture, and EF performances and rating scales have differential effects on general behavioral outcomes. First, the differential role of language and cultural advantage effects on behavioral outcomes will be addressed, with a particular outlook on its effect through development. Finally, relationships found between EF and behavior, with particular distinctions between hot vs. cool and task performance vs. parental ratings, will be discussed.

Developmental Influences of Culture and Language Status

First, results on language status demonstrate that when language and culture are separately analyzed, language status is significant for Externalizing and Internalizing Problems. Externalizing and Internalizing Problems are indexes for negative behaviors involved in hyperactivity, aggression, anxiety, depression, and somatization. Results on the raw BASC-2 scores of Externalizing and Internalizing Problems over the course of 5 time points demonstrate that bilingual and monolinguals did not differ on their behavioral ratings. See Figure 3a and 3b. However, Vietnamese-English children were rated significantly different from the standardized norm at Time 4 and 5, while monolingual Vietnamese children were significantly different at all 5 time points.

The change of reported behavioral differences in Externalizing and Internalizing Problems for Vietnamese-English bilingual children at Time 4 and 5 (from Time 1, 2, and 3) may suggest some involvement of behavioral problems exhibited during the transitional period between preschool to kindergarten (i.e., age 4.5- and 5-years-old for kindergarten). This transition has been found to increase shock, anxiety, aggression, and withdrawn behaviors in children, even for children who have spent time in preschool classroom or child-care settings (Cowan, Cowan, Schulz, & Heming, 1994; Brostrom, 2002). This is especially the case because elementary classes are typically larger than most preschools or day-care facilities, with larger teacher and student ratio in each room. Moreover, children must now familiarize themselves to the new surroundings and get along with strangers, which has been found to play a role on their emotional state (Cowan et al, 1994). Therefore, the transition from preschool to elementary school has been deemed a “critical period” for children (Cowan et al., 1994) as it is influential to the

development of essential adaptive behaviors (Scott, Fredericson, & Fuller, 1951; Tinbergen, 1951) and school readiness and success beyond kindergarten (Thompson, 1975; Ladd & Price, 1987; Pianta & McCoy, 1997; Lewit & Baker, 1995). As such, the transitional period during age 4.5 to 5 years of the following participants to kindergarten may suggest why Vietnamese-English children were reported significantly lower than the norm. However, the lack of change for other groups at Time 4 and 5 may be due in part to the difference in preschool settings. Here, the present English, Spanish-English, and Spanish children were recruited from preschools that provided the same language instruction when transitioned to kindergarten—i.e., English to English for English monolinguals and Spanish-English bilinguals, Spanish to Spanish for Spanish monolinguals, etc. However, some of the Vietnamese-English children were recruited from Vietnamese language programs at smaller preschools and daycares. For Vietnamese-English children not recruited at Vietnamese-centered programs, post phone-interviews with the parents confirmed that their children were exposed to Vietnamese language instructions at their preschool, day-care, or weekend classes at the local church or temple. Therefore, the shift in the size of classrooms and possible change from Vietnamese-centered to English-centered institutions from preschool to kindergarten may explain the present results. However, additional investigations in the effects of the shift between different language instructions in formal schooling need to be further analyzed.

Finally, results on the reported differences of monolingual Vietnamese children at *all* time points may suggest the lack of cultural relevancy of the BASC-2 measure in Vietnam. This supports the notion that standardized behavioral forms in the U.S. may not be directly translated to other countries and cultures. However, the BASC-2 may be more

relevant to the present sample of children in Argentina as the standardization sample includes Spanish-speaking population (Reynolds & Kamphaus, 2004). Compared to their Western counterparts, those from Eastern cultures (such as those in China, Japan, and Vietnam) typically report lower levels of self-esteem and well-being (Spencer-Rogers et al., 2004). On numerous studies, East Asians have been found to report greater negative affect, such as guilt and shame, anxiety, pessimism, depression, and lower well-being compared to other cultural groups (Spencer-Rogers et al., 2004; Diener & Diener, 1995; Heine & Lenman, 1997; Lee & Seligman, 1997; Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997; Kitayama, Markus, & Kurokawa, 2000; Diener, Suh, Smith, & Shao, 1995; Crocker, Major, & Steele, 1998). Yet, despite previous reports demonstrating that most East Asians are poorly adjusted individuals with a plethora of potential psychological and behavioral problems, East Asians children typically outperform Western children on tasks assessing EF (Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Imada, Carlson, & Itakura, 2013). Sabbagh et al. (2006) found that Chinese preschoolers outperformed their U.S. counterparts on all measures of EF. Similarly, Imada et al. (2013) found that Japanese children showed significantly greater context sensitivity (paying attention to contextual information in a visual scene) compared to American children, which is linked to EF. Imada and colleagues (2013) further adds that this might explain findings in previous research, which have shown that East Asian children outperformed their counterparts in the United States on tasks that measure EF. The current study results on monolingual Vietnamese children further support this idea when analyzing their performance over other monolingual groups (English, Spanish) on the Day/Night, Bear/Dragon, and Gift/Delay task.

On the other hand, the present results demonstrate that culture influenced all behavioral indexes. In particular, culture was significantly related to Externalizing Problems, Internalizing Problems, Behavioral Symptoms Index, and Adaptive Skills, which involves subsets in hyperactivity, aggression, anxiety, depression, somatization, adaptability, social skills, activities of daily living, functional communication aspects, atypicality, withdrawal, and attention problems. This finding supports the present study's hypothesis 1 regarding the general influence of culture and its mediated role on all behavioral outcomes. This finding further supports previous notions regarding the importance of parent-child relations and rearing practices on behavior (Deater-Deckard & Dodge, 2009). Here, the culture and context in which children are raised and exposed to has been found to be important in determining children's mental health and treatment-seeking (adaptive) behaviors in adolescence (Cauce et al., 2002). This is particularly important given its role in cognition, emotion, and motivation in establishing oneself (Markus & Kitayama, 1991), suggesting the importance of cultural practices in fostering children's behavior. Therefore, significant relations between culture and different aspects of the BASC-2 may suggest that behavior is deeply rooted in the environment a child is raised and exposed to. This demonstrates the robustness of culture on positive and negative aspects of general behavior.

EF Tasks and their Influence on Behavioral Outcomes

The current study results demonstrate that not all EF tasks were related to behavioral outcomes. Relationships were found for the Day/Night and Bear/Dragon tasks on behavioral outcomes, however, there were no significance of the DCCS and Gift Delay task. Here, the Day/Night and Bear/Dragon tasks were significantly predictive of

behavioral outcomes involved in Internalizing Problems and Adaptive Systems. Internalizing Problems is an index for negative behaviors, such as anxiety, depression, and somatization. Adaptive Systems, however, is an index for positive behaviors that includes adaptability, social skills, activities of daily living, and functional communication. The present study hypothesized that hot EF tasks should be related more to Internalizing Problems and Adaptive Systems. However, the Day/Night and Bear/Dragon tasks are generally perceived as "cool" EF tasks. Although the present findings fail to support the idea that "hot" EF aspects may be more related to general behavioral outcomes than "cool" EF, it brings forth a more interesting aspect about the vulnerability of EF tasks to culture and how culture may influence ratings on behavior.

