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Research Timeline

Cognitive development of bilingual children

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There has always been a common-sense view that the number of languages that children learn, whether through natural exposure or educational intervention, has consequences for their development. The assumption was that these consequences were potentially damaging. Even now, after approximately 50 years of research on the topic, parents remain concerned about their children's development when it includes a bilingual experience. It is now clear that although parents were correct that speaking more than one language has consequences, the assumption about the nature of these consequences is not: the outcome of the experience is in fact the opposite of what many early researchers claimed and what many contemporary parents intuitively believe. In contrast to early warnings about negative consequences, bilingualism turns out to be an experience that BENEFITS many aspects of children's development. Although there are documented delays in acquiring some formal aspects of each language, such as vocabulary (Bialystok 2010), bilingualism has either no effect (intelligence) or positive effects (metalinguistic awareness, cognitive development) on development.

There are many reasons why the early research was consistent in its negative conclusions, but two of them are (a) the way in which the question was formulated and (b) the methodology used to conduct the research. Regarding the first, the early research focused primarily on intelligence as defined by standardized test scores. It is not at all clear what is measured by such tests, but we do know that IQ scores are strongly influenced by such factors as socioeconomic status (SES). Furthermore, IQ is a conglomerate measure that tells us little about specific aspects of intellectual functioning. In this sense, there is no compelling reason to expect that bilingualism *per se*, or at least bilingualism on its own, would influence IQ score outcomes. In the early studies, bilingual children actually scored lower than monolinguals on these tests, but it soon became apparent that the problem was in the second factor mentioned above, namely, methodology. In most studies, bilingual children were lower SES than monolinguals; when subsequent studies controlled for SES, IQ differences between groups disappeared. Similarly, bilingual children often have poorer verbal skills in the language of testing than monolingual children, a factor that was not considered in comparing performance on tests that typically have a high verbal component.

The field has progressed through the examination of different domains in search of bilingual effects on development. Following the early studies on measures of standardized intelligence, during the 1970s and 1980s interest turned to language acquisition and to metalinguistic development in particular. This was a sensible place to seek evidence of bilingual effects on development, and, indeed, the studies showed almost uniformly positive outcomes for

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bilinguals. Learning two languages in childhood changed the way in which children could think about language. Such metalinguistic insights are a central component of academic success in that they are in part what schools are designed to teach. Therefore, another line of research examined the effect of bilingualism on school achievement, in particular on literacy and mathematical abilities. Along with this, research began investigating the impact of new educational programs in which a language not necessarily used in the home was the medium of school instruction. Research in immersion education began in the late 1960s, but more focused studies on literacy and mathematical abilities were more prevalent in the 1990s.

An active focus of research since 2000 has been the effect of bilingualism on cognitive ability: specifically, the set of cognitive abilities known as the executive function. These are the processes responsible for attention, selection, inhibition, shifting and flexibility that are at the centre of all higher thought. Exciting new research is now providing strong evidence that early bilingualism has the power to set in place precocious development of these crucial skills.

Our review traces the main developments in this research by focusing on its evolution from the search for effects of bilingualism on intelligence, through interest in linguistic outcomes, to school achievement and, finally, to cognitive development. In some sense, the advancement of the field depended on the two points noted above, namely, getting the question right and designing an appropriate methodology. But there may have been a third factor responsible for the dire conclusions of the early research: there may have been a pre-existing bias to believe that bilingualism was harmful for children. Throughout each of the four thematic areas examined there is early evidence for either neutral or even positive outcomes of bilingualism, but negative claims typically continue for 20 years beyond those initial findings. Thus, for example, the result reported by Darcy (1946) showing superior bilingual performance on non-verbal tasks, in conjunction with poorer performance on verbal tasks, is precisely the result found in the most current research, but the study was nonetheless used to support the view that bilingualism created a handicap for children.

The next stage in this research will be to engage in systematic studies of the consequences of bilingualism on structural and functional brain outcomes. This research is just beginning, and the next decade will take us to exciting new levels of understanding.

Our review is organized around the four major outcome variables examined in the literature we review.

