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An assessment of the effects of SES on the development of executive attention in Singapore: Early English–Malay bilinguals*

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Thirty-four English–Malay bilinguals of between four and six years of age (both balanced and dominant) characterized as low socioeconomic status (SES) on income and parental education were tested on the child-Attentional Network Task (child-ANT; Rueda, Fan, McCandliss, Halparin, Gruber, Lercari & Posner, 2004) measuring executive attention. Although SES measures fell below the Singapore median, Malay children's performance on the child-ANT remained high when compared to other age-matched monolingual and bilingual children previously tested with the child-ANT (Yang, Yang & Lust, 2011), and English–Chinese Singaporean bilinguals (Kang, 2009). None of the three SES measures – father's and mother's education, and income, significantly correlated with child-ANT components. Regression analyses confirmed that none of the SES measures significantly predicted performance on the child-ANT. Caregiver reports suggested that both balanced and dominant bilinguals displayed high executive control. We consider the possibility that cultural variations – simultaneous and pervasiveness of bilingualism in Singapore, or pervasive code-switching – may ameliorate potential negative effects of SES on executive control development.

Keywords: bilingualism, cognitive development, executive attention, socioeconomic status, culture, child multilingualism questionnaire, Malay

Research on the early acquisition of two languages has evidenced a bilingual advantage in young children on tasks requiring executive control (Barac & Bialystok, 2012; Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Videsott, Della Rosa, Wiater, Franceschini & Abutalebi, 2012; Yang et al., 2011). In these tasks, executive control comprises inhibiting attention to misleading information, selective attention, and switching (or shifting) attention in tasks with distracting and competing cues (Bialystok & Martin, 2004). Bilinguals outperformed their monolingual counterparts on tasks requiring attentional control in ignoring certain perceptual features of stimulus or tasks requiring behavioral inhibition (Bialystok, 1999).

Despite the accumulating evidence of the bilingual cognitive advantage, some studies have argued against it (Hilchey & Klein, 2011; Mezzacappa, 2004; Morton & Harper, 2007; Paap & Greenberg, 2013). One of the issues of debate concerns the role of socioeconomic status (SES). Some have argued that the hypothesized bilingual advantage may be confounded with variations in SES across bilingual and monolingual populations tested (e.g., Mezzacappa, 2004; Morton & Harper, 2007). This is in line with the literature demonstrating that children from low SES backgrounds perform more poorly on executive function (EF) tasks, compared to their wealthier counterparts (Ardila, Rosselli, Matute & Guajardo, 2005; Hughes & Ensor, 2005; Lipina, Martelli, Vuelta & Colombo, 2005; Noble, McCandliss & Farah, 2007; Noble, Norman & Farah, 2005). On the other hand, more recent studies that controlled for SES and background demographics of participants have argued that bilingualism may compensate for the adverse effects of poverty on cognitive processes (e.g., Carlson & Meltzoff, 2008; Engel de Abreu, Cruz-Santos, Martin & Bialystok, 2012).

In this paper, we consider the role of SES in the hypothesized bilingual advantage. We do so, recognizing that many factors may influence children's cognitive

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performance, possibly in combination with SES. One set of factors concerns the nature of children's bilingualism, for example, whether children learn their two languages sequentially or simultaneously (Akhtar & Menjivar, 2012). The context of language exposure is another factor – e.g., better inhibitory control might only be observed with bilingualism serving as a buffer against the negative effects of SES if two languages are acquired in similar context (Kovács & Mehler, 2009). Other important factors related to language development, such as level of language proficiency (Videsott et al., 2012), language use, formal education in both languages (for older children), and quantity of languages the child is exposed to, have to be taken into consideration too. Another important issue concerns the potentially variable role of SES, since SES effects are known to vary cross-culturally (Bradley, 1994; Bronfenbrenner, 1999. With respect to the measurement of SES, common and stable measures comprise occupation, income, and education although these may not always cohere (Ensminger & Fothergill, 2003; Mcloyd, 1998; White, 1982). Clearly, SES is not a homogeneous concept.

Finally, a significant amount of previous research on the bilingual advantage has been at least partially confounded by the role of "Asian superiority" effects (Carlson & Meltzoff, 2008; Lewis, Koyasu, Oh, Ogawa, Short & Huang, 2009; Oh & Lewis, 2008; Sabbagh, Xu, Carlson, Moses & Lee, 2006; Yang et al., 2011). In these studies, Asian children outperformed their Western counterparts on tasks of cognitive control, and some researchers attribute this to parenting practices that emphasize self-regulation (Lewis et al., 2009) and the focus of Asian preschools on impulse control, as compared to U.S. preschools (Tobin, Wu & Davidson, 1989). Consequently, Carlson & Meltzoff (2008) highlighted the need to replicate the bilingual cognitive advantage in "non-Chinese" samples, to further confirm that the bilingual advantage is independent of supposed Asian cultural advantage on executive function tasks.

In this paper, we report the results of an investigation of the development of executive attention in a population of bilingual children, English–Malay speakers – all simultaneous bilinguals – within the "Asian milieu" of Singapore, who are characterized as "low SES" in Singapore, in terms of income, occupation, education and social indicators, according to official socioeconomic figures (Mutalib, 2011). We compare results to previous research in Singapore on a contrasting high SES bilingual group, English–Chinese speaking (Kang, 2009),[1] as well as to other Asian populations previously assessed for the bilingualism effect (Yang et al., 2011). In Singapore, English is the official medium of instruction, and children learn this at the first language (L1) level, whereas one's mother tongue – usually assigned on the basis of one's father's ethnicity (i.e., Mandarin for Chinese, Malay for Malays) – is learned at the second language (L2) level. As such, home language may involve both languages; therefore, the terms "first" and "second" language are especially difficult to apply in Singapore. All English–Malay children are characterized as simultaneous bilinguals, given the mandatory bilingual education policy since 1966 in Singapore (Dixon, 2003), and have no immigration history. In addition, it is reputed to be almost impossible to find monolingual speakers in this pervasively bilingual culture of Singapore, with statistics revealing that all three major ethnic groups (Chinese, Malay, Indians) speak at least one other non-English home language (Department of Statistics, 2010). An even larger proportion of Malays (82.7%) speak their mother tongue/L2 (Malay) at home, compared to the other two groups – the Chinese speak Mandarin 47.7% of the time at home, and the Indians speak Tamil 36.7% (Department of Statistics, 2010). In fact, Stroud (2007) described Malays as being more resilient to the language shift towards English in Singapore, compared to the other racial groups (i.e., Chinese and Indians) where there are proportionally fewer speakers of the mother tongues.

Above and beyond the differences in low SES Malay and high SES Chinese populations in Singapore, all share the "Asian milieu" of the Singapore culture. The general literacy rate among Singapore residents aged 15 years and above is approximately 96.4% (as of 2012), while unemployment rate is currently at 2.1% (as of the last quarter of 2013) (Department of Statistics, 2013). Through our study of a previously unstudied English–Malay bilingual child culture, we now attempt to investigate whether SES variation within a shared Asian multilingual culture can significantly depress a cognitive advantage assumed to cohere with bilingualism. The socioeconomic progression of the Malays, who form approximately 13.3% of the population (Department of Statistics, 2013 falls behind that of the Chinese and Indians (Association of Muslim Professionals, 2012; Mutalib, 2005, 2011). The average monthly household income of the Malays is the lowest of the three main ethnic groups, standing at S$4,575 per month compared to the Chinese and Indians (S$7,326 and S$7,664 respectively)

[1] In Kang's (2009) study, 49 English–Chinese bilinguals were tested on the child-ANT and the English PPVT–IV, among other measures. This Chinese sample had an average age of 69.3 months ($SD = 4.8$, range = 56–78 months), and comprised 26 males and 23 females. The Chinese sample's age did not significantly differ from the Malay sample. Independent *t*-tests were performed to compare both samples' performance on the child-ANT. Due to unequal sample sizes and violations of homogeneity of variance, bootstrapped significance tests were performed (with 10,000 bootstrap replicates). However, bootstrapped results did not change appreciably (i.e., no changes from non-significance to significance and no substantial difference in the standard errors).