In particular, previous studies demonstrate that children in Eastern cultures outperformed those from Western cultures on the Day/Night and Bear/Dragon (Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Oh & Lewis, 2008; Tran, Arredondo, & Yoshida, in review). Their superior performance has been attributed to the collectivistic cultural practices for early self-impulse and control and obedience to authority figures in the Eastern culture (e.g., Ahadi, Rothbart, & Ye, 1993; Chao & Tseng, 2002; Chen, Hastings, Rubin, Chen, Chen & Stewart, 1998; Ho, 1994; Nisbett, Peng, Choi, & Norenzayan, 2001; Oh & Lewis, 2008; Parmar, Harkness, & Super, 2004; Tobin, Wu, & Davidson, 1989; Vinden, 2001; Wu, 1996). Therefore, these attributes are relevant to task success as children must not readily answer "day" when shown the "sun" card (and vice versa for the "moon" card) for the Day/Night task, requiring early self-impulse and control. Further, success on the Bear/Dragon task requires children to listen carefully to the adult's instructions that they must perform what the "good" bear says while not listening

to what the "bad" dragon tells them to do, therefore requiring attributes for obedience to authority figures, and early self-impulse and control. This is further supported by the present research findings where the cognitive subscale in Emotional Control and Inhibit of the BRIEF-P are found to relate to Internalizing Problems. Therefore, the present findings between the Day/Night and Bear/Dragon task on behavioral outcomes demonstrate the possible importance of emotional control, self-impulse, and obedience to authority figures on Internalizing Problems and Adaptive Systems, and, more importantly, the role that culture may play on mediating the effects of EF task and behavioral outcomes.

Perhaps the most interesting are results involving the DCCS and the Gift Delay task. The DCCS task, commonly perceived as a robust "cool" cognitive EF task devoid of affective states (Zelazo & Müller, 2002), reward or punishment (Hongwanishkul, Happaney, Lee, & Zelazo, 2005), and cultural influences (Tran, Arredondo, & Yoshida, in review), was not significantly related to any of the 4 behavioral indexes of the BASC-2 (i.e., Adaptive Systems, Behavioral Symptoms Index, Externalizing Problems, and Internalizing Problems). Given success on the DCCS task is invulnerable to cultural influences (Tran, Arredondo, & Yoshida, in review), this result aligns with the present notion on the mediation effects of culture on EF task performances and behavioral results. Further, the Gift Delay task, commonly perceived as a robust "hot" EF task given the involvement of affect states involved in emotional regulation and reward (Zelazo & Müller, 2002; Anderson, Anderson, Jacobs, & Smith, 2007), was also not significantly related to any of the BASC-2 indexes. Closer inspections of task performances on the Gift Delay task in the present study (Figure 2d) reveal that all children generally perform

similar to each other (reaching ceiling at Time 2), with the exception of Spanish monolinguals in Argentina. The lack of differences between the Eastern and Western group, therefore, may suggest the lack of influence of the Gift Delay task on behavioral outcomes. The present results are particularly interesting given previous research demonstrating that East Asian children performed significantly better than their Western counterparts in the Gift Delay task (Oh & Lewis, 2008), while others suggest Eastern children performed worse (Carlson & Choi, 2009; Imada, Carlson, & Itakura, 2013). The discrepancies between the present study results and previous study may be related to differences in the task design (experimenter looked at test sheets while leaving the gift on table for 2.5 minutes, experimenter left the room for 3 minutes), culture (Korean and Japanese), and/or age range (3.5 to 9 year olds) included in previous studies. The Gift Delay task used in the present study included the presence of the experimenter the entire session (lasting only for 1 minute), Vietnamese children, and 3 year olds. Therefore, the EF demands of the Gift Delay task may not be well matched across cultures (Sabbagh et al., 2006) given the cultural differences in the custom of gift giving (Hua, Wei, & Yuan, 2000). However, additional research needs to be implemented to understand the possible factor behind differences within Eastern cultures (Korean and Japanese vs. Vietnamese) on task performance of the Gift Delay task.

In sum, the present study demonstrates the specific nature of bilingualism, culture distinct EF tasks, as well as the potential cognitive processes that are relevant to different aspects of behavior. Specifically, the present results shed light and offer a new perspective on reported cultural and bilingual cognitive advantage and its effect on children's behavioral outcomes. Such specificity, therefore, may further explain how

findings concerning the effects of bilingualism and culture may be disseminated on the development of early cognitive advantage as it relates to behavior. This is particularly important given the weight provided on cognitive task assessments in early childhood and its implications for bilingual education, language development, and cognitive impairments.

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TABLE AND FIGURE CAPTIONS

TABLES

Table 1. Spectrum of the degrees of collectiveness among different cultures.

Degree of Societal Structure:	**Individualistic**		**Collectivistic**
			
	Loosely Structured		Highly Structured
Cultural Groups:	Western	Western-European with Latin Influences	Eastern
Language Groups (Country):	English (U.S.)	Spanish (Argentina) & Spanish-English (Argentina / U.S.)	Vietnamese (Vietnam) & Vietnamese-English (Vietnam / U.S.)

Table 2. Sample Characteristics

Time	Cultural group	Language status	*N*	Mean age (range) in months
1	Western	English	14	37.82 (35.56–41.94)
	Western-European	Spanish	19	38.38 (31.09–46.48)
		Spanish–English	13	39.80 (35.56–45.53)
	Eastern	Vietnamese	20	38.08 (31.97–42.57)
		Vietnamese–English	15	40.44 (36.18–45.53)
2	Western	English	14	44.41 (41.68–48.42)
	Western-European	Spanish	19	45.18 (37.76–53.29)
		Spanish–English	13	46.33 (42.73–51.51)
	Eastern	Vietnamese	20	44.56 (38.45–49.05)
		Vietnamese–English	15	47.01 (42.17–51.55)
3	Western	English	13	51.18 (48.36–55.03)
	Western-European	Spanish	19	50.21 (42.80–58.32)
		Spanish–English	13	52.28 (48.39–57.96)
	Eastern	Vietnamese	20	50.53 (44.51–55.20)
		Vietnamese–English	15	53.88 (47.76–59.97)
4	Western	English	11	57.56 (54.08–61.28)
	Western-European	Spanish	19	55.73 (49.84–64.05)
		Spanish–English	13	58.34 (54.41–63.03)
	Eastern	Vietnamese	20	55.55 (49.47–60.16)
		Vietnamese–English	11	60.54 (54.87–67.53)
5	Western	English	10	63.44 (58.91–69.18)
	Western-European	Spanish	19	62.55 (55.36–70.72)
		Spanish–English	13	64.30 (60.40–68.42)
	Eastern	Vietnamese	19	61.43 (55.49–65.89)
		Vietnamese–English	10	66.71 (61.35–73.13)

Table 3. Socio-Economic Status (SES) scores.