A Intelligence
- A1: Verbal IQ test performance
- A2: Non-verbal IQ test performance
- A3: Creativity

B Metalinguistic awareness

C School achievement
- **C1** Literacy
- **C2** Mathematics

D Cognition
- **D1** Theory of mind (i.e., the ability to attribute mental states to other people)
- **D2** Executive functioning

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YEAR	REFERENCES	ANNOTATIONS	THEME
1923	Saer, D. J. (1923). The effect of bilingualism on intelligence. *The British Journal of Psychology* 14, 25–38.	This is one of the earliest studies claiming that speaking two languages leads to detrimental cognitive effects in children. **Saer** compared monolingual and Welsh–English bilingual children coming from rural or urban backgrounds and reported that bilingual children from rural areas obtained significantly lower scores than monolinguals on the Stanford-Binet Scale of intelligence. Later criticism pointed out that groups were not matched for age, socioeconomic status (SES) and degree of bilingualism.	**A**
1935	Manuel, H. T. (1935). A comparison of Spanish-speaking and English-speaking children in reading and arithmetic. *Journal of Applied Psychology* 19, 189–202.	**Manuel** moved from measuring IQ as in the earlier studies to focusing on school outcomes. He compared Spanish-speaking and English-speaking children (grades 2–8), who were instructed in English on reading and arithmetic tasks. The Spanish-speaking children lagged behind the English-speaking children on both arithmetic (approximately 1.5 years) and reading measures (approximately 2 years) and the gap persisted through grade 8. Additionally, Spanish-speaking children gained less between the two testing points (fall-spring) on reading measures but showed similar gains on arithmetic performance to the English-speaking children. It was argued that the results reflected discontinuous schooling of the Spanish-speaking group, creating a 'language handicap'. Again, however, the groups were not matched on SES, with the Spanish-speaking children coming from lower SES backgrounds. Nonetheless, the study was used to support the view that bilingualism interferes with children's school success.	**C**
1936	Hill, H. S. (1936). The effect of bilingualism on the measured intelligence of elementary school children of Italian parentage. *The Journal of Experimental Education* 5, 75–79.	**Hill** investigated the effect of bilingualism on intelligence by comparing monolingual and Italian–English bilingual children who were matched on age, gender, mental age and socioeconomic status. Having matched the groups more carefully, this was the first study to show that there were no differences between monolingual and bilingual children on any of the measures. Importantly, this early study showed no detriment to intelligence from bilingualism but the view that it was harmful continued for another 25 years.	**A**

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1937	Pintner, R. & S. Arsenian (1937). The relation of bilingualism to verbal intelligence and school adjustment. *Journal of Educational Research* 31, 255–263.	The researchers investigated the relationship between degree of bilingualism, verbal intelligence, and school adjustment (as measured by a questionnaire). Participants were Jewish–English bilingual children in grades 6 and 7 who were divided into two groups (high and low bilinguals) based on their scores on a questionnaire assessing the degree of bilingualism. The two groups were matched on SES. The authors found no differences between the high and low bilingual groups on any of the measures and null correlations between the degree of bilingualism and verbal intelligence scores. This study was important because it was one of the first to look more carefully at the definition of bilingualism.	**A**
1937	Arsenian, S. (1937). *Bilingualism and mental development*. New York, NY: College Press.	**Arsenian** proposed five factors to be considered when conducting bilingualism research: degree of bilingualism, degree of similarity of the two languages, age of learning, method of learning and attitude toward the L2. The author found no support for the early studies reporting negative outcomes nor was there acceleration of mental development as measured by intelligence tests. Again, the conclusion of this book was ignored.	**A**
1939–1949	Leopold, W. F. (1939–1949). *Speech development of a bilingual child: a linguist's record*. Evanston, IL: Northwestern University Press.	In this seminal four-volume work, **Leopold** followed the development of his daughter, Hildegard, who was exposed to English and German from birth in a one-parent one-language environment. Leopold noted that his daughter could tell a story in two languages, showed awareness of the two languages, and experienced minimal interference between the languages. Noteworthy is the observation that this bilingual experience had some benefits on the child's language development. For instance, Hildegard showed an early ability to separate word form from word meaning ('a noticeable looseness of the link between the phonetic word and its meaning', as Leopold wrote later in 1953[1], p. 13), and to understand the arbitrariness of linguistic labels, which was believed by Leopold to lead to more abstract forms of thinking. Although Leopold's investigation was primarily about language acquisition, he pointed to the possibility of enhanced metalinguistic awareness, providing the first link between bilingualism and cognitive systems.	**B**