(Department of Statistics, 2010). Despite this, Malays continued to have the largest family size amongst the other two racial groups, and resident Malay females of between 40 to 49 years of age had a mean number of 2.73 children in 2010, compared to 1.89 for Chinese and 2.05 for Indians (Department of Statistics, 2010). In terms of education, the Malays have the highest proportion with below secondary level education (i.e., U.S. equivalent of below high school), standing at 37%, compared to 33.8% for the Chinese and 22.5% for the Indians (Department of Statistics, 2010). Only 5.1% of Malays had university-level qualifications, compared to 22.5% for the Chinese and 35% for the Indians (Department of Statistics, 2010).

Some scholars have suggested a relationship between socioeconomic advancement in Singapore and the use of English at home (Bokhorst-Heng, 1998). Analyzing the 1990 census, Bokhorst-Heng (1998) noticed that only one out of ten low-income families spoke English as a home language. In addition, English as a home language has increased in higher income families. From the Year 2000 Census, 75% of the families using English as home language had income levels above S$4000 (Cavallaro & Serwe, 2010). In contrast, only 25% of families with Malay as home language were in similar income brackets. When examining the occupation types of the heads of the Malay language families, a large percentage have occupations such as sales staff and clerks (28.7%), while almost half of them had low-income professions like cleaners, craftsmen or machine operators (Cavallaro & Serwe, 2010).[2] The authors concluded that in households where English is not the home language, this served as a "factor against upward social mobility" (Cavallaro & Serwe, 2010, p. 130). Thus, we conclude that the Malay population we studied in this paper can be classified as "low SES".

Method

Design

Our design allows us to test our leading hypothesis that low SES measures do not necessarily result in depression of executive attention development in bilingual children. We adopt a focused study of executive control, concentrating on "executive attention", and tailor our methodology accordingly. Executive attention emphasizes the role of attention in "monitoring and resolving conflict" between different brain areas (Posner & Fan, 2004, p. 38). Both theoretical and empirical foundations exist for studying this area (Posner & Fan, 2004; Posner & Rothbart, 2007).

[2] Empirical assessment of "functional" bilingualism in this population has not been available to date. See Cavallaro & Serwe (2010) for initial study with regard to this issue.

We adopted the child-friendly version of the ANT (Fan, McCandliss, Sommer, Raz & Posner, 2002), the child-ANT (Rueda et al., 2004). Our previous research in Singapore had used the ANT task in a study of 49 high SES English–Chinese bilingual preschoolers to assess within-bilingual group differences in literacy levels and its relationship with the bilingual advantage on executive attention (Kang, 2009). This study and previous study using the child-ANT with Korean–English bilingual children (in Korea and the U.S.) (Yang et al., 2011) provided background and comparison points for our current research with English–Malay bilinguals. SES measures were obtained through a family background questionnaire. In addition, a Child Multilingualism Questionnaire (Blume, Yang & Lust, 2014) completed by caregivers provided caretaker assessment of the nature of each child's bilingualism. Regression and correlational analyses were employed to investigate whether the SES measures influenced the executive attention performance on the child-ANT.

As background, a test of general intelligence (Kaufman Brief Intelligence Test Second Version, KBIT–2; Kaufman & Kaufman, 2004) was included to ascertain the general intellectual level of the sample and allow comparability to other bilingual populations tested in the literature and to assess whether SES factors might be significantly depressing general intelligence, as well as executive attention. The Fourth Edition of the English Peabody Picture Vocabulary Test (PPVT–IV; Dunn, Dunn & Dunn, 2006) provided a measure of English language vocabulary competence, which allowed us to examine whether English vocabulary is significantly influenced by SES factors and whether it plays a role in influencing executive attention performance in these English–Malay bilinguals. We included age, the English vocabulary test (PPVT) and the general intelligence test (KBIT–2) scores as predictors in our regression model to investigate how much each of these might independently predict child-ANT performance.

Participants

Thirty-four bilingual children were recruited from Singapore (mean age = 66.21 months, $SD = 9.14$, range = 54–77 months, 19 females). It was practically impossible to recruit monolingual preschoolers for this study due to Singapore's mandatory bilingual education policy. All the children were recruited from a public Muslim school, and were educated in both English and Malay at school on a daily basis. Seventeen parents completed the Child Multilingualism Questionnaire which confirmed that all 17 English–Malay bilinguals spoke both languages at the preschool, at home, and other places. All the parents completed consent forms before testing began.

No monetary compensation was given for children's participation in this study.

Tasks

Background measures

Parents first completed a socioeconomic background information sheet (Appendix A). Caregivers provided information on their highest educational attainment, average monthly household income and occupation. In this questionnaire, education is measured by the highest academic qualification received by both parents, which is divided into five levels: 1 – None/Primary, 2 – Secondary/Pre-university, 3 – Vocational/Technical, 4 – Tertiary/University and 5 – Postgraduate. The average monthly household income is divided into the following five categories: 1 – less than S$1000, 2 – from S$1000 to less than S$3000, 3 – from S$3000 to less than S$6000, 4 – from S$6000 to less than S$9000, and 5 – more than S$9000 per month. Parents were then interviewed over the phone for a five-part Virtual Linguistic Lab Child Multilingualism Questionnaire (MQ) (Blume et al., 2014) that provided descriptive data on the child, child language, family background, code-switching and reading/writing ability where relevant. Based on these, the questionnaire allows us to assess both balanced and dominant bilinguals in an introductory way.

Receptive English vocabulary in the child was measured using Versions A and B of the Peabody Picture Vocabulary Test (PPVT–IV, Dunn et al., 2006). For every item, the child was presented with four colored pictures and asked to select the picture that best illustrated the word the experimenter read aloud. This test is standardized with a mean score of 100, and a standard deviation of 15.

The matrices subtest of the KBIT–2 (second version, Kaufman & Kaufman, 2004) was used to control for nonverbal intelligence. Standardized KBIT–2 scores were used in correlational and regression analyses, to explore the relationship between nonverbal intelligence and executive attention. This subtest measures non-verbal intelligence in terms of understanding relationships and analyzing visual analogies. This subtest comprised 46 items with three levels of increasing difficulty. In the first section, the child had to point to one of five drawings that matched the target image on the center of the page. In the other two sections, the child was presented with an incomplete matrix of visual stimuli and asked to choose one of five options below that completed the pattern displayed.

Executive control task: Child-Attention Network Task (Rueda et al., 2004)

Posner & Petersen (1990) first showed that attention sources could be broken down into three networks that carry out alerting, orienting and executive control functions. The attention network task (ANT) was subsequently developed to measure these three networks in one integrated computerized task (Fan et al., 2002) and has been used to assess executive attention in bilingualism (Costa, Hernández & Sebastián-Gallés, 2008).

The child-ANT was subsequently developed as a more child friendly version of this test. It is a computerized cue by flanker task that measures the three attentional components of alerting, orienting, and executive control in an integrated test (Rueda et al., 2004). Rueda et al., (2004) adapted the integrated Attention Network Test (ANT) (Fan et al., 2002) into a child version through the replacement of the arrows with fish that had arrows embedded in them. The ANT has been shown to provide reliable single subject estimates in all three dimensions (Fan et al., 2002). The efficiency of the three networks can be measured through observing how alerting cues, spatial cues and flankers influence reaction time and accuracy. The stimuli in the child-ANT were presented visually on a laptop, and children were asked to help the experimenter feed hungry fish. Children responded to two input keys on the keyboard with both their index fingers (left/right arrow) as quickly as possible when the fish appeared on the screen. These arrows matched the swimming direction of the arrow in the fish on the screen. The child-ANT comprised 168 trials – a training block of 24 practice trials, and three experimental blocks with 48 trials each. To ensure children were familiarized with the use of the computer, they first completed a training block with 24 practice trials. Experimenters provided children with positive feedback and encouragement throughout the session. To reduce fatigue, experimenters offered the children a short break between each block if the need arose.