Country	Language Status	Languages	SES Mean scores (SD)	
			Education (out of 20)	**Income (out of 9)**
Argentina	Monolingual	Spanish	13.63 (3.30)	5.00 (2.73)
Vietnam	Monolingual	Vietnamese	10.00 (3.28)	7.26 (2.18)
U.S.	Monolingual	English	16.67 (1.92)	7.45 (1.44)
	Bilingual	Spanish-English	16.97 (1.49)	7.00 (2.13)
	Bilingual	Vietnamese-English	14.31 (3.33)	5.88 (1.72)

Table 4. Pre- and Post-switching Tasks of the Dimensional Change Card Sorting (DCCS) Task

Pre-switching 1. *"What do you see?"* 2. *"Good, that's right, this is (a) boat/bunny/blue/pink."* 3. *"Now, could you tell me which one is also (a) boat/bunny/blue/pink in the box?"* (Point to both sides of the box. Put it in the box, matching the card.) 4. *"Good, that's right, this is also (a) boat/bunny/blue/pink."* 5. *"Now, what I'm going to do is put this boat/bunny/blue/pink along with this other boat/bunny/blue/pink, like this."*
Post-switching 1. *"Now, we are going to change the game a little bit, okay?"* 2. *"Let me explain."* 3. *"Now, could you tell me what color/shape (i.e., opposite dimension from pre-switching trials) you see?"* 4. *"Good, that's right, this is (a) boat/bunny/blue/pink."* 5. *"Now, could you tell me which one is also (a) boat/bunny/blue/pink in the box?"* (Point to both sides. Put it in the box, matching the card.) 6. *"Good, that's right, that is also (a) boat/bunny/blue/pink."* **7.** *"Now, what I'm going to do is put this boat/bunny/blue/pink along with this other boat/bunny/blue/pink, like this."*

Table 5. Card Order and Script for the Day/Night Task

Fixed card order

1. Sun
2. Moon
3. Moon
4. Sun
5. Moon
6. Sun
7. Sun
8. Moon
9. Sun
10. Moon
11. Sun
12. Sun
13. Moon
14. Sun
15. Moon
16. Moon

Script

1. *"What do you see?"*
2. *"Good, that's right, this is a sun/moon."*
3. *"Now, could you tell me, when does the sun/moon come out (day or night)?"*
4. *"That's right, this does come out during the day/night."*

Note: Did the practice for each card sun/moon.

5. *"Now, we are going to change the game a little bit, okay?"*
6. *"Let me explain: When I show you the sun/moon card, you say night/day instead of day/night."*
7. *"Could you do that for me?"*
8. *"Good."*
9. *"Now, let's try. What do you say for this card?"*

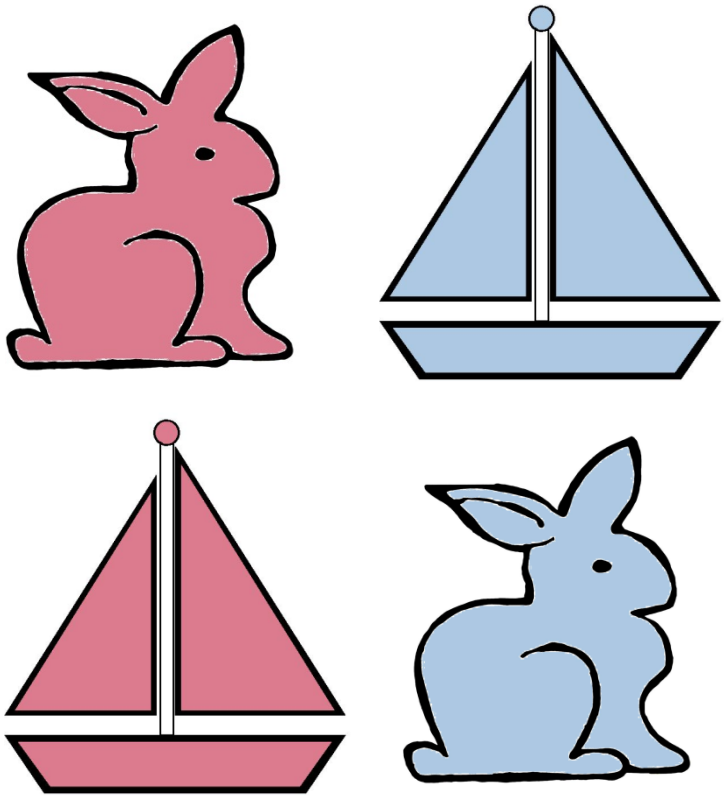
Table 6. Instructions and Script for the Bear/Dragon Task

Instructions *"This is Mr. Bear (show the puppet). He is very nice. You have to do what Mr. Bear says, okay? For example, if Mr. Bear says to touch your hair, you touch your hair! Can you try that? Yeah! Good job!"* *"This is Mr. Dragon (show the puppet). He is not nice. You don't do what Mr. Dragon says. For example, if Mr. Dragon says to touch your hair, you would just simply not do it. Okay?" Can you try that? Yeah! Good job!"*
Script 1. *Lets start:* 2. *Mr. Bear says to touch your nose! Good job!* 3. *Mr. Dragon says to touch your ears! Good Job!* 4. *Mr. Bear says to wiggle your fingers! Perfect!* 5. *Mr. Dragon says to touch your eyes. Good job!* 6. *Mr. Bear says to clap your hands. Perfect!* 7. *Mr. Dragon says to touch your head. Perfect!* 8. *Mr. Bear says to raise your arms. Good Job!* 9. *Mr. Dragon says to move your fingers. Perfect!* 10. *Mr. Bear says to put your hands to your sides* 11. *Mr. Dragon says to pretend like you are swimming, moving your arms to the front and back. Good Job!*

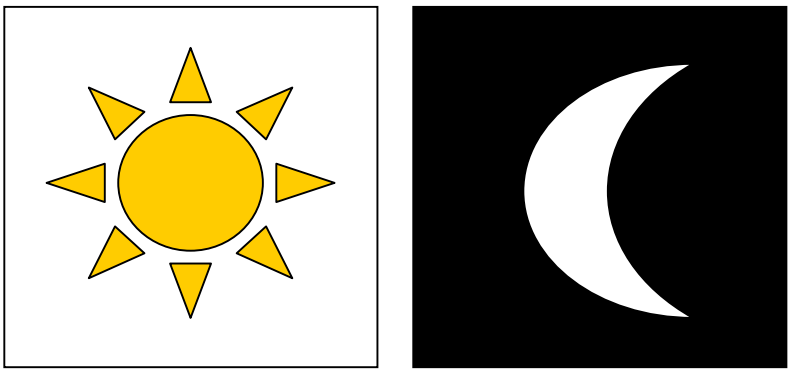
FIGURES

Figure 1. Sample stimuli used in the (a) Dimensional Change Card Sorting (DCCS) task, (b) Day/Night, (c) Bear/Dragon task, and (d) Gift Delay.