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1940	Stark, W. A. (1940). The effect of bilingualism on general intelligence: An investigation carried out in certain Dublin primary schools. *British Journal of Educational Psychology* 10, 78–79.	**Stark** compared Irish–English bilinguals and English monolinguals (aged 10–12) on two measures of verbal intelligence and one individual performance test. Bilinguals outperformed monolinguals on one verbal measure, but the pattern was reversed on the other. The two language groups did not differ in their performance on the non-verbal test. The author interpreted the results as showing that learning two languages has positive consequences on cognitive development and does not bring any cost to the home language.	**A**
1946	Darcy, N. T. (1946). The effect of bilingualism upon the measurement of the intelligence of children of preschool age. *The Journal of Educational Psychology* 37, 21–44.	**Darcy** tested English monolingual and Italian–English bilingual children aged 2.5–4.5 on verbal (Revision of the Stanford-Binet Scale) and non-verbal (Atkins Object-fitting Test) tests of intelligence. Children were matched on age, socioeconomic status and gender. Results showed an interesting dissociation: bilingual children outperformed monolinguals on the non-verbal test and the monolinguals showed superior performance on the verbal test. The author concluded that bilinguals suffered from a 'language handicap' but did not discuss their superior non-verbal performance.	**A**
1953	Darcy, N. T. (1953). A review of the literature on the effects of bilingualism upon the measurement of intelligence. *Journal of Genetic Psychology* 82, 21–57.	In this extensive review, **Darcy** identified and discussed three main patterns of results found in studies examining the cognitive consequences of bilingualism: positive effects or no reliable differences (i.e. a minority of studies) and negative effects (most studies conducted until the 1950s). Darcy concluded that when intelligence testing included verbal measures, monolingual children outperformed bilinguals, but on non-verbal measures monolingual and bilingual children generally performed similarly. In a later review (Darcy 1963[2]), the author found the same general trend in performance between monolinguals and bilinguals, with bilingualism producing costs in verbal intelligence tests and no difference in non-verbal intelligence. Darcy also pointed out that some early research determined bilingualism on the basis of parents' names or country of birth. This analysis	**A**

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		clearly blamed early negative outcomes to methodological flaws and set the stage for finding cognitive benefits of bilingualism. Interestingly, Darcy's view of linguistic costs and possible cognitive benefits is the position advocated in most current research.	
1959	Kittell, J. E. (1959). Bilingualism and language: non-language intelligence scores of third grade children. *Journal of Educational Research* 52, 263–268.	**Kittell** examined monolingual and bilingual third graders' performance on the language and non-language sections of the California Test of Mental Maturity. The bilingual children formed a heterogeneous group speaking a total of fifteen non-English languages. Bilingual and monolingual children obtained similar performance on the reading tests in English and similar IQ. The author argued for the inclusion of measures other than standardized intelligence tests when comparing monolingual and bilingual children.	**A**
1959	Lewis, D. G. (1959). Bilingualism and non-verbal intelligence: A further study of test results. *British Journal of Educational Psychology* 29, 17–22.	**Lewis** compared 10-year-old monolingual and Welsh–English bilingual children on a non-verbal intelligence test to shed light on the inconsistent results reported in previous studies. This study is important because it was the first to use a language questionnaire to quantify the degree of bilingualism, but the groups were not matched on SES. The main finding was that monolinguals outperformed bilinguals on these IQ measures.	**A**
1961	Lerea, L. & S. Kohut (1961). A comparative study of monolinguals and bilinguals in a verbal task performance. *Journal of Clinical Psychology* 17, 49–52.	The aim was to investigate the performance of monolingual and bilingual children aged 9–11 on a task requiring learning Hebrew characters both visually and auditorily. Bilingual children (most of whom spoke Polish as the non-English language) were matched to monolinguals in terms of gender, age, socioeconomic status and intelligence. The bilingual children needed fewer trials to acquire the same performance as monolinguals. The authors argued for 'the presence of a learning potential among bilinguals that has yet to be recognized' (p. 52), acknowledging the possibility of broad bilingual learning advantages.	**C**
1962	Peal, E. & W. E. Lambert (1962). The relation of bilingualism to intelligence. *Psychological Monographs: General and Applied* 76, 1–23.	This is the first study to provide strong empirical evidence showing positive effects of bilingualism in children. **Peal & Lambert** compared 10-year-old monolingual and French–English bilingual children on verbal and	**A**