Each of the 168 trials has a combination of four cues (NO CUE, DOUBLE CUE, CENTRAL CUE, and SPATIAL CUE) and three flanker conditions (NEUTRAL, CONGRUENT, and INCONGRUENT). These conditions test the three attentional networks of alerting, orienting, and executive control. The trials are composed of different combinations of these conditions in a randomized order. The cues function either to direct the child's attention to the location of the target, or to enhance the child's alertness in order to prepare them for the target's impending presentation on the screen. Flankers serve to assess attention control capability when faced with flankers that distract one's attention. A neutral condition is composed of a single fish stimulus that swims to the left or right. A congruent condition comprises five fish swimming in the same direction, and an incongruent condition comprise five fish swimming, but with the central target fish swimming in the opposite direction as its flankers. A diagrammatic explanation on the workings of the child-ANT is shown in Figure B1 in Appendix B.

Percentage accuracy is based on the number of times the child accurately responds to the direction where the

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target fish swims. Efficiency scores based on reaction times (RT) are computed for all three components of the network. First, the ALERTING function is described as the achievement and maintenance of a state of readiness for the effortful processing of information. The alerting effect is calculated by subtracting the mean RT of the double cue condition from mean RT of the no cue condition. In the no cue condition, attention is diffused between two potential target locations. The use of double cues not only keeps attention divided between the two potential target locations, but also alerts one to the impending target appearance.

Second, ORIENTING EFFECT refers to the ability to shift one's focus from one stimulus to another, and this can be measured using valid spatial pre-cues. The orienting effect is calculated by subtracting the mean RT of the spatial cue from the mean RT of central cue condition. While the center and spatial cues serve as alerting cues, only the spatial cue gives predictive spatial information prompting subjects to start orienting their attention to the appropriate location before the target appears. The center cue, like the single cue, serves as a control because it prompts attention orienting to one location. Lastly, CONFLICT EFFECT is made up of processes involved when an individual carries out goal-directed behaviors, and is also related to one's ability to overcome distracting stimuli. Executive control is often studied using tasks involving conflict, which is introduced by incongruent flankers producing interference. The conflict effect is calculated by subtracting the mean RT of the congruent conditions from the mean RT of incongruent conditions, across cue types. Lower efficiency scores reflect higher network efficiency because they represent a small increase in reaction time when conditions become more difficult. In addition to accuracy and RT scores, INVERSE EFFICIENCY (IE) was also calculated. IE scores are used to analyze both accuracy and RT together, without including speed–accuracy tradeoffs; as such, they provide us with a better understanding of processing efficiency (Townsend & Ashby, 1978). This is calculated using the mean reaction times on accurate trials divided by the proportion of accurate responses. A higher inverse efficiency score represents worse performance.

Results

Basic demographics and results on background measures

Socioeconomic status

The average monthly household income in the Malay sample was approximately at "level 3", which is between S$3,000 and less than S$6000. The majority of the Malay sample ($n = 28$ out of 34) fell below the median household income in Singapore (S$7,570 in 2012) (Department of Statistics, 2013). As for parental occupation, for mothers, half the sample ($n = 17$) were housewives, while the majority (both parents) were blue-collar workers (e.g., technicians and service-industry–related workers). Table 1 summarizes sociodemographics for the Malay sample in comparison with previously studied Chinese sample.

Figure 1 presents the distribution of father's and mother's highest educational attainment in the Malay sample.

The standardized KBIT scores for the Malay children had an average of 104.1 ($SD = 11.4$, range = 77–126), suggesting that this sample fell within the average non-verbal intelligence for their age.[3] Standardized English vocabulary scores (as measured by the PPVT) did not significantly differentiate the low SES Malay sample from the high SES Chinese previous studied – with the Malays scoring an average of 92.12 ($SD = 11.66$, range = 67–116) and the Chinese scoring an average of 93.86 ($SD = 13.53$, range = 71–131).

Nature of bilingualism

Out of 34 parents, 17 were contactable via the phone for this interview.[4] On the basis of the caregiver reports, the 17 children's English and Malay estimated proficiency in listening comprehension, oral production, and overall proficiency was evaluated. The ratio of the 17 children's overall exposure and overall use of English to Malay revealed that the children were not only exposed to both languages on a daily basis, but were also using both languages in their daily communications. Out of 17, nine were classified as "balanced bilinguals",[5] while the remaining eight were classified as either dominant or slightly dominant in English or Malay – two dominant in Malay, two slightly dominant in English, and four

[3] In the Bialystok & Barac (2012) paper, children in that study ($M = 98$ months, $SD = 6.6$) took the matrices subset of the KBIT–2 and scored an average of 104.3 ($SD = 15.3$).

[4] We have reason to believe that this sub-sample of 17 is representative of the entire sample of 34, due to the following reasons. First, the missing data from the other half of the sample were mainly due to parents who left their e-mail addresses (instead of contact numbers) on the consent forms. We tried e-mailing these parents, but received no replies. Additionally, though we managed to contact some parents, they did not have enough credit on their cell phones, or were unwilling/could not afford to spend time and effort to sit through a 45–60-minute telephone interview. Finally, *t*-tests conducted revealed no significant differences between the two groups (contactable via phone vs. missing data) in terms of age, gender, SES variables (Fed, Med, Y), and critically, English vocabulary scores.

[5] A bilingual may use both languages daily but have greater mastery of, or feel more comfortable with, using one of their languages. On the other hand, a balanced bilingual may have equal command in both languages but may not use both languages daily (Gathercole, Thomas, Jones, Guasch, Young & Hughes, 2010). Thus, we should not confuse balanced bilingualism with daily use and/or exposure of both languages.

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Table 1. *Summary of SES demographics of Malay and Chinese (Kang, 2009) samples.*

	Malay ($n = 34$) (SD)	Chinese ($n = 49$) (SD)
Age (in months)	67.21 (9.34)	69.33 (4.80)
Male-to-female ratio (M:F)	15:19	26:23
Father's highest educational attainment (Fed) (scale of 1–5)	3.03 (0.97)	3.18 (1.18)
Mother's highest educational attainment (Med) (scale of 1–5)	2.94 (1.04)	3.16 (1.11)
Average monthly household income (scale of 1–5)	2.85 (1.04)	3.43 (1.04)

Educational attainment scale: 1 = None/Primary, 2 = Secondary/Pre-university, 3 = Vocational/Technical, 4 = Tertiary/University, 5 = Postgraduate.
Average monthly household income scale: 1 = less than S\$1000, 2 = S\$1000 – less than S\$3000, 3 = S\$3000 – less than \$6000, 4 = S\$6000 – less than S\$9000, 5 = more than S\$9000 per month.

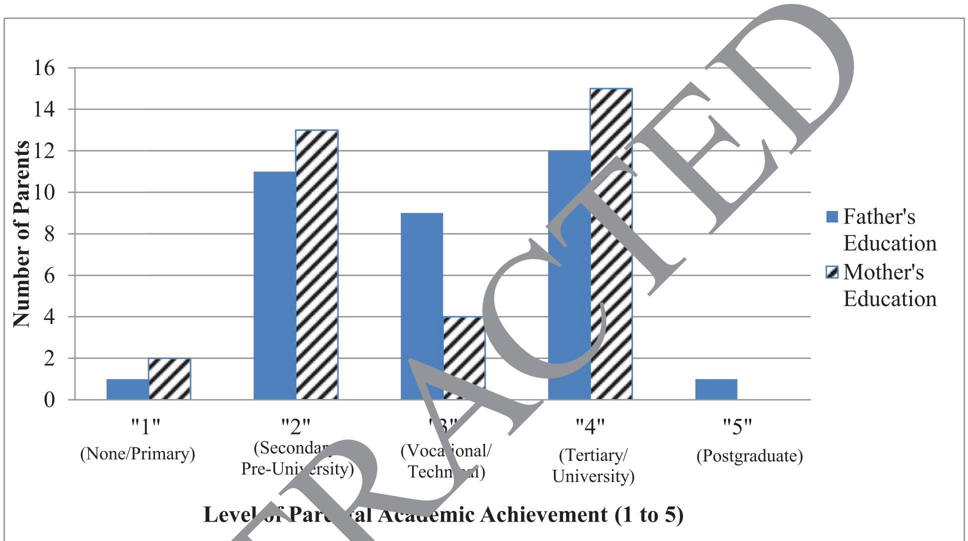

Figure 1. (Colour online) Highest academic achievement for both parents in the Malay sample.

dominant in English. All 17 children were exposed to both languages before four years of age, matching Patterson's (2002) definition of simultaneous bilinguals (i.e., children exposed to two languages during infancy and early childhood). Hence, by this definition, we can classify our Malay sample as simultaneous bilingual learners.

