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Independent effects of bilingualism and socioeconomic status on language ability and executive functioning

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ABSTRACT

One hundred and seventy-five children who were 6-years old were assigned to one of four groups that differed in socioeconomic status (SES; working class or middle class) and language background (monolingual or bilingual). The children completed tests of nonverbal intelligence, language tests assessing receptive vocabulary and attention based on picture naming, and two tests of executive functioning. All children performed equivalently on the basic intelligence tests, but performance on the language and executive functioning tasks was influenced by both SES and bilingualism. Middle-class children outperformed working-class children on all measures, and bilingual children obtained lower scores than monolingual children on language tests but higher scores than monolingual children on the executive functioning tasks. There were no interactions with either group factors or task factors. Thus, each of SES and bilingualism contribute significantly and independently to children's development irrespective of the child's level on the other factor.

1. Introduction

There is great interest in understanding the environmental conditions that affect cognitive ability and the mechanisms behind their influence as a complement to more biologically-based approaches to intelligence and performance. Two experiences that have been extensively investigated in this regard are bilingualism and socioeconomic status (SES), both of which have been shown to correlate with measures of cognitive performance and language ability throughout development. Robust effects of SES have been found across cognitive skills, including language, memory, and intelligence (Bradley & Corwyn, 2002; Hoff-Ginsberg, 1991; McCall, 1981) showing a relation between higher SES and better outcomes. In contrast, the effects of bilingualism on cognitive functioning vary in their direction, with positive outcomes for cognitive measures but negative outcomes for verbal measures (Akhtar & Menjivar, 2012). However, it is possible that these experiences interact and their effect depends on a specific level of the other. Thus, it may be that bilingualism only leads to cognitive advantages for certain levels of SES, such as middle-class children, or that SES only compromises ability for certain levels of language experience, such as monolingual children. Empirically studying this question is complicated by the fact that SES and bilingualism themselves are often correlated, making it difficult isolate the effect of each on performance. However, precisely because these two experiences frequently intersect it is particularly important to distinguish between the influence of each, both practically in terms of children's development and theoretically in terms of the possible mechanism underlying each. The purpose of the present study is to examine the effects of SES and bilingualism independently to determine the role each plays on cognitive and language outcomes, the extent to which their influence on development is similar or not, and whether their combined effects are interactive or independent.

The role of SES on intellectual functioning and academic performance is well established: children growing up in

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families with more financial resources and parents who are more educated obtain higher scores on cognitive measures than do children without these advantages (Bradley & Corwyn, 2002; Brooks-Gunn & Duncan, 1997; McLoyd, 1998; Sirin, 2005). The difference in IQ scores between high and low SES groups is reported to be about one standard deviation (Bradley & Corwyn, 2002; Seifer, 2001).

Studies of SES have focused as well on specific cognitive systems, particularly language acquisition. Typically, children from low SES backgrounds have lower levels of both receptive and expressive language skills than more affluent children (Arriaga, Fenson, Cronan, & Pethick, 1998; Hart & Risley, 1995; Locke, Ginsborg & Peers, 2002; Qi, Kaiser, Milan, & Hancock, 2006). Using the Peabody Picture Vocabulary Test (PPVT), the difference in score for children in medium vs. low SES groups is 0.75 to 1 standard deviation (Noble, Norman, & Farah, 2005; Qi et al., 2006). These differences are more evident in complex language tasks, such as Clinical Evaluation of Language Fundamentals Assessment-Preschool (CELF-P; Semel, Wiig, & Secord, 2003). In a sample of low SES preschoolers, Locke, Ginsborg, and Peers (2002) reported that more than half the children met criteria for diagnosis of at least moderate language impairment by scoring 1 standard deviation or more below the population mean. These findings are consistent with research showing differences not only in the level but also the trajectory and rate of vocabulary growth as a function of SES (Arriaga et al., 1998; Dollaghan et al., 1999; Hart & Risley, 1995; Rescorla & Alley, 2001).