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		non-verbal intelligence tests. The children were matched on age, SES and gender and bilinguals were fully competent in both languages, i.e. 'balanced bilinguals'. Contrary to the findings of earlier work, bilingual children outperformed monolinguals on both verbal and non-verbal measures of intelligence. These results were used as a justification for setting up French Immersion programs in Canada where Anglophone children would be educated in French. That movement was an important link between the intellectual consequences of bilingualism (theme **A**) and outcomes in school achievement (theme **C**) and educational policy.	
1966	Macnamara, J. (1966). *Bilingualism and primary education: A study of Irish experience.* Edinburgh: The University Press.	**Macnamara** examined the impact of the program to restore Irish language in school on children's arithmetic and English attainment. Children from English-speaking homes spent about half their time in primary schooling using Irish. Macnamara reported that these children were about 17 months behind children studying in English on written English tests and behind Irish-speaking children on tests of written Irish. Similarly, teaching arithmetic in Irish was associated with 'retardation' in problem, but not in mechanical, arithmetic. The author concluded that the most 'grave' consequence of this program of Irish language restoration is the low English language attainment. These results and conclusions were opposite to those reported for French immersion in Canada (LAMBERT & MACNAMARA 1969[3]).	**C**
1969	Lambert, W. E. & J. Macnamara (1969). Some cognitive consequences of following a first-grade curriculum in a second language. *Journal of Educational Psychology* 60, 86–96.	This study examined the consequences of a French immersion program by comparing grade one children from English-speaking homes who were instructed in French to children attending English or French classes. After one year of immersion, these children showed similar mathematical performance to the other two control groups. On the language tasks, children instructed in their L2 showed rapid progress in learning French and transfer to their English skills. Unlike in previous studies, no negative consequences were found for immersion education.	**C**

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1970	Torrance, E. P., J. C. Gowan, J. M. Wu & N. C. Aliotti (1970). Creative functioning of monolingual and bilingual children in Singapore. *Journal of Educational Psychology* 61, 72–75.	**Torrance et al.** tested a large sample of monolingual and bilingual children in Singapore (grades 3–5) on a measure of creativity – the Figural Form of the Torrance Test of Creative Thinking. Monolinguals outperformed bilinguals on two measures of creativity (i.e. fluency and flexibility) but bilinguals scored higher on two other measures (elaboration and originality). This study helped to specify which aspects of intelligence might be affected by bilingualism so that future studies could be more precise.	**A**
1971	Feldman, C. & M. Shen (1971). Some language-related cognitive advantages of bilingual five-year-olds. *Journal of Genetic Psychology* 118, 235–244.	The main direction of research in the 1970s was the development of metalinguistic awareness. In this early study on the topic, five-year-old Spanish–English bilinguals and English monolinguals attending the Head Start program in the United States received tasks assessing their understanding of object constancy, the arbitrary nature of words, and their ability to use three types of labels (standard, non-words and common-switched) in sentences. Bilinguals were better than monolingual children in their ability to switch familiar labels and use various types of labels in the context of sentences. It was suggested that this precocious development in bilinguals was due to the fact that bilinguals operate on 'two language codes'. The study was the first to clearly document metalinguistic advantages in bilingual children. Evidence for differential development of metalinguistic awareness set the stage for discovering the non-verbal cognitive advantages 20 years later.	**B**
1972	Ianco-Worrall, A. (1972). Bilingualism and cognitive development. *Child Development* 43, 1390–1400.	**Ianco-Worrall** set out to empirically test Leopold's observation (LEOPOLD 1939–1949) that bilingual children show an early separation of word sound from word meaning. Afrikaans–English bilinguals and monolinguals in Afrikaans or English matched on IQ, age (4–6 and 7–9), SES and grade level, completed metalinguistic tasks. The young bilinguals were more likely than monolinguals to treat words as arbitrary labels and showed a strong preference for semantic over phonetic similarity when asked to match words for similarity. This preference for semantic similarity was observed only in older monolingual children, again supporting precocious metalinguistic development in bilingual children.	**B**