All 17 children were exposed to and used both languages on a daily basis, and a majority of them were exposed to both languages since infancy. The caregivers of these 17 children mentioned that it was important for their child to be bilingual and were all actively involved in teaching the child both languages. This was through reading books in English, Malay, or both languages on a daily basis, or a few times each week. Hence, their literacy practices at home confirm that this sample consists of active bilingual learners. Additionally, reports on the code-switching tendencies of the 17 children revealed that all of them code-switched/code-mixed frequently either between or within sentences, or both. In a multicultural and multilingual society like Singapore, the frequency of code-switching illustrates the "high degree of linguistic heterogeneity in Singapore" (Leimgruber, 2013, p. 70).

Hence, background results revealed that our Malay sample was highly bilingual, while low on several SES measures. Through the Child Multilingualism Questionnaire (CMQ), our Malay sample can also be characterized as active bilingual learners.

Child-ANT results

Table 2 summarizes results from the ANT task on the Malay children and compares them to previous study of a Chinese sample (Kang, 2009). As highlighted earlier, lower scores on the 3 networks and the inverse efficiency score represent higher efficiency. Independent *t*-tests revealed no significant differences on the child-ANT performance of the Malay and Chinese samples. In fact, the Malay sample had slightly higher overall accuracy, and had higher efficiency on the orienting network and the inverse efficiency score.

Apart from these components, cue (no cue, center, double, spatial) and flanker (neutral, congruent, incongruent) effects were analyzed separately in terms of percentage accuracy and RT (ms). These results

Table 2. *Mean scores and standard deviations on components of the child-ANT.*

Variable	English–Malay (n = 34) Mean (*SD*)	English–Chinese (n = 49) (Kang, 2009) Mean (*SD*)
Child-ANT overall accuracy	94.85 (3.3)	93.14 (6.5)
Child-ANT mean reaction time (ms)	1072 (160)	1026 (182)
Alerting (ms)	36.71 (63.0)	64.57 (81.9)
Orienting (ms)	10.35 (63.4)	39.4 (69.5)
Conflict (ms)	99.71 (83.6)	85.7 (81.7)
Inverse efficiency	12.68 (3.1)	14.0 (3.9)

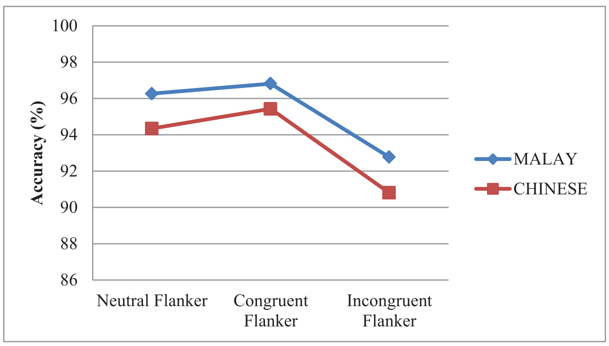

Figure 2. (Colour online) Flanker effects across Malay & Chinese groups (accuracy).

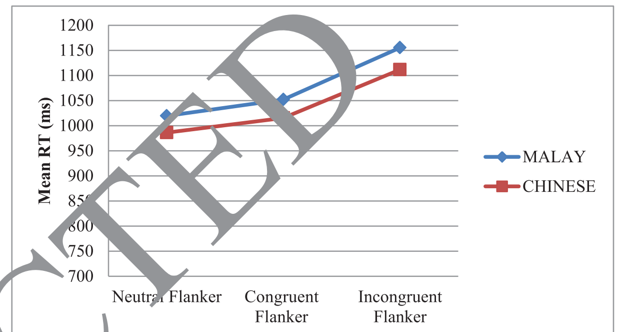

Figure 4. (Colour online) Flanker effects across Malay & Chinese groups (mean RT).

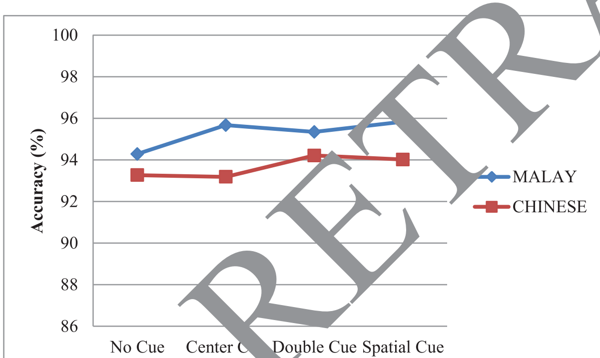

Figure 3. (Colour online) Cue effects across Malay & Chinese groups (accuracy).

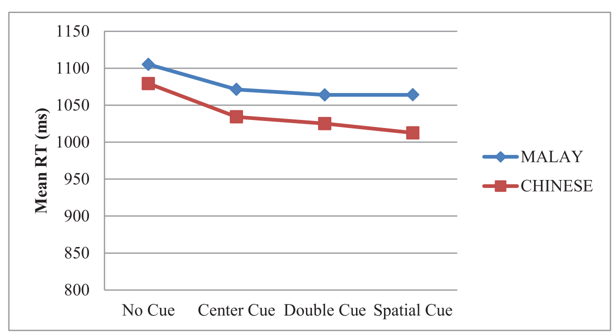

Figure 5. (Colour online) Cue effects across Malay & Chinese groups (mean RT).

are summarized in Figures 2 and 3. A more detailed table with the descriptive statistics can be found in the Appendix C (Table C1). Figure 2 shows that across all flanker conditions (neutral, congruent and incongruent), the Malays did not differ significantly from the Chinese bilinguals, although they had had slightly higher accuracy.

Figure 3 shows that Malays had slightly higher accuracy (compared to the Chinese) across all cue conditions – no cue, center cue, double cue and spatial cue, but this difference was not significant. In both center and spatial cue conditions, the Malays showed higher accuracy compared to the Chinese. Specifically, the Malay participants' higher accuracy on the spatial cue condition implied that they were better able to utilize the spatial cues to facilitate their performance (in terms of accuracy) on those trials.

As for mean RT, Figures 4 and 5 revealed that the Malay sample was slightly slower than the Chinese across all flanker and cue conditions, although this difference was not significant.

Summarizing results from Figures 2–5, we conclude that the Malays did not differ significantly from the high-SES Chinese sample, although they took a slightly longer time to produce more accurate responses on these trials.

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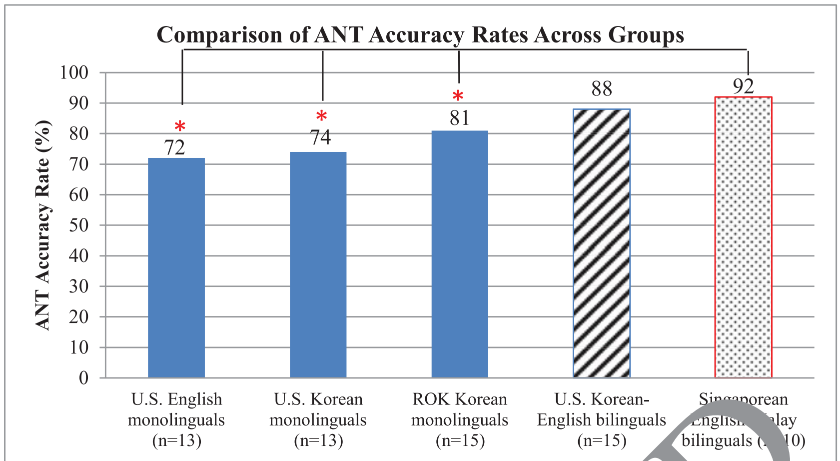

Figure 6. (Colour online) Comparison of overall ANT accuracy scores across monolingual and bilingual groups for the youngest sub-set of the present sample.

