The compensational effects of bilingualism on cognitive control in low-income immigrant children

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Abstract
The aim of this study was to investigate the compensational effects of bilingualism on the cognitive development of low-income de facto immigrant children. We compared the performance of 5-year-old Portuguese-Japanese bilinguals and age-matched Japanese monolinguals on measures of executive function and theory of mind. Despite their lower socioeconomic status and verbal ability, the bilingual children did not perform differently from their monolingual peers on measures of executive function. However, the monolingual children outperformed the bilingual children on measures of theory of mind. The results suggest that dual-language experiences had protective effects on the bilingual children’s executive function, but such effects did not extend to their theory of mind development.

1 Introduction
Bilingualism has been associated with cognitive advantages in executive function (EF), an umbrella term for processes involved in controlling thoughts and actions (Adesope, Lavin, Thompson, & Ungerleider, 2010). Bilinguals actively “train” their EF (a) in their infancy, by identifying and distinguishing two language systems, and (b) in later years, by selectively attending to the target language appropriate for a specific interlocutor. Bilingual advantages have further been reported for theory of mind (ToM), or ‘mind-reading’ abilities, in children (e.g. Kovacs, 2009). Advantages in EF could be mediating the positive link between bilingualism and ToM, considering that a large body of research has shown that EF plays an important role in ToM development (Devine & Hughes, 2014).

Although previous studies have mostly investigated bilingual children from higher socio-economic status (SES) backgrounds (Morton & Harper, 2007), two studies have shown that bilingual advantages in cognitive development also extend to children from low-income families. Carlson and Meltzoff (2008) reported that Spanish-English bilingual children performed similarly to English monolingual children on a battery of EF tasks, despite having lower SES and verbal ability than their monolingual peers. Engel de Abreu, Cruz-Santos, Tourinho, Martin, and Bialystok (2012) found that Portuguese-Luxembourgish bilingual children from low-income immigrant families outperformed Portuguese monolingual children from comparable low SES backgrounds on EF tasks despite displaying lower verbal scores. The findings of the above two studies are particularly striking as low SES and limited verbal ability are expected to impede healthy cognitive development (e.g. Noble, Norman, & Farah, 2005; Fuhs & Day, 2011). Engel de Abreu et al. (2012) state that bilingualism “provides the opportunity to strengthen executive control mechanisms that build a defense to counteract the negative impact of poverty on cognition” (p. 1369).

The aim of the present study was to further explore whether bilingualism has protective effects on the cognitive control of low-income immigrant children. Specifically, we investigated the EF and
ToM development of Portuguese-Japanese bilingual preschoolers from low SES immigrant families in comparison with Japanese monolinguals from middle SES backgrounds. We expected a phenomenon which Carlson and Meltzoff (2013) describe as “doing more with less” (p. 15), where regular language-switching experiences would protect cognitive control abilities in the face of poverty. Previous studies have not explored the compensational effects of bilingualism on ToM development, which like EF, is also influenced by SES and language development (e.g. Holmes, Black, & Miller, 1996; de Villiers & Pyers, 2002). As bilingualism has been linked to advanced ToM, we considered the possibility that the bilingual and monolingual children would perform similarly on ToM measures despite differences in SES.

2 Method

2.1. Participants

Seventeen Portuguese-Japanese bilingual children (M age = 65.29 months, SD age: 4.50 months, 9 male and 8 female) and 17 Japanese monolingual children (M age = 62.47 months, SD age: 4.81 months, 7 male and 10 female) participated in the present study. Fourteen of the bilingual children were second-generation immigrants of Brazilian descent, whereas three moved from Brazil to Japan before or at one year of age. The bilingual children were from lower class families, whereas their monolingual peers were from middle class families. Aside from the practical difficulty of matching the two groups in SES, we intended for the control group to reflect demographic trends in Japan where monolingual Japanese-speaking children commonly occupy middle SES households. At the time of assessment, the bilingual children were attending a preschool in Shizuoka prefecture whereas the monolingual children were attending a kindergarten in Tokyo prefecture.

2.2. Measures

The Portuguese-Japanese bilinguals were given the following 5 types of assessments: (1) a measure of non-verbal intelligence (Raven’s Colored Progressive Matrices, RCPM); (2) measures of receptive vocabulary in Japanese (Picture Vocabulary Test - Revised, PVT-R) and Portuguese (translation of Peabody Picture Vocabulary Test, PPVT); (3) a measure of syntactic ability (False Complement (FC) task,) (de Villiers & Pyers, 2002); specifically of sentential complements, which has been linked to ToM development; (4) two types of EF tasks assessing response suppression (Go/no-go task) (Noble et al., 2005) and inhibitory control (Simon task) (Martin-Rhee & Bialystok, 2008); and (5) three types of ToM tasks (verbal and non-verbal unexpected transfer tasks, and unexpected contents task). The Japanese monolinguals were administered a similar battery of assessments with the following differences: (a) they were not administered the measure of receptive vocabulary in Portuguese, and (b) they were only administered one type of ToM task, the verbal unexpected transfer task, due to time constraints.

3 Results and Discussion

Table 1 presents the descriptive statistics of scores in each task measure by language group.
The bilingual and the monolingual children did not perform differently on the measure of non-verbal intelligence (\(U = 138.00, ns\)), which suggests that any differences between the two groups in the linguistic or cognitive measures occurred independent of non-verbal intelligence. The bilingual children performed significantly worse on the Japanese vocabulary measure than the monolingual children (\(U = 0.00, p < 0.01\)). Although the Portuguese version of the PPVT is not standardized, the mean score of the bilingual children (59.16) would be equivalent to a verbal mental age between 3 years and 9 months and 3 years and 10 months in the standardized English version. The bilingual children performed significantly worse on the FC tasks than the monolingual children (\(U = 81.00, p < 0.05\)). Overall, the results suggest that the bilingual children were delayed in language development compared to their monolingual peers.

Despite their lower verbal intelligence and SES, the bilingual children did not perform differently from their monolingual peers on all measures of the EF tasks, including accuracy (\(U = 130.00, ns\)) and reaction times (\(U = 136.00, ns\)) in the Go/no-go task and accuracy (\(U = 133.00, ns\)) and reaction times (\(U = 143.00, ns\)) in the Simon task. However, the bilingual children performed significantly worse on the ToM tasks than their monolingual peers (\(U = 63.00, p < 0.01\)). This suggests that the protective
effects of bilingualism may not extend to ToM development in immigrant children in Japan, despite the commonly reported link between EF and ToM (Devine & Hughes, 2014). There was no correlation between the bilingual children’s performance on ToM tasks and EF tasks. Instead, there was a strong positive correlation between the bilingual children’s performance on FC tasks and ToM tasks \((r = 0.54, p < 0.05)\). Considering that the bilingual children scored significantly lower on the FC tasks than their monolingual peers, the bilingual children’s delay in syntactic development may have hindered their ToM development beyond the effects of healthy EF development (Pyers & Senghas, 2009). The present study contributes to the bilingual literature (a) by confirming the compensational effects of bilingualism on the EF development of children facing linguistic and economic challenges, and (b) by newly demonstrating that such protective effects may not extend to immigrant children’s ToM development in the face of language delay.

References