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1974	Bain, B. (1974). Bilingualism and cognition: Toward a general theory. In S. T. Carey (ed.), *Bilingualism, biculturalism, and education*. Edmonton, Canada: University of Alberta, 119–128.	**Bain** examined problem-solving abilities and sensitivity to emotional expressions in 11-year-old monolinguals and French–English bilinguals matched on SES, IQ and academic performance. Bilinguals performed better than monolingual children in solving problems based on logical operations and in identifying emotional expressions of characters depicted in portraits. Bain concluded that 'the bilingual child has a greater cognitive plasticity than his unilingual counterpart' (p. 127). This was the first study to claim cognitive advantages in problem solving, but the tasks were not defined with sufficient precision to determine which aspects of cognition were affected by bilingualism or why.	**D**
1974	Cummins, J. & M. Gulutsan (1974). Some effects of bilingualism on cognitive functioning. In S. T. Carey (ed.), *Bilingualism, biculturalism, and education*. Edmonton, Canada: University of Alberta, 129–136.	The authors administered tests of memory, reasoning and divergent thinking using both verbal and spatial stimuli to 11-year-old monolingual and bilingual children. Bilinguals outperformed monolinguals on verbal ability, general reasoning and originality, but the pattern was reversed for memory performance. The authors suggested that the bilingual's outperformance in general reasoning and verbal ability is the result of a common mechanism that emerges from having two labels for the same referent. This idea anticipates later research proposing a general mechanism underlying bilingualism-related changes. The authors' findings were interpreted in terms of enriched metalinguistic awareness for bilingual children.	**B**
1974	Landry, R. G. (1974). A comparison of second language learners and monolinguals on divergent thinking tasks at the elementary school level. *The Modern Language Journal* 58, 10–15.	**Landry** tested the hypothesis that learning an L2 enhances children's divergent thinking abilities. Children in grades 1, 4 and 6 who attended a Foreign Language in the Elementary School (FLES) program were compared to children in regular school programs on their performance on the Torrance Tests of Creative Thinking. Only in grade 6 was there a significant benefit for children learning another language. Landry concluded that sufficient experience with the two languages was required for benefits to emerge, which is in line with the 'threshold hypothesis' developed later by Cummins (Cummins 1976[4]). Landry also proposed that learning two languages promoted the ability to switch between tasks, a skill essential for modern concepts of multi-tasking, anticipating later research on bilingual advantages in executive control.	**A**

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1976	Barick, H. C. & M. Swain (1976). A longitudinal study of bilingual and cognitive development. *International Journal of Psychology* 11, 251–263.	This is the first longitudinal study to examine the effects of becoming bilingual on children's intelligence. The authors compared children enrolled in a French-immersion program (from senior kindergarten to grade 4) and children attending regular English programs. An initial analysis showed that the two groups did not differ in the magnitude of IQ increase over the period tested, suggesting that learning an L2 is not associated with cognitive benefits. However, when the immersion group was divided according to French proficiency, the high-French achievers obtained higher IQ scores than lower-French-achievers even when the results were adjusted for the effect of grade and IQ at the end of kindergarten. Again, the results support the idea that the level of language proficiency has to be considered when discussing the effects of bilingualism, an idea that had been proposed by Arsenian almost four decades earlier (ARSENIAN 1937) and would be discussed in more detail by CUMMINS (1979).	**A**
1977	Bruck, M., W. E. Lambert & G. R. Tucker (1977). Bilingual schooling through the elementary grades: the St. Lambert project at grade seven. *Language Learning* 24, 183–204.	This study examined children from English-speaking families who were instructed in an L2 (French) for seven years. Compared to control monolingual groups or to the norms of standardized tests, these children showed similar academic performance and achieved high levels of French proficiency. These results offer strong support to the earlier tentative findings showing no detrimental effects after one year of education in an L2.	**C**
1977	Ben-Zeev, S. (1977). The influence of bilingualism on cognitive strategy and cognitive development. *Child Development* 48, 1009–1018.	**Ben-Zeev** tested monolingual children (English or Hebrew) and Hebrew–English bilingual children (7 years old) to examine the cognitive strategies developed in the process of learning two languages. There were three outcome measures: syntactic rule usage, semantic knowledge and non-verbal processing. In spite of lower receptive vocabulary scores, bilinguals outperformed monolinguals on the other measures. The author suggested that bilingual children show a more analytic processing approach that is evident in verbal tasks and that this carries over to certain non-verbal, spatial-perceptual tasks. The study anticipated later research (e.g. BIALYSTOK 1999) showing non-verbal cognitive advantages for bilingual children.	**B**