Based on our classification of the Malay sample as either balanced or dominant bilinguals, comparisons were made between these two groups. Out of the 17 children, nine were classified as balanced bilinguals while eight were dominant in either English or Malay. Although the father's education (Fed) for the dominant bilinguals ($M = 3.88$, $SD = 0.84$) was significantly higher than that for the balanced bilinguals ($M = 2.9$[illegible], $SD = 0.78$); $t(15) = 2.52$, $p = .02$, $d = 1.22$, both groups (balanced and dominant bilinguals) did not significantly differ on any of the components of the child-ANT (i.e., accuracy, mean RT, three network efficiency scores and inverse efficiency score). Analysis of data in this subset Malay sample suggests that level of bilingualism did not significantly influence executive attention performance on the child-ANT. A more detailed summary of both group's performance on the child-ANT can be found in Table C2 in Appendix C.

Comparisons of Malay child-ANT across other monolingual/bilingual populations

To investigate how the Singaporean English–Malay bilingual sample fared (on ANT accuracy) compared to other age-matched groups of Asian and American four-year-old monolinguals and bilinguals, the overall ANT accuracy scores of a subset of the youngest children in this sample ($n = 10$) were compared against the age-matched sample in Yang et al.'s (2011) study, where the child-ANT was also employed to measure executive attention in Korean–English bilinguals. In Yang et al.'s (2011) study, SES was controlled using proxy measures like parental education level and middle-class neighborhoods. The three groups of children recruited from the U.S. (Korean–English, English, and Korean) were born in the U.S. and recruited from nursery schools in the middle-class urban areas in New York and New Jersey. The other group of Korean children was recruited from a middle-class urban neighborhood in Chonju, Korea. All parents were college-educated. Table C3 (Appendix C) summarizes the participants' descriptions from Yang et al.'s (2011) study and the youngest subset of participants from this study.

Independent samples *t*-tests revealed that the English–Malay bilinguals scored significantly higher on the overall ANT accuracy, compared to all three groups of monolinguals – U.S. English monolinguals ($d = 1.98$), U.S. Korean monolinguals ($d = 2.06$), and Republic of Korea (ROK) monolinguals ($d = 1.09$); all $ps < .05$. Figure 6 summarizes these comparisons.

Although the English–Malay bilinguals did not score significantly higher than the Korean–English bilinguals $p > .05$, the Cohen's *d* was 0.66 (i.e., large effect size). Based on background information provided in Yang et al.'s (2011) study, although our English–Malay bilinguals were comparatively lower on SES (in terms of parental education), they still outperformed their age counterparts in that study. Overall, the low SES English–Malay bilinguals significantly outperformed the monolinguals in Yang et al.'s (2011) on the child-ANT, while not displaying significant differences on child-ANT performance from the Korean–English bilinguals in the same study.

Correlational and regression analyses across child-ANT and SES measures

In our Malay sample, correlational analyses revealed that none of three SES measures – father's education (Fed), mother's education (Med), income (Y) – were significantly correlated with any of the ANT scores (overall accuracy, mean RT, three network efficiency

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Table 3. *Linear regression model with child-ANT overall accuracy as outcome variable.*

	Model 1 (standardized coefficients and *SE*s)	Model 2 (standardized coefficients and *SE*s)	Model 3 (standardized coefficients and *SE*s)
Intercept	93.79 (2.26)	77.82 (4.91)	64.74 (9.09)
Income (Y)	0.41 (0.84)	0.31 (0.72)	0.11 (0.80)
Mother's education (Med)	−0.46 (0.77)	−0.35 (0.66)	−0.33 (0.65)
Father's education (Fed)	0.09 (0.69)	0.11 (0.58)	0.19 (0.58)
Age	–	0.52** (0.07)	0.61 (0.07)
PPVT (standardized)	–	–	0.24 (0.05)
KBIT (standardized)	–	–	0.19 (0.04)

**Significant at .01 level (two-tailed).

Table 4. *Linear regression model with child-ANT Inverse Efficiency as outcome variable.*

	Model 1 (standardized coefficients and *SE*s)	Model 2 (standardized coefficients and *SE*s)	Model 3 (standardized coefficients and *SE*s)
Intercept	93.79 (2.26)	77.82 (4.90)	64.74 (8.09)
Income (Y)	0.41 (0.84)	0.31 (0.72)	0.11 (0.80)
Mother's education (Med)	−0.46 (0.77)	−0.35 (0.66)	−0.33 (0.65)
Father's education (Fed)	0.09 (0.68)	0.11 (0.58)	0.19 (0.58)
Age	–	0.52** (0.07)	0.61** (0.07)
PPVT (standardized)	–	–	0.19 (0.04)
KBIT (standardized)	–	–	0.24 (0.05)

**Significant at .01 level (two-tailed).

scores, inverse efficiency score); *ps* $> .05$. Similarly, nonverbal intelligence (KBIT) was not significantly correlated with any SES measure. At the same time, one of the SES measures (income) was highly correlated with standardized PPVT scores, $r(34) = .47, p < .01$. Table C4 (Appendix C) summarizes the full correlational analysis performed.

We next asked whether SES factors (defined by the three variables) were individually predictive of our outcomes of interest on components of the child-ANT. To answer this question, we conducted the following regression analyses. First, we estimated a linear regression model predicting overall ANT accuracy results from three SES variables – father's and mother's education, and income. Age, PPVT and KBIT scores were also included in the model in order to assess possible independent effects of either English vocabulary or general intelligence on executive attention development in this sample.

As Table 3 suggests, individual predictors of SES did not contribute significantly to overall accuracy score on the child-ANT in Model 1. Even when all 3 SES variables were considered as a whole in the Model 1, the effect of SES on overall accuracy was also insignificant, with an overall R^2 value of .13 ($SE = 3.18$), $p > .05$. Then, an additional predictor (i.e., age) was added to Model 1 and the R^2 value increased to .31 ($SE = 2.71$), $p = .001$. Finally, in Model 3, standardized KBIT and PPVT scores were added to Model 2, and the R^2 value was .47 ($SE = 2.61$), $p > .05$. In sum, age was the only significant predictor of overall accuracy on the child-ANT. Neither the three SES variables nor English vocabulary OR non-verbal intelligence significantly predicted overall accuracy on the child-ANT.

Next, we estimated a linear regression model predicting inverse efficiency score from the three SES variables – father's and mother's education, and income, as well as age and standardized PPVT and KBIT scores. Inverse efficiency scores were used instead of mean RT, because they analyze both accuracy and RT together, without including speed–accuracy tradeoffs; thereby providing a better understanding of processing efficiency (Townsend et al., 1978). As Table 4 suggests, again, individual predictors of SES did not contribute significantly to inverse efficiency on the child-ANT in Model 1. Even when all 3 SES variables were considered as a whole in the Model 1, the effect of SES on overall accuracy was also insignificant, with an overall R^2 value of .12 ($SE = 3.03$), $p > .05$. Then, age was added to Model 1 and the R^2 value increased to .51 ($SE = 2.31$), $p = .000$. Finally, in Model 3, standardized KBIT and PPVT scores were added to Model 2, and the R^2 value was .54 ($SE = 2.31$), $p > .05$. In sum, both regression models revealed that while age was a significant predictor of executive attention performance on the child-ANT, SES (as measured by parental education and income) did not significantly predict executive attention performance. Additionally, English vocabulary and non-verbal intelligence also did not significantly predict executive attention performance (as measured by overall accuracy and inverse efficiency).

Summary of results

Despite being classified as low SES by Singapore's standards, results revealed that the Malay sample's executive attention performance on the child-ANT remained high when compared to other populations of monolinguals and bilinguals. Although they had significantly lower average monthly household income than the Chinese sample in Singapore (Kang, 2009), the Malay sample did not significantly differ from the Chinese sample on any of the child-ANT components. Despite being low SES, there was no diminished executive attention performance by the Malay children on the child-ANT, as revealed when comparing their child-ANT results with other groups of monolinguals and bilinguals from previous studies (Kang, 2009; Yang et al., 2011).