1a. DCCS Task



1b. Day/Night Task

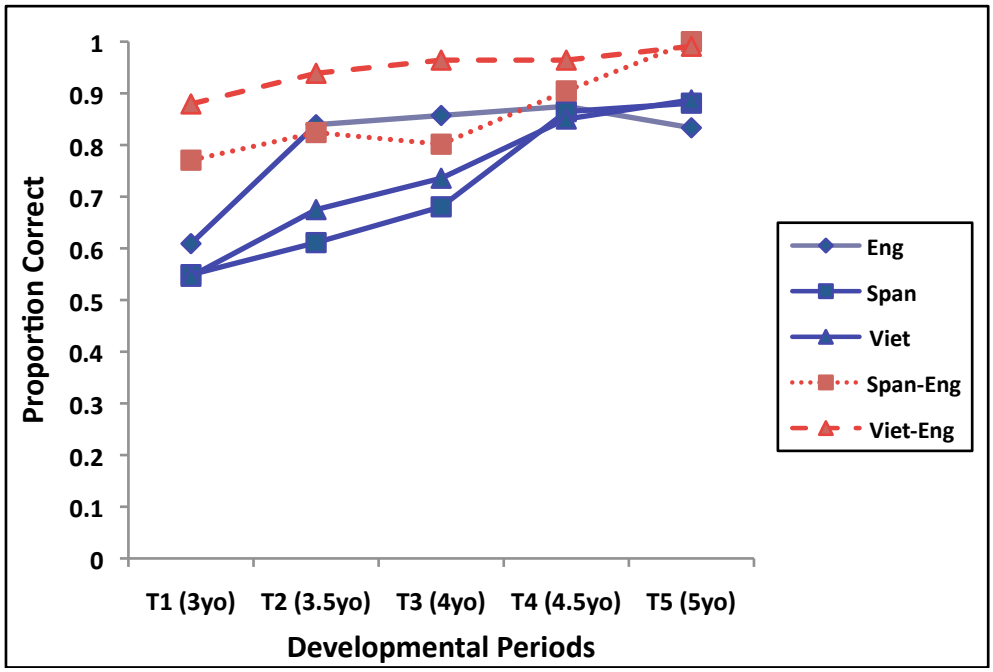


1c. Bear/Dragon Task

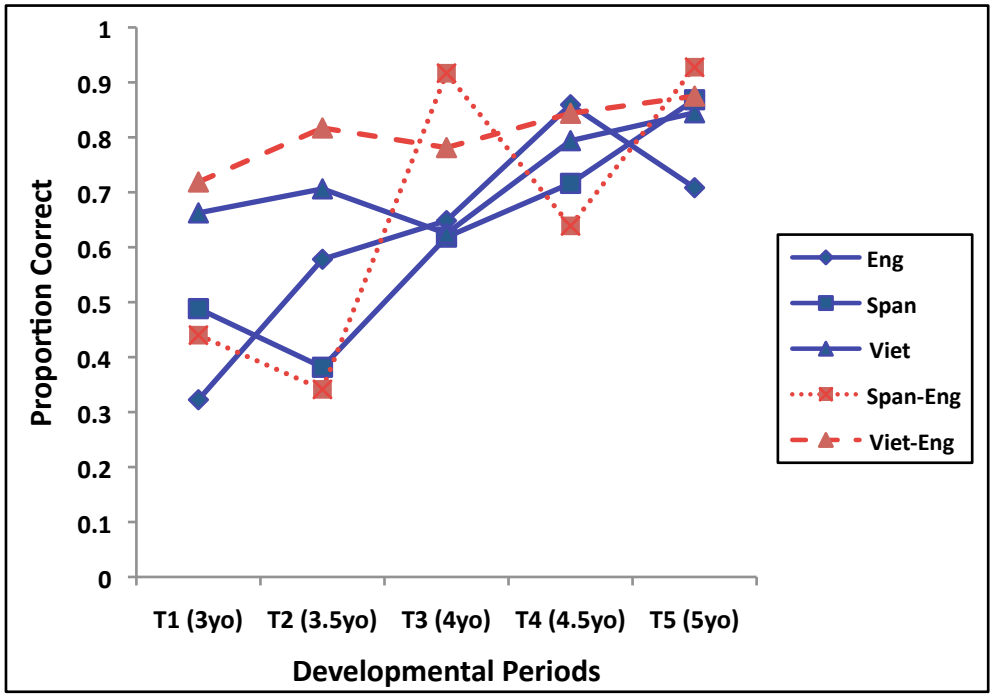
1d. Gift Delay Task

Figure 2. EF Tasks Performances on the (a) Dimensional Change Card Sorting (DCCS), (b) Day/Night, (c) Bear/Dragon, and (d) Gift Delay task. Note: dotted red lines represent bilinguals, while solid blue lines represent monolinguals.