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1978	Cummins, J. & R. Mulcahy (1978). Orientation to language in Ukrainian-English bilingual children. *Child Development* 49, 1239–1242.	The authors compared three groups of children (Ukrainian–English bilinguals, Ukrainian L2 learners, and English monolinguals) matched on SES, non-verbal IQ, sex and age, attending grades one and three, on a set of metalinguistic tasks. The tasks assessed ability to analyze linguistic structures and detect ambiguities, and to understand the arbitrary nature of linguistic labels. Bilingual children performed better than monolinguals on most tasks. Although the bilingual metalinguistic advantage was found by past studies (e.g. FELDMAN & SHEN 1971), the present paper used different tasks and the bilingual children spoke different languages.	**B**
1978	Cummins, J. (1978). Bilingualism and the development of metalinguistic awareness. *Journal of Cross-Cultural Psychology* 9, 131–149.	Irish–English bilinguals and English monolinguals in grades three and six matched on age, SES, IQ and sex received tasks assessing the understanding of the stability of word meanings (e.g. what does 'giraffe' mean if no more giraffes are left in the world?), the arbitrary nature of linguistic labels (e.g. whether it is possible to interchange word labels if one decides to make up words), the non-physical nature of words (e.g. whether the word 'book' is made of paper), and evaluation of the truth nature of empirical (e.g. 'The counter in my hand is yellow and it is not green') and non-empirical (e.g. 'Either the counter in my hand is white or it is not white') statements. Bilinguals at both grades showed a better understanding of the arbitrary nature of linguistic labels and greater ease in evaluating non-empirical contradictory statements.	**B**
1979	Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research* 49, 222–251.	This paper explains the interdependence of language and cognitive ability in bilingual children through the 'threshold hypothesis'. The idea is that a bilingual child must achieve certain levels of proficiency in both languages in order to avoid negative developmental outcomes and show cognitive benefits. Therefore, it is the attainment of adequate LEVELS of proficiency in the L1 that leads to positive cognitive and academic consequences for the bilingual child. This paper is important because **Cummins** elaborates on the idea that the relationship between bilingualism and cognitive/academic outcomes is mediated by the level of language proficiency, which helps to explain some of the inconsistent findings reported by past research.	**B, C**

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1983	Diaz, R. M. (1983). Thought and two languages: the impact of bilingualism on cognitive development. *Review of Research in Education* 10, 23–54.	**Diaz** identified two methodological flaws in early bilingualism research: the use of monolingual and bilingual groups with different SES backgrounds and failure to quantify the degree of bilingualism. He showed that in carefully controlled studies bilingualism led to improvements in various aspects of cognitive functioning such as cognitive flexibility (stemming, he argued, from the experience of switching between the two languages), metalinguistic awareness (in contrast to the early research talking about 'mental confusion' (SAER 1923)), concept formation, divergent thinking and creativity, and field-independence.	**A, B, D**
1985	Diaz, R. M. (1985). Bilingual cognitive development: addressing three gaps in current research. *Child Development* 56, 1376–1388.	Two groups of Spanish–English bilingual children (aged 5–7), with varying degrees of proficiency in English and attending a bilingual education program, were tested at two time points. In contrast to the prediction made by Cummins' threshold hypothesis (CUMMINS 1976), **Diaz** found a strong relationship between degree of bilingualism and cognitive abilities in children with low English proficiency, suggesting that it is the efforts of learning an L2, rather than the increasing language proficiency, that leads to cognitive benefits. At the second testing, children with low English proficiency who were also from a lower SES background showed significant progress and differed from the highly proficient group on only one measure. This suggests that a bilingual education program has the potential to compensate for the negative effects associated with lower SES, which is consistent with positive effects of immersion programs (e.g. BRUCK ET AL. 1977).	**B, D**
1986	Bialystok, E. (1986). Factors in the growth of linguistic awareness. *Child Development* 57, 498–510.	Although previous studies (e.g. CUMMINS & MULCAHY 1978) found that bilingual children outperformed monolinguals on tasks of metalinguistic awareness, the explanations proposed were vague and formulated in terms of bilinguals showing a greater orientation to language. **Bialystok** proposed that metalinguistic awareness relies on two skill components: analysis of linguistic knowledge and control of attentional process. She hypothesized that bilinguals outperform monolinguals on tasks requiring high levels of control. To test this hypothesis, Bialystok compared monolingual and bilingual children (ages 5, 7 and 9) on a sentence judgment task and	**B**