SES has also been shown to influence the development of executive functioning (EF), a relation that Noble et al. (2005) argued could be central in explaining SES effects on IQ and achievement. Supporting this view, components of EF (planning, monitoring, switching) have been theoretically and empirically linked to general intelligence (Gray & Thompson, 2004; Kail, 2000; Kyllonen, 2002). For example, Carpenter, Just, and Shell (1990) derived a model for general intelligence through simulation studies heavily dependent on the working memory component of EF. In contrast, highly automatized tasks that are not part of overall assessments of intelligence do not require EF because they are driven by environmental cues and are ultimately run by 'plans and programs' already in long term memory (Miller & Cohen, 2001; Rabbitt, 1997; Shiffrin & Schneider, 1977). Thus, effects of SES are particularly apparent for asks that engage the EF system.

Disparities in EF for children at different SES levels have been reported even in infancy. Lipina, Martelli, Vuelta, and Colombo (2005) evaluated the performance of 280 infants (6- to 14-months old) in the A not B task (Diamond, 1985) and found that infants from families with the lowest SES made more errors than their higher SES peers. Ardila, Rosselli, Matute, and Guajardo (2005) administered a battery of EF tests to 622 children ranging in age from 5- to 14-years old who differed in SES as measured by parents' education. Higher SES children performed better overall, and parental education was a significant predictor of performance for the majority of EF measures in the battery. Finally, Noble and colleagues (Noble et al., 2005) showed that language and EF were the two neurocognitive systems most affected by SES. In two follow-up studies aimed at uncovering more precise relations (Farah et al., 2006; Noble, McCandliss, & Farah, 2007), they examined the relation between SES and working memory, cognitive control, and reward processing. Significant SES differences were found for working memory and cognitive control measures, both aspects of EF, with no difference in reward processing.

A parallel body of research has examined the effects of bilingualism on children's language and EF abilities. Two aspects of language ability in children that have been extensively studied in bilinguals and monolinguals are vocabulary and metalinguistic skills. Bilingual children typically obtain lower scores than monolinguals on measures of both receptive (Bialystok, Luk, Peets, & Yang, 2010) and productive (Oller & Eilers, 2002) vocabulary. In the studies by Oller and colleagues of Spanish–English bilingual children, lower vocabulary scores were found in both English and Spanish assessments (Fernández, Pearson, Umbel, Oller, & Molinet-Molina, 1992; Oller, Pearson, & Cobo-Lewis, 2007), were independent of the level of usage of each language (Oller & Eilers, 2002), and persisted after accounting for SES (Cobo-Lewis, Pearson, Eilers, & Umbel, 2002). Using the PPVT with a heterogeneous sample of more than 1,700 bilingual children between the ages of 3- and 10-years old, Bialystok, Luk, et al. (2010) reported significantly higher scores for monolinguals at every age examined. Importantly, studies that match samples on SES replicate the vocabulary discrepancy in which monolinguals obtain higher English vocabulary scores than bilinguals (Hoff et al., 2012; Vagh, Pan, & Mancilla-Martinez, 2009).

The results for metalinguistic awareness are different: bilinguals typically show more advanced metalinguistic development than monolingual children in tasks examining the understanding of arbitrariness of linguistic labels (Bialystok, 1988; Cummins, 1978; Cummins & Mulcahy, 1978; Feldman & Shen, 1971; Ianco-Worrall, 1972) or requiring selective attention to information from form or meaning (Bialystok, 1986, 1988; Cromdal, 1999). These paradigms require EF to direct attention to the relevant feature (usually form) and ignore salient distracting information (usually meaning), implicating EF into language processing (Bialystok, 2001).

Evidence that bilingual children outperformed their monolingual peers on metalinguistic tasks that required EF led to the hypothesis that there might be a general EF advantage from bilingualism in nonverbal processing as well. Numerous studies have now supported this idea (see Akhtar & Menjivar, 2012 for review). Beginning again with infants, Kovács and Mehler (2009) compared 7-month-old infants being raised in homes that were monolingual or bilingual on an A-not-B type task in which they had to learn a new response to obtain the reward. Infants from bilingual homes were significantly more successful in learning the new response than were those exposed to only one language, suggesting that the basis for EF differences is established in the first few months of life. Research with preschool and early school-aged children has shown better performance by bilinguals on a Simon task (Martin-Rhee & Bialystok, 2008), flanker task (Yang, Yang, & Lust, 2011), Stroop task (Poulin-Dubois, Blaye, Coutya, & Bialystok, 2011), and the dimensional change card sort