In correlational analyses performed to explore the relationship between the SES measures, child-ANT components, PPVT and KBIT scores, none of the SES measures significantly correlated with any of the child-ANT scores. Within the Malay sample, higher SES in terms of father's, mother's education and income, did not correlate with better performance on the child-ANT. Similarly, regression analyses performed with overall ANT accuracy and inverse efficiency scores as outcome variables in two regression models revealed that the three SES variables combined – father's and mother's education, and income – did not significantly predict executive attention performance on accuracy and inverse efficiency. For our Malay sample, English vocabulary (PPVT) and nonverbal intelligence (KBIT) were also not significant predictors of executive attention performance, although income did predict English vocabulary performance on the PPVT. Only age was a significant predictor of executive attention performance.

Discussion

The results of this study document that low SES need not diminish high executive attention performance in a bilingual population. Only age was a significant predictor of executive attention performance, consistent with the developmental literature on executive attention (Rueda, Rothbart, McCandliss, Saccomanno & Posner, 2005). The high executive attention performance on the child-ANT despite the low SES characteristics of this Malay population leads us to inquire as to what factors in the Singapore Malay context may act to override potential diminishment effects that are often expected to cohere with low SES (Ardila et al., 2005; Hughes & Ensor, 2005; Lipina et al., 2005; Noble et al., 2005, 2007).

The prolific productive inclusive ambience of bilingualism in this culture would surely be expected to advantage any positive effects of bilingualism. Community-level influences in language attitudes may have worked to ameliorate the negative effects of SES on cognitive development. Ideals of society may be associated with achievement outcomes even after controlling for individual-level income and education. In Singapore's case, there are strong communities that believe in reading to their children, and doing so in both languages. The generally high literacy rates in the Singapore culture at large, as well as the documented reading of both Malay and English materials to children in the Malay families may be another advancing factor. In addition, properties of the child's bilingualism, including simultaneity of acquisition and daily use across contexts, including constant code switching, may also be enhancing the executive attention advantage. For example, recent studies have suggested a possible relationship between code-switching in language and task-switching in general in cognition (Abutalebi & Green, 2008; Yim & Bialystok, 2012). One's ability to code-switch may be a critical tool in this multilingual context, and has been found to be prevalent even in young children's developing language (Foley, 1998). Future work is currently in progress to examine the relationship between frequency and types of code-switching on executive attention.

In conclusion, our results suggest that SES must be viewed as non-homogenous and culturally sensitive and differentiated. SES operates at multiple levels (Bradley & Corwyn, 2002) and may be modulated by culture (Bradley, 1994; Bronfenbrenner, 1999. For example, family income does not necessarily correlate with level of education (Ardila et al., 2005). Although Malay participants had below-median monthly income, parental education was not all in the low range, as can be seen in Figure 1 above. The distribution of father's and mother's education in the Malay sample highlights that not all parents in this low SES sample had low educational attainment (i.e., distribution is mostly concentrated and equally distributed around levels 2–4, with very few 1s and 5s). This appeared to be the case for the analysis of parental education in the Chinese sample as well, suggesting that the relationship between SES and education in Singapore in general, may not be a direct one.

As it was practically impossible to recruit a control group of age-matched monolinguals within the same cultural setting in Singapore, this study could only make within-group bilingual comparisons of Chinese and Malay Singaporean bilinguals that differed in terms of SES and culture and comparisons to other Asian monolingual groups outside of Singapore. Therefore, it is not possible for us to argue that it is this Malay sample's proficient, productive, prolific bilingualism *per se* which is causing or supporting the high executive attention development in this sample; nor is it possible for our result to identify the precise mechanism by which bilingualism may cause such advances, issues which we must leave to future research. Future larger samples may aid in differentiating factors which may provide such mechanisms, as well as rule out continuous concern for Type II error. Thus, although our results are consistent with the view that bilingualism may compensate for the adverse effects of poverty on cognitive processes (e.g., Carlson & Meltzoff, 2008; Engel de Abreu et al., 2012), comparative studies of a within-Singapore monolingual population would advance this hypothesis.

On the other hand, this research does not rule out the possibility that advances in executive attention that may potentially be explained to a large degree by properties of the "Asian milieu", for example the self-discipline emphasized by religious practices or by parent–child rearing practices of the community (Lewis et al., 2009; Tobin et al., 1989). Related to this, our results highlight the non-homogeneous characteristics of populations in an "Asian milieu", as Singapore clearly demonstrates in its diverse ethnic and income groups. Our results suggest that Asian superiority effects extend beyond Chinese populations alone (Carlson & Meltzoff, 2008). Further research similar to the Yang et al. (2011) study may help to dissociate potential confounding effects of culture and bilingualism.

As the child-ANT is a type of computer game, it is possible that familiarity with technology may influence children's performance on this task. This familiarity, in turn, may also be related to SES, since lower income families have less access to technology in general. Thus, technology access may be a factor that interacts with SES to influence performance on computer-related tasks. Future studies using computer-related tasks should incorporate items on caregiver questionnaires to obtain information of children's familiarity with technology. Finally, as the present study only focused on the non-verbal aspect of the bilingual cognitive advantage, more work should also be conducted to examine if any differences arise in terms of bilingual children's performance on verbal and non-verbal executive function tasks. These results will be important in helping to elucidate the mechanism underlying the bilingual cognitive advantage.

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Appendix A. Family background information

This section allows us to assess the child's family background. Your response to the following is necessary and we ensure that all provided information is strictly confidential.

Child's Name: ________________ Date of Birth: ___________________

Does your child have siblings? ☐ Yes ☐ No

If yes, what is your child's birth order? ______

How many people are there in your household? (Family size) _______

<u>Father's details:</u>

Occupation type:

☐ Unemployed/Most Recent Job _______________ ☐ Media/PR ☐ MNC

☐ Uniformed Group/ Government ☐ Banking/ Finance ☐ Service ☐ Public-listed

☐ Manufacturing ☐ SME ☐ Construction Industry

☐ Others, please state: ________________________

Highest Academic Qualification:

☐ None/Primary ☐ Secondary/ Pre-University ☐ Vocational/ Technical

☐ Tertiary/ University ☐ Postgraduate

☐ Others, please describe: ________________________ ***Years of Schooling*:** ___________

<u>Mother's details:</u>

Occupation type:

☐ Unemployed/Most Recent Job _______________ ☐ Media/PR ☐ MNC

☐ Uniformed Group/ Government ☐ Banking/ Finance ☐ Service ☐ Public-listed

☐ Manufacturing ☐ SME ☐ Construction Industry

☐ Others, please state: ________________________

Highest Academic Qualification:

☐ None/Primary ☐ Secondary/ Pre-University ☐ Vocational/ Technical

☐ Tertiary/ University ☐ Postgraduate

☐ Others, please describe: ________________________ ***Years of Schooling:*** ___________

<u>Average Monthly Household Income:</u>

☐ Less than S$1000 ☐ S$1000 – less than S$3000 ☐ S$3000 – less than S$6000
☐ S$6000 – less than S$9000 ☐ S$9000 or more

On this note, we would like to stress that **all the information provided here will remain strictly confidential.** Upon the receipt of this information, we will **immediately** remove the name of the child and these papers will be coded subsequently. Only the Principal investigator will have access to this information.