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		manipulated the analysis and control demands by creating sentences that (i) had intact grammar and meaning, (ii) had grammatical error but intact meaning, (iii) had meaning anomalies but were grammatically intact (i.e. high control demands), and (iv) had both grammatical and semantic anomalies. Bilingual children found it easier to judge the sentences requiring high levels of control, suggesting that bilingualism boosts children's ability to ignore irrelevant information. The description of tasks in terms of analytic and control demands is an important contribution to research because it offers a framework for understanding and interpreting bilingual processing.	**B**
1988	Bialystok, E. (1988). Levels of bilingualism and levels of linguistic awareness. *Developmental Psychology* 24, 560–567.	**Bialystok** used the analysis and control framework to investigate the relationship between degree of bilingualism and metalinguistic awareness. The results showed that bilingual children had better control of processing than monolinguals and that bilingual children with higher proficiency in their L2 had better analysis skills than children of lower proficiency.	**B**
1992	Ricciardelli, L. A. (1992). Bilingualism and cognitive development in relation to threshold theory. *Journal of Psycholinguistic Research* 21, 301–316.	**Ricciardelli** compared 5- to 6-year-old monolingual and Italian–English bilinguals on measures of creativity, metalinguistic awareness, non-verbal abilities and reading achievement to test the hypothesis derived from the threshold theory that high levels of proficiency in bilinguals lead to cognitive benefits and lack of cognitive disadvantages. The highly proficient bilinguals in this study showed enhancement in several (but not all) tested abilities. In line with the threshold theory (CUMMINS 1979), bilingual children with low proficiency in both languages performed worse than bilingual children with high proficiency in at least one language, but did not differ from low-proficiency monolinguals.	**B, C**
1997	Bialystok, E. (1997). Effects of bilingualism and biliteracy on children's emerging concepts of print. *Developmental Psychology* 33, 429–440.	**Bialystok** tested three groups of 4- and 5-year-old children (English monolinguals, French–English bilinguals and Chinese–English bilinguals) on tasks assessing the understanding of how print refers to language. Bilingual children showed better understanding of the symbolic representation of the written word. There were differences between the French and Chinese groups in some tasks, indicating a role for the relation between languages in this development.	**B, C**

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1998	Bialystok, E. & S. Majumder (1998). The relationship between bilingualism and the development of cognitive processes in problem solving. *Applied Psycholinguistics* 19, 69–85.	This is the first study to use cognitive tasks to assess non-verbal ability rather than intelligence tests. The study compared balanced bilinguals, partial bilinguals and monolinguals on non-verbal tasks that varied in their demands for analysis and control. Balanced bilinguals outperformed the other two groups when the problems relied heavily on control, with greater effects for higher levels of bilingualism.	**D**
1999	Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development* 70, 636–644.	Bilingual and monolingual children (ages 4 and 5) with similar receptive vocabulary and memory span performed the dimensional change card sort task and the moving word task, both relying on attentional control. Bilingual children outperformed their monolingual peers on both tasks, showing the first evidence for bilingual advantages in the development of the executive functioning system. Importantly, this study differs from past research showing bilingual advantages (e.g. BAIN 1974) in that it proposes the mechanism underlying the experience-related changes in bilingual children.	**D**
2003	Goetz, P. J. (2003). The effects of bilingualism on theory of mind development. *Bilingualism: Language and Cognition* 6, 1–15.	This study examined the effect of bilingualism on theory of mind development in 3- and 4-year-old children. English monolinguals, Mandarin monolinguals, and Mandarin–English bilinguals solved problems in appearance–reality, perspective-taking, and false-belief. Bilingual children performed better than monolinguals, with no difference between the two monolingual groups. **Goetz** attributed the bilingual advantage to better inhibitory control, stronger metalinguistic skills and greater sociolinguistic understanding than monolinguals. This is the first study to show improved theory of mind abilities in bilingual children.	**D**
2003	Bialystok, E., S. Majumder & M. M. Martin (2003). Developing phonological awareness: Is there a bilingual advantage? *Applied Psycholinguistics* 24, 27–44.	Attempting to resolve mixed results reported for phonological awareness in bilinguals, three studies were carried out and found no general bilingual advantage on this skill. Only one group (Spanish–English bilinguals) on one of the tasks (phoneme segmentation) showed a difference compared to the other groups. These results limit the generality of the bilingual advantage in metalinguistic awareness and indicate other factors that are also involved in this development.	**B**