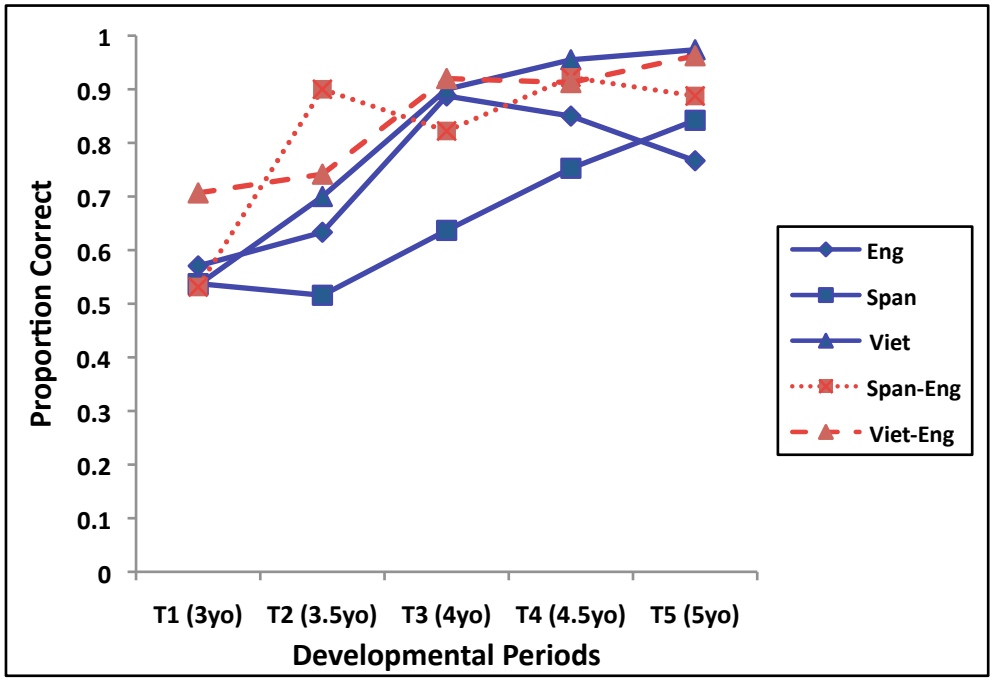
2a. DCCS Task



2b. Day/Night Task



2c. Bear/Dragon Task



2d. Gift Delay Task

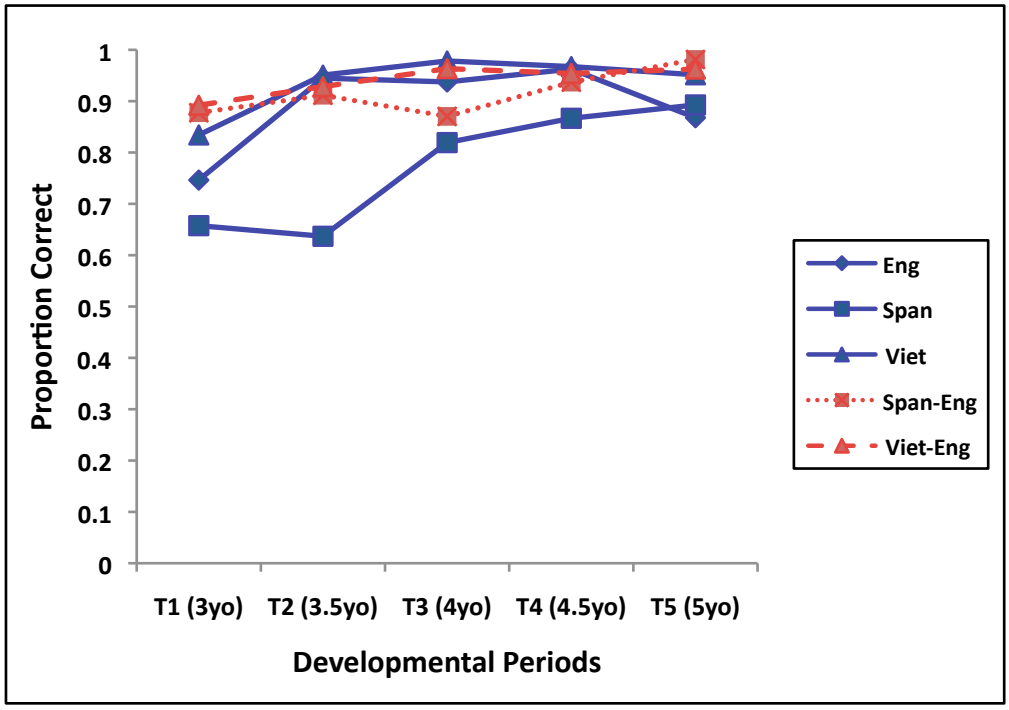
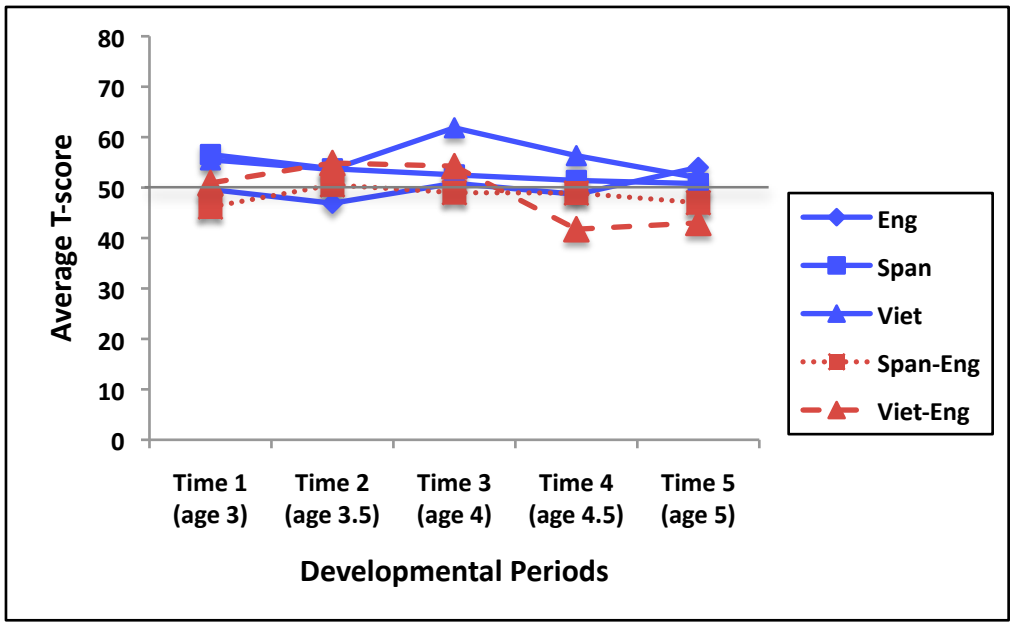
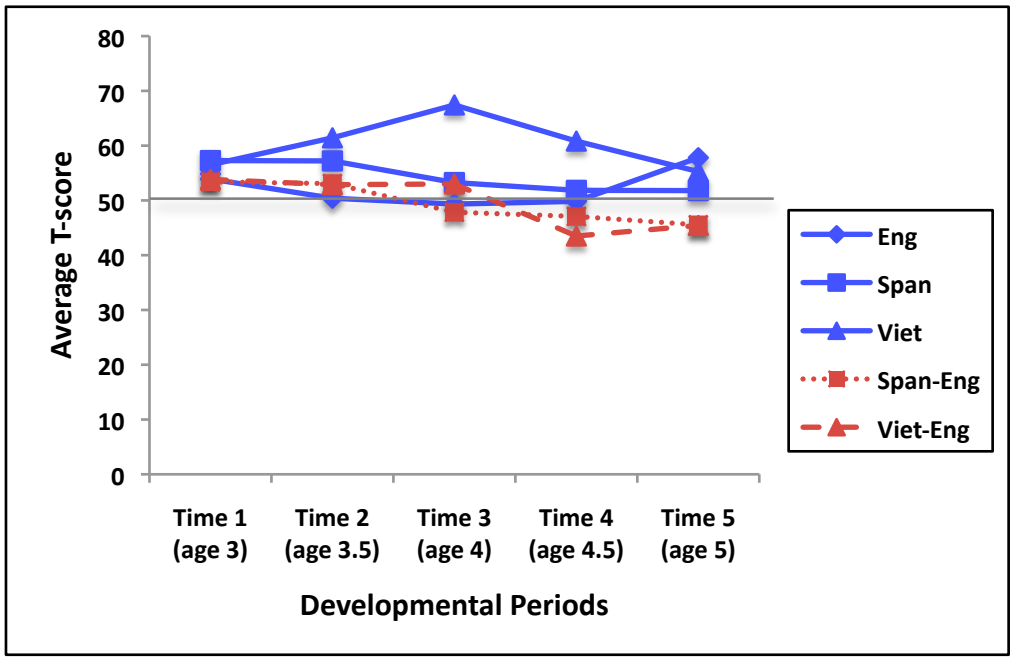


Figure 3. BASC-2: Behavioral rating scores for the (a) Externalizing Problems, (b) Internalizing Problems, (c) Behavioral Symptoms, and the (c) Adaptive Systems Index. Note: dotted red lines represent bilinguals, while solid blue lines represent monolinguals.