Parent's Name: ____________________________

Contact Number: ___________________________

***We'd be greatly appreciative if you leave your mobile number here, so that we can give you a brief 10-minute phone interview to ask you questions about your child's language background. If you choose this phone interview, you would not be required to complete the Multilingualism Questionnaire. Thank you! ☺

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Appendix B: Child-Attentional Network Task (child-ANT; Rueda et al., 2004)

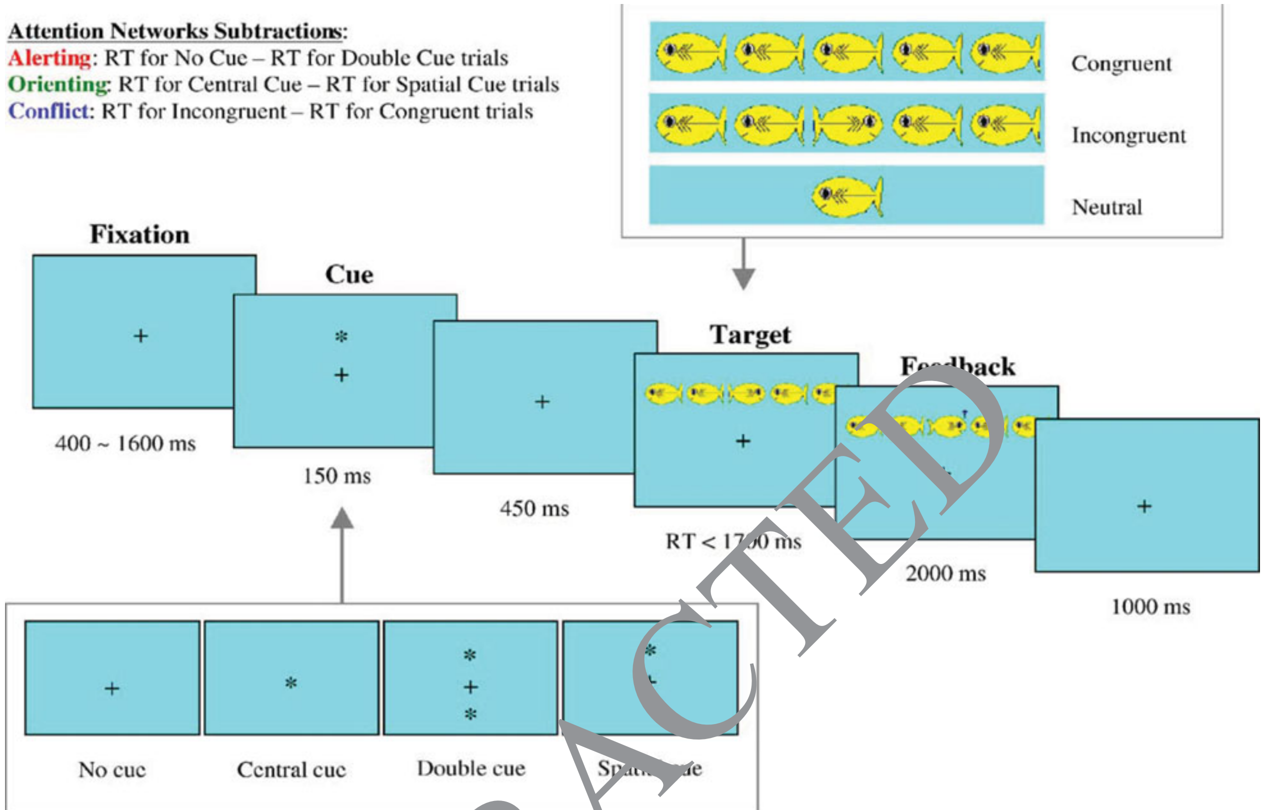

Figure B1. (Colour online) The structure of the child-ANT (Rueda et al., 2004).

Appendix C. Critical results

Table C1. *Accuracy (%) and mean reaction times (RTs), along with standard deviations in parentheses for Malay and Chinese participants separated by flanker and cue conditions.*

Accuracy (%)		Malay (*n* = 34) (SD)	Chinese (*n* = 49) (SD)
Flanker	Neutral	96.3 (3.7)	94.3 (5.3)
	Congruent	96.8 (3.2)	95.4 (5.3)
	Incongruent	92.8 (5.4)	90.8 (10.8)
Cue	No cue	94.3 (5.4)	93.3 (6.8)
	Center cue	95.7 (4.5)	93.2 (7.0)
	Double cue	95.3 (4.6)	94.2 (7.0)
	Spatial cue	95.8 (4.0)	94.0 (5.6)
Mean RT (ms)			
Flanker	Neutral	1019 (156)	986 (183)
	Congruent	1052 (168)	1015 (190)
	Incongruent	1155 (148)	1112 (176)
Cue	No cue	1105 (156)	1079 (168)
	Center cue	1071 (152)	1034 (179)
	Double cue	1064 (160)	1025 (183)
	Spatial cue	1064 (157)	1013 (209)

Table C2. *Comparison of balanced and dominant bilinguals.*

Components Components of ANT	Balanced (*n* = 9)	Dominant (English/ Malay) (*n* = 8)
Overall accuracy	95.44 (4.45)	93.88 (3.23)
Mean RT	1065 (145)	1141 (196)
AlertingZ*	−0.33 (0.50)	−0.38 (0.92)
OrientingZ*	0.22 (0.97)	0.25 (1.39)
ConflictZ*	0.33 (1.32)	−0.25 (0.71)
Inverse efficiency	12.53 (2.98)	14.35 (4.47)
Fed	2.89 (0.78)	3.88 (0.84)
Med	2.56 (1.01)	3.50 (0.93)
Y	2.67 (0.87)	3.00 (0.76)

*Standardized alerting, orienting, and conflict scores (ms) were employed. Fed = father's education; Med = mother's education; Y = income

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Table C3. *Summary of demographics of the present sample and Yang et al.'s (2011) study.*

	Background profiles			
Groups	Mean age (*SD*)	Age range (months)	Gender ratio (M:F)	PPVT raw (*SD*)
English monolinguals (N = 15)	56.0 (3.2)	49–60	8:7	79.0 (19.8)
U.S. Korean monolinguals (N = 13)	53.0 (1.8)	51–56	12:1	40.0 (13.6)
ROK Korean monolinguals (N = 13)	52.0 (3.6)	49–60	8:5	55.0 (16.9)
Korean–English bilinguals (N = 15)	57.0 (2.4)	51–60	8:7	47.0 (16.6)
English–Malay bilinguals (N = 10)	57.3 (2.4)	54–61	4:6	66.3 (15.3)

M = Male, F = Female, ROK = Republic of Korea

Table C4. *Correlation matrix.*

	Fed	Med	Y	PPVT_S	KBIT_S	ANT-Acc	Mean RT	A	O	C	IE
Fed	–	.54**	.33	−.01*($p = .054$)	−.08	−.03	.20	.11	.08	−.06	.25
Med		–	.63**	.18	.17	−.16	.23	.14	.05	.06	.24
Y			–	.47**	.22	.14	−.01	−.20	−.04	.07	−.02
PPVT_S				–	.28	.23	−.14	−.21	.06	−.10	−.09
KBIT–2					–	.07	.19	−.09	−.27	.17	−.02
ANT-Acc						–	−.34	.11	−.30	−.05	−.60**
Mean RT							–	−.18	.10	−.23	.87**
A								–	.10	−.13	−.21
O									–	.04	.27
C										–	−.27
IE											–

* Correlation significant at .05 level (2-tailed). ** Correlation significant at .01 level (two-tailed). Fed = father's education; Med = mother's education; Y = income; PPVT = Peabody Picture Vocabulary Test, PPVT_S = Peabody Picture Vocabulary Test (Standardized Scores); KBIT–2 = Kaufman Brief Intelligence Test (2nd edition); KBIT_S = Kaufman Brief Intelligence Test (2nd edition); ANT-Acc = ANT overall accuracy; Mean RT = mean reaction time; A = alerting; O = orienting; C = conflict; IE = inverse efficiency

References

Abutalebi, J., & Green, D. W. (2008). Control mechanisms in bilingual language production: Neural evidence from language switching studies. *Language and Cognitive Processes, 23,* 557–582.

Akhtar, N., & Menjivar, J. A. (2012). Cognitive and linguistic correlates of early exposure to more than one language. *Advances in Child Development and Behavior, 42,* 41–78.

Ardila, A., Rosselli, M., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental Neuropsychology, 28,* 539–560.

Association of Muslim Professionals (AMP). (2012). Demographic study on Singapore Malays. http://www.amp.org.sg/edisi/data/Publications/3rd%20Convention%20Journal/Section%209%20-%20Demographic%20Study.pdf (retrieved October 7, 2013).

Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development, 83,* 413–422.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70,* 636–644.

Bialystok, E., & Barac, R. (2012). Emerging bilingualism: Dissociating advantages for metalinguistic awareness and executive control. *Cognition, 122,* 67–73.

Bialystok, E., & Martin, M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental Science, 7,* 325–339.

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition, 112,* 494–500.