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2004	Bialystok, E. & L. Senman (2004). Executive processes in appearance-reality tasks: the role of inhibition of attention and symbolic representation. *Child Development* 75, 562–579.	Four- and five-year-old monolingual and bilingual children solved appearance–reality tasks. Scoring distinguished between appearance questions ('What did you think this was when you first saw it?') and reality questions ('What is it really?'). Bilinguals were better than monolinguals at answering the reality questions because it is only these that present a conflict that must be resolved through attention and inhibition.	**D**
2004	Bialystok, E. & M. M. Martin (2004). Attention and inhibition in bilingual children: evidence from the dimensional change card sort task. *Developmental Science* 7, 325–339.	The authors aimed to distinguish between the contribution of three possible abilities that could underlie the bilingual advantage previously documented on the dimensional change card sort task (BIALYSTOK 1999): representation, response inhibition or conceptual inhibition. Bilinguals outperformed monolinguals when card sorting was based on a perceptual (as opposed to semantic) feature of the stimulus, indicating the greater attentional control of bilinguals. There was no difference between groups for conditions requiring greater analysis of the representations.	**D**
2004	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.	This study was designed to examine the effect of SES on three dimensions of attention: alerting, orienting and executive attention. Participants were 6-year-old children from three SES backgrounds who belonged to three ethnic groups (African/American, Caucasian and Hispanic). The Hispanic children, many of whom were from a low SES background, showed the most proficient performance on executive attention. The author suggested that the bilingualism of this group may be responsible for their greater success.	**D**
2005	Bialystok, E. & D. Shapero (2005). Ambiguous benefits: the effect of bilingualism on reversing ambiguous figures. *Developmental Science* 8, 595–604.	This study extended the control differences to a task based on perceptual analysis. Children inspected ambiguous figures (e.g. the rat-man) and were guided through a process of attempting to see the alternative image. Six-year-old bilingual children were superior to monolingual children matched on age, general cognitive functioning and memory span in their ability to assign a new interpretation to an already identified and labeled figure. Although previous studies (e.g. BEN-ZEEV 1977) showed a bilingual advantage in a different spatial-perceptual task, the present study is important because it moves beyond description and it interprets the results in terms of differences in executive control abilities.	**D**

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2005	Bialystok, E., G. Luk & E. Kwan (2005). Bilingualism, biliteracy, and learning to read: interactions among languages and writing systems. *Scientific Studies of Reading* 9, 43–61.	The authors examined the effect of bilingualism on children's early literacy abilities. Four groups of grade one children (English monolinguals, Spanish–English bilinguals, Chinese–English bilinguals and Hebrew–English bilinguals) received tests of decoding and phonological awareness in English if they were monolinguals and in both languages if they were bilinguals. All bilingual children showed some general advantage over monolinguals in their ability to decode written forms into meaningful units. Additionally, results demonstrated that a more specific bilingual advantage in early literacy abilities and transfer of reading skills across languages was present when the two languages of the bilingual children used similar writing systems (i.e. Hebrew and Spanish bilinguals).	**C**
2008	Martin-Rhee, M. M. & E. Bialystok (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition* 11, 81–93.	Using tasks that differ in the type of inhibition required, **Martin-Rhee & Bialystok** established that bilinguals outperformed monolinguals on tasks requiring attentional control to competing cues but not on tasks requiring inhibition of a response or the withholding of a practiced response. The first type of inhibition is sometimes measured by a Simon task. In this task children need to respond to the color of a stimulus appearing on the left or the right side of a screen by pressing either the left or the right mouse button. Conflict is created when there is a mismatch between the position of the stimulus and its correct response key, and attentional control is needed to resolve that conflict. The second type of inhibition requires the ability to resist executing a cued response and is thus less a matter of attention, control and conflict. Both types of inhibition are part of the executive function, but bilingualism only improves one of them. These results helped to refine the understanding of the cognitive effects of bilingualism.	**D**
2008	Carlson, S. M. & A. N. Meltzoff (2008). Bilingual experience and executive functioning in young children. *Developmental Science* 11, 282–298.	**Carlson & Meltzoff** tested three groups of 6-year-old children (English monolinguals, Spanish–English bilinguals, and an immersion group) on a large battery of executive function tasks. Although the bilingual children had lower SES and receptive vocabulary than the other two groups, they obtained higher scores than monolinguals on conflict tasks when the effect of SES, receptive vocabulary and age were statistically controlled. There were no group differences on measures of impulse control or withholding a response.	**D**

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2009	Kovács, A. M. (2009). Early bilingualism enhances mechanisms of false-belief reasoning. *Developmental Science* 12, 48–54.	Previous research (GOETZ 2003) showed advanced theory of mind abilities in bilingual children. **Kovács** examined the possible mechanisms underlying this advantage by comparing 3-year-old children on a control task and two theory of mind tasks (standard false-belief task and modified theory of mind task that required understanding others' mental states). Bilingual children outperformed monolinguals on both tasks. Her interpretation was that the precocious development of bilinguals is related to better executive control abilities and not to specific knowledge about language-switching.	**D**
2009	Kovács A. M. & J. Mehler (2009). Cognitive gains in 7-