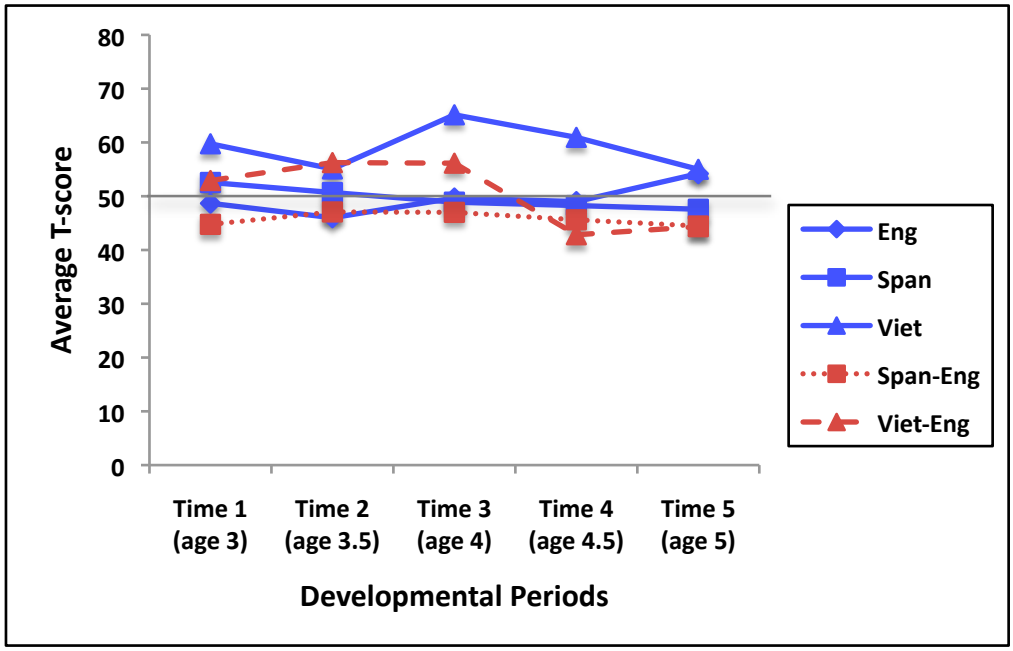
3a. Externalizing Problems (Hyperactivity, Aggression)



3b. Internalizing Problems (Anxiety, Depression, Somatization)



3c. Behavioral Symptoms Index (Atypicality, Withdrawal, Attention Problems)



3d. Adaptive Systems (Adaptability, Social Skills, Activities of Daily Living, Functional Communication)