Blume, M., Yang, S., & Lust, B. (2014). Virtual Linguistics Lab Child Multilingualism Questionnaire. Ms., Cornell University.

Bokhorst-Heng, W. (1998). Language planning and management in Singapore. In J. A. Foley, T. Kandiah, Bao Zhiming,

A. F. Gupta, L. Alsagoff, Ho Chee Lick, L. Wee, I. S. Talib & W. Bokhorst-Heng (eds.), *English in new cultural contexts: Reflections from Singapore*, pp. 287–309. Oxford: Oxford University Press.

Bradley, R. H. (1994). The HOME Inventory: Review and reflections. In H. Reese (eds.), *Advances in child development and behavior*, pp. 241–288. San Diego, CA: Academic Press.

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53,* 371–399.

Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In S. L. Friedman & T. D. Wachs (eds.), *Measuring environment across the life span: Emerging methods and concepts*, pp. 3–28. Washington, DC: American Psychological Association Press.

Carlson, S., & Meltzoff, A. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11,* 282–298.

Cavallaro, F., & Serwe, S. K. (2010). Language use and language shift among Malays in Singapore. *Applied Linguistics Review, 1,* 129–170.

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition, 106,* 59–86.

Department of Statistics (2010). Census of Population 2010 Statistical Release 1: Demographic characteristics, education, language and religion. Department of Statistics, Ministry of Trade and Industry. http://internet-stg2.singstat.gov.sg/publications/publications_and_papers/cop2010/census_2010_release1/cop2010sr1.pdf (retrieved October 20, 2013).

Department of Statistics (2013). Singapore in figures. Department of Statistics, Ministry of Trade and Industry. http://internet-stg2.singstat.gov.sg/statistics/latest_data.html#16 (retrieved October 20, 2013).

Dixon, L.Q. (2003). The bilingual education policy in Singapore: Implications for second language acquisition. In J. Cohen, K. T. McAlister, K. Rolstad & J. MacSwan (eds.), *Proceedings of the 4th International Symposium on Bilingualism*, pp. 625–635. Somerville, MA: Cascadilla Press.

Dunn, L. M., Dunn, L. L., & Dunn, D. M. (2006). *Peabody Picture Vocabulary Test – Fourth Edition examiner's manual and norms booklet*. Circle Pines, MN: American Guidance Service.

Engel de Abreu, P. M. J., Cruz-Santos, A., Martin, R., & Bialystok, E. (2012). Bilingualism enriches the poor. *Psychological Science, 23,* 1364–1371.

Ensminger, M. E., & Fothergill, K. (2003). A decade of measuring SES: What it tells us and where to go from here. In M. H. Bornstein & R. H. Bradley (eds.), *Socioeconomic status, parenting, and child development* (Monographs in Parenting Series), pp. 13–27. Mahwah, NJ: Lawrence Erlbaum.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14,* 340–347.

Foley, J. A. (1998). Code-switching and learning among young children in Singapore. *International Journal of the Sociology of Language, 130,* 129–150.

Gathercole, V. C. M., Thomas, E. M., Jones, L., Guasch, N. V., Young, N., & Hughes, E. K. (2010). Cognitive effects of bilingualism: Digging deeper for the contributions of language dominance, linguistic knowledge, socio-economic status and cognitive abilities. *International Journal of Bilingual Education and Bilingualism, 13,* 617–664.

Hilchey, M. D., & Klein, R. M. (2011). Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin Review, 18,* 625–658.

Hughes, C., & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: A family affair? *Developmental Neuropsychology, 28,* 645–668.

Kang, C. K. (2009). Tracing the etiology of discrepancies: When socioeconomic and literacy effects are considered in the bilingual advantage of executive attention. Honors thesis, Singapore Management University.

Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman Brief Intelligence Test – Second Edition*. Circle Pines, MN: American Guidance Service, Inc.

Kovács, Á. M., & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. *Proceedings of the National Academy of Sciences, 106,* 6556–6560.

Leimgruber, J. R. E. (2013). *Singapore English: Structure, variation, and usage* (Studies in English Language). Cambridge: Cambridge University Press.

Lewis, C., Koyasu, M., Oh, S., Ogawa, A., Short, B., & Huang, Z. (2009). Culture, executive function, and social understanding. *New Directions in Child and Adolescent Development*, *123,* 69–85.

Lipina, S. J., Martelli, M. I., Vuelta, B., & Colombo, J. A. (2005). Performance on the A-not-B task of Argentinean infants from unsatisfied and satisfied basic needs homes. *Interamerican Journal of Psychology, 39,* 49–60.

Mezzacappa, E. (2004). Alerting, orienting, and executive attention: Developmental properties and sociodemographic correlates in an epidemiological sample of young, urban children. *Child Development, 75,* 1373–1386.

Mcloyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist, 53,* 185–204.

Morton, J. P., & Harper, S. N. (2007). What did Simon say? Revisiting the bilingual advantage. *Developmental Science, 10,* 719–726.

Mutalib, H. (2005). Singapore Muslims: The quest for identity in a modern city-state. *Journal of Muslim Minority Affairs, 25,* 53–72.

Mutalib, H. (2011). The Singapore minority dilemma. *Asian Survey, 51,* 1156–1171.

Noble, K. G., Norman, M. F., & Farah, M. J. (2005). The neurocognitive correlates of a socioeconomic status in kindergarten children. *Developmental Science, 8,* 74–87.

Noble, K. G., McCandliss, B. D., & Farah, M. J. (2007). Socioeconomic background predicts individual differences in neurocognitive abilities. *Developmental Science, 10,* 464–480.

Oh, S., & Lewis, C. (2008). Korean preschoolers' advanced inhibitory control and its relation to other executive skills and mental state understanding. *Child Development, 79,* 80–99.

Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology, 66,* 232–258.

Patterson, J. L. (2002). Relationships of expressive vocabulary to frequency of reading and television experience among bilingual toddlers. *Applied Psycholinguistics, 23,* 493–508.

Posner, M. I., & Fan, J. (2004). Attention as an organ system. In J. Pomerantz & Michael C. Crair (eds.), *Topics in integrative neuroscience: From cells to cognition*, pp. 31–61. Cambridge: Cambridge University Press.

Posner, M. I., & Petersen, S. E. (1990). The attention systems of the human brain. *Annual Review of Neuroscience, 13,* 25–42.

Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annual Review of Psychology, 58,* 1–23.

Rueda, M. R., Fan, J., McCandliss, B. D., Halparin, J. D., Gruber, D. B., Lercari, L. P., & Posner, M. I. (2004). Development of attentional networks in childhood. *Neuropsychologia, 42,* 1029–1040.

Rueda, M. R., Rothbart, M. K., McCandliss, B. D., Saccomanno, L., & Posner, M. I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences of the United States of America, 102,* 14931–14936.

Sabbagh, M. A., Xu, F., Carlson, S. M., Moses, L. J., & Lee, K. (2006). The development of executive functioning and theory of mind: A comparison of Chinese and U.S. preschoolers. *Psychological Science, 17,* 74–80.

Stroud, C. (2007). Multilingualism in ex-colonial countries. In P. Auer & Li Wei (eds.), *Handbook of multilingualism and multilingual communication*, 509–538. Berlin & New York: Mouton de Gruyter.

Tobin, J. J., Wu, D. Y. H., & Davidson, D. H. (1989). *Preschool in three cultures*. New Haven, CT: Yale University Press.

Townsend, J. T., & Ashby, F. G. (1978). Methods of modeling capacity in simple processing systems. In J. Castellan & F. Restle (eds.), *Cognitive theory* (vol. III), pp. 200–239. Hillsdale, NJ: Lawrence Erlbaum.

Videsott, G., Della Rosa, P. A., Wiater, W., Franceschini, R., & Abutalebi, J. (2012). How does linguistic competence enhance cognitive functions in children? A study in multilingual children with different linguistic competences. *Bilingualism: Language and Cognition, 15,* 884–895.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91,* 461–481.

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.

Yim, O., & Bialystok, E. (2012). Degree of conversational code-switching enhances verbal task switching in Cantonese–English bilinguals. *Bilingualism: Language and Cognition, 15,* 873–883.

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