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Brief article

Emerging bilingualism: Dissociating advantages for metalinguistic awareness and executive control

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ABSTRACT

The present studies revealed different factors associated with the reported advantages found in fully bilingual children for metalinguistic awareness and executive control. Participants were 100 children in Study 1 and 80 children in Study 2 in the process of becoming bilingual by attending immersion programs. In both studies, *level of proficiency* in the language of testing was related to performance on metalinguistic tasks and *length of time* in the immersion program was related to performance on executive control tasks. This dissociation is consistent with models of lifespan development that distinguish between representational structure and executive control.

1. Introduction

Children who are raised with two languages show advantages over monolingual peers in two domains – metalinguistic awareness (Ben-Zeev, 1977; Cummins, 1978; Galambos & Goldin-Meadow, 1990; Galambos & Hakuta, 1988; Ricciardelli, 1992) and nonverbal executive control (Bialystok & Martin, 2004; Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Mezzacappa, 2004; Yang, Yang, & Lust, 2011). The children in these studies have typically been bilingual from birth, so this research has been unable to determine the point at which developmental patterns diverge for monolingual and bilingual children or which features of the bilingual experience are responsible for the reported effects. The outcomes may depend on the achievement of adequate linguistic proficiency or a particular duration for bilingual experience, factors that would lead to different interpretations of the *mechanism* by which bilingualism affects cognition. In fully bilingual children, these factors are confounded. Here, we examine children who are in the process of becoming bilingual to evaluate these factors separately.

Not all children have the opportunity to learn two languages from home. In immersion education, school instruction takes place in a language different from that normally used in the home, creating a controlled setting in which to study the emergence of bilingualism. These programs develop skill in a second language with no cost to the child's first language (Genesee, 1987). Hence, we assessed children in two different immersion programs in Canada for their development of metalinguistic awareness and executive control to determine the features of the bilingual experience that contribute to performance in each domain as children become bilingual.

2. Study 1

The children attended a school in which Hebrew is the language of instruction. Children varied in home language background, language proficiency, and length of time spent in this immersion environment.

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2.1. Method

2.1.1. Participants

Participants were 100 children in Grades 2 and 3. Children can enter the program at any time so participants differ in their competence in each language and experience in this environment. For 65 children, English was the exclusive or predominant language of the home; the remaining children spoke primarily Hebrew or Russian at home. All testing was conducted in English with the exception of Hebrew vocabulary.

2.1.2. Tasks

2.1.2.1. Background measures. Parents completed a questionnaire in which they rated the use of English and Hebrew in 23 situations on a 4-point scale in which 0 indicated that language was never used and 3 indicated that language was always used, to a maximum of 69. Receptive vocabulary in English was measured with the Peabody Picture Vocabulary Test (PPVT-III, Dunn & Dunn, 1997, Version A), and Hebrew vocabulary was measured using a Hebrew translation of this test (PPVT-III, Version B). In this test children select a picture from four options to match a word given by the experimenter. The English test is standardized with a mean score of 100 and standard deviation of 15, although the Hebrew translation was not standardized. Non-verbal intelligence was assessed by the matrices subtest of the KBIT-2 (Kaufman & Kaufman, 2004). The test consists of 46 items divided into three sections of increasing difficulty. On each trial, the child was presented with visual stimuli representing either drawings of concrete objects or abstract figures. In the first part of the test the child saw one target drawing at the centre of the page with five drawings below it and was asked to identify the option that matched the target image. In the other two sections the child saw an incomplete matrix of visual stimuli with one stimulus missing, and five options below the display. The task was to choose the stimulus to complete the displayed pattern.

2.1.2.2. Metalinguistic task. In the Wug task (Berko, 1958) children are shown cartoon-like images and given a sentence containing a nonsense word which must be manipulated to conform to morphological rules of English. This test assesses children's ability to apply morphological rules of English to unfamiliar forms, therefore reflecting metalinguistic awareness. The items assess morphological agreement for number, 3rd person singular, past tense, comparative/superlative, present progressive and possessive. The maximum score is 33.

2.1.2.3. Nonverbal executive control tasks. The first task was a flanker task (Eriksen & Eriksen, 1974) in which black arrows pointing left or right appeared in the center of the screen. Children indicated the direction of the middle arrow by pressing a mouse on the left or right side of the display. There were two control blocks of 24 trials each in which a single arrow appeared in the centre of the screen and 1 conflict block of 48 trials consisting of 24 congruent and 24 incongruent trials in which the central arrow was flanked by four distractors. Each block was preceded by practice with feedback. Trials began with a fixation cross for 250 ms, followed by the stimulus for 2000 ms or until the child made a response.

The second task was a test of task switching.[1] A blue horse and a red cow appeared on the top of the screen, and on each trial, a red horse or blue cow was presented on the bottom center with a visual cue indicating whether it was to be matched by color or shape to the targets. Children responded by touching the correct picture. There were 200 trials across 2 non-switch blocks (25 trials each) and 3 switch blocks (50 trials each). The stimulus remained on the screen until the child made a response, and the next trial started after 1000 ms.

Global switch cost was calculated as the difference between mean reaction time (RT) of non-switch trials in the switch and non-switch blocks. Local switch cost was calculated as the difference between mean RT of non-switch and switch trials in the switch blocks (Cepeda, Kramer, & de Sather, 2001). Global costs reflect the ability to maintain task sets and show a U-shaped trajectory across lifespan, indicating changes in executive control. In contrast, local switch costs measure changes in specific stimulus–response associations and remain relatively stable across time (Reimers & Maylor, 2005). Because global switch costs index executive control, bilingualism should be associated with smaller global costs but not local costs, as found by Costa, Hernández, and Sebastián-Gallés (2008).

Table 1
Descriptive statistics for background measures in Study 1[a].

Variable	*N*	Mean	SD
Age in months	100	98	6.6
PPVT English (Standard)	100	103.1	13.4
PPVT Hebrew	90	48.0	10.1
Balance ratio	89	0.47	0.13
K-BIT (Standard)	98	104.3	15.3
Home English[b]	83	62.5	12.0
Home Hebrew[b]	83	8.1	13.4
Years in day school	83	4.7	1.3

[a] Some children did not complete all tasks and 17 parents did not complete the language background questionnaire.
[b] Home English and Home Hebrew are scores out of 69 indicating the extent to which that language is used in the child's environment.

2.2. Results and discussion

Results for the background measures are reported in Table 1. There was a negative correlation between home usage scores for English and Hebrew, $r\,(83) = -0.71$, $p < .001$, indicating a distinction between home language environments. Home use of each language correlated with PPVT score in that language (English, $r\,(83) = 0.42$, $p < .001$; Hebrew, $r\,(83) = 0.53$, $p < .001$), with no correlation across languages, $r\,(90) = -0.05$, n.s. Surprisingly, there was no correlation between Hebrew PPVT and the number of years in day school, $r\,(86) = 0.20$, n.s., possibly because some children acquired Hebrew at home irrespective of how long they have spent in the program. Degree of balanced

[1] This task was programmed by Dr. Nicholas Cepeda.