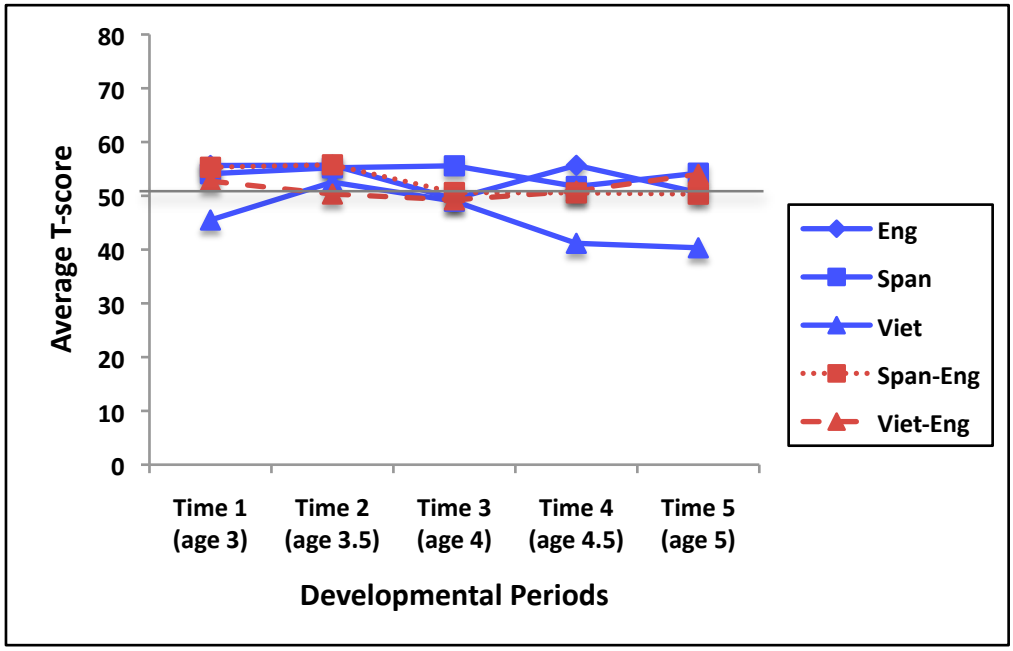
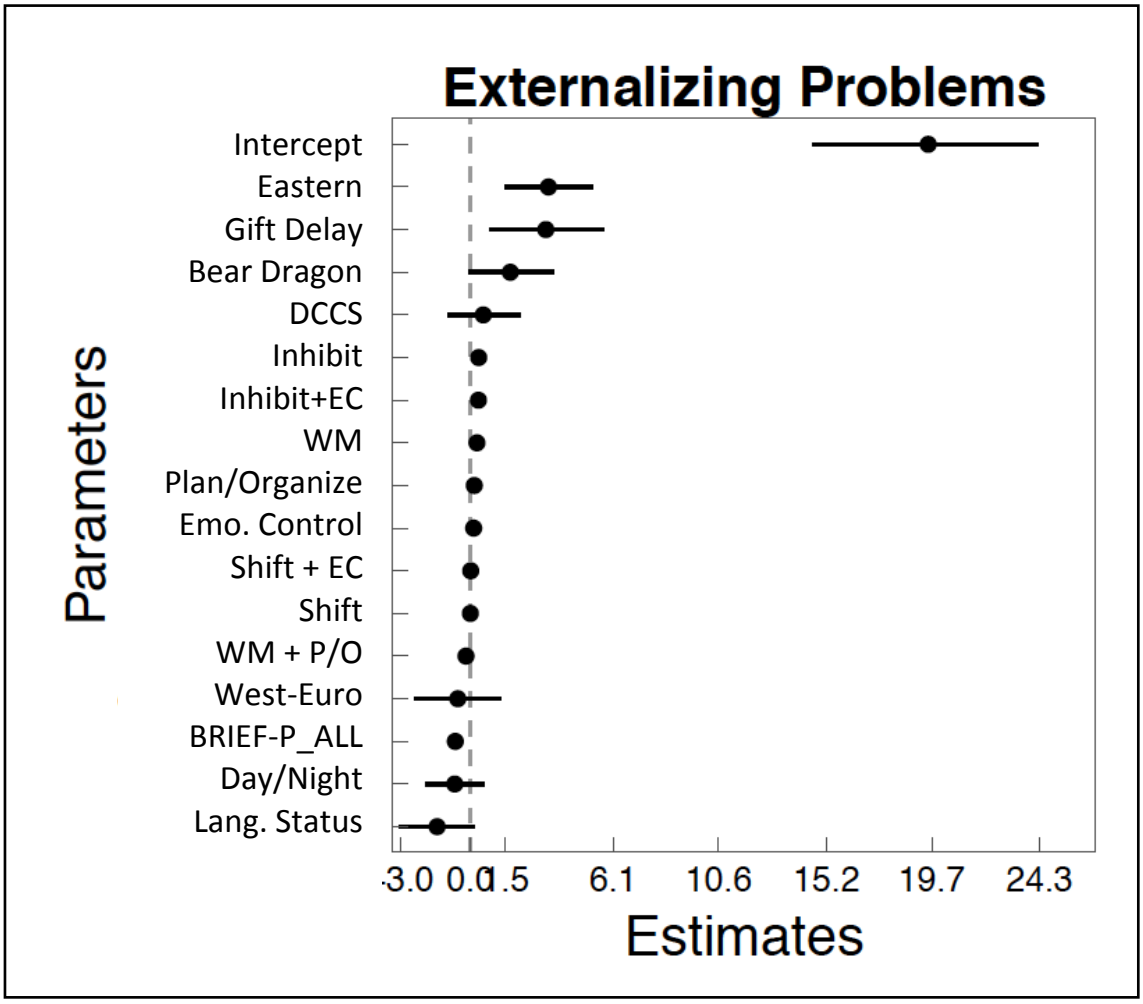
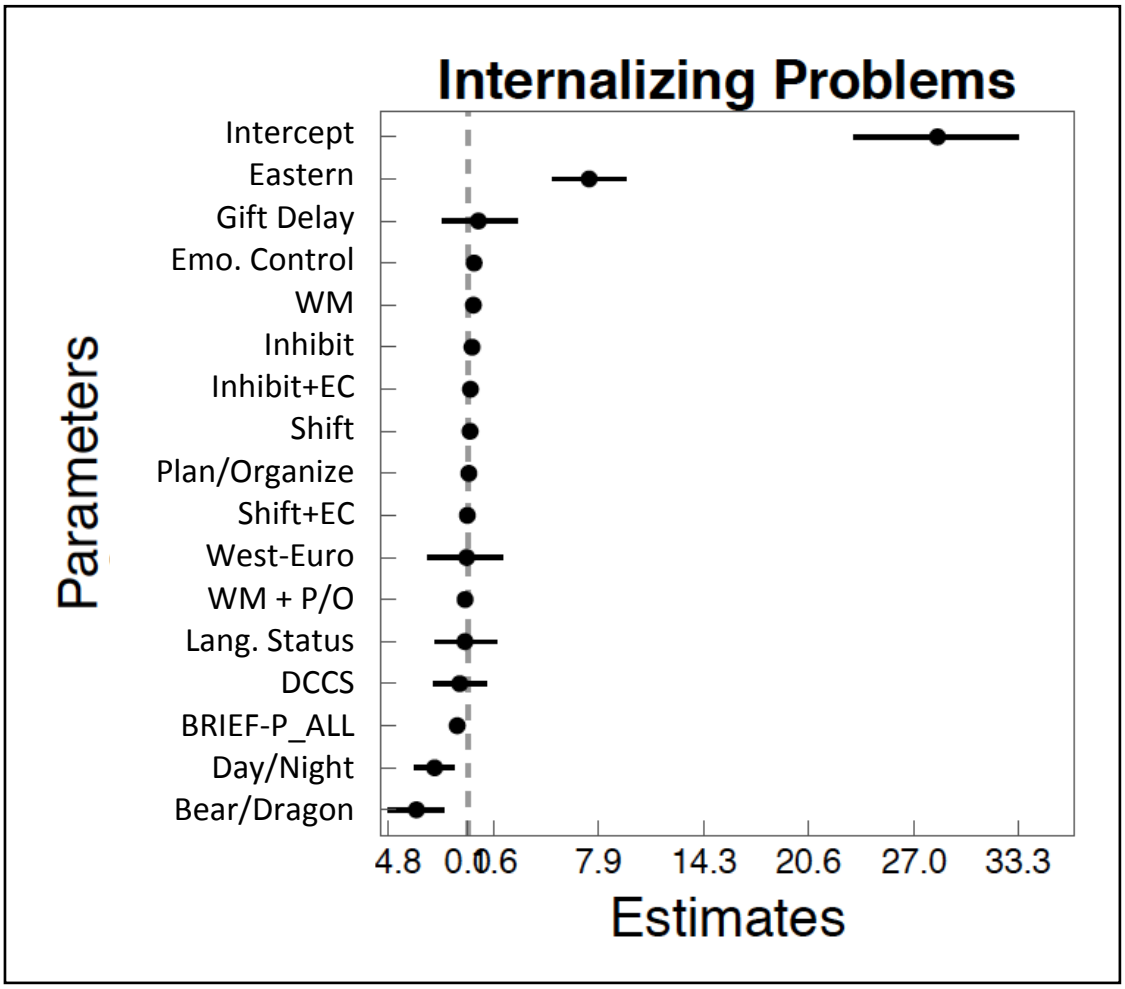


Figure 4. Parameter Estimates of the 4 behavioral BASC-2 indexes for the (a) Externalizing Problems, (b) Internalizing Problems, (c) Behavioral Symptoms, and the (c) Adaptive Systems Index.

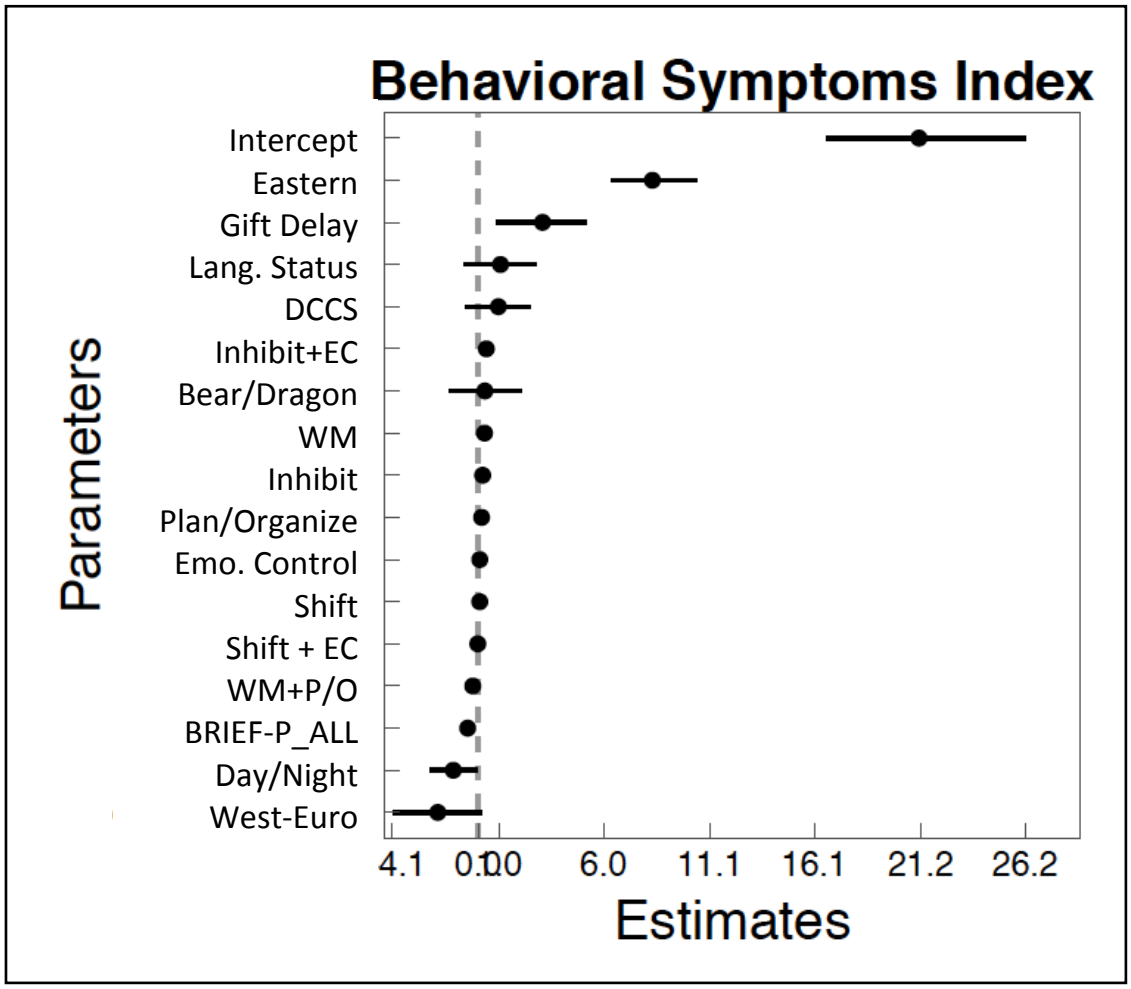
4a. Externalizing Problems



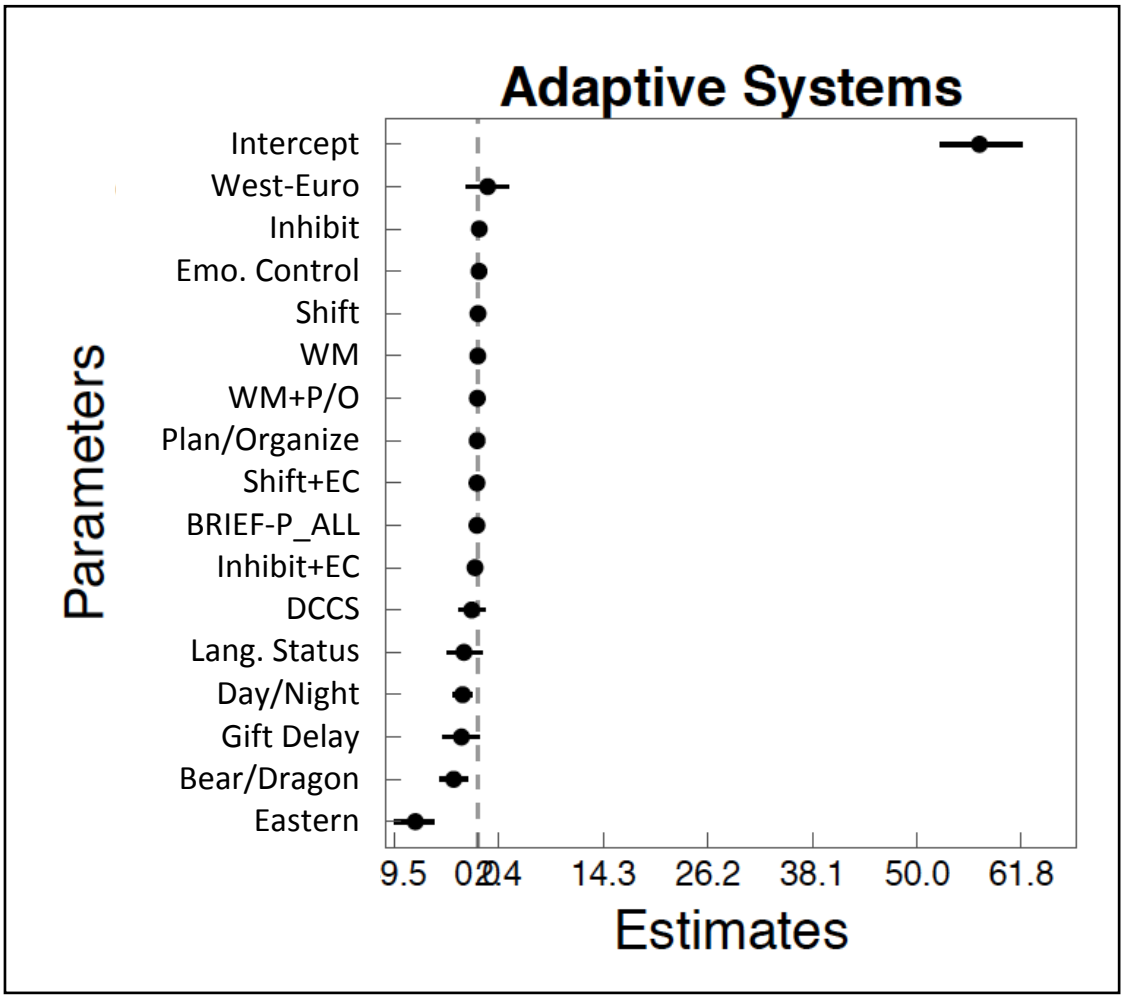
4b. Internalizing Problems



4c. Behavioral Symptoms Index



4d. Adaptive Systems



APPENDICES

Appendix A: Socioeconomic Status (SES) Questionnaire

Appendix A1: Self-Rate in the Community

Think of this ladder as representing where people stand in their communities.

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

Where would you place yourself on this ladder?

Please place a large **"X"** on the rung where you think you stand at this time in your life, relative to other people in your community.

Appendix A2: Self-Rate in the Nation

Think of this ladder as representing where people stand in the United States.

At the **top** of the ladder are the people who are the best off – those who have the most money, the most education and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

Where would you place yourself on this ladder?

Please place a large **"X"** on the rung where you think you stand at this time in your life, relative to other people in the United States.

Appendix A3: Highest Education Level

What is the highest grade (or year) of regular school you have completed? (Check one.)

Elementary School	High School	College	Graduate School
01____	09____	13_____	17_____
02____	10____	14_____	18_____
03____	11____	15_____	19_____
04____	12____	16_____	20+____
05____			
06____			
07____			
08____			

Appendix A4: Total Household Income

Which of these categories best describes your total combined family income for the past 12 months? This should include income (before taxes) from all sources, wages, rent from properties, social security, disability and/or veteran's benefits, unemployment benefits, workman's compensation, help from relatives (including child payments and alimony), and so on.

_____Less than $5,000

_____$5,000 through $11,999

_____$12,000 through $15,999

_____$16,000 through $24,999

_____$25,000 through $34,999

_____$35,000 through $49,999

_____$50,000 through $74,999

_____$75,000 through $99,999

_____$100,000 and greater

_____Don't know

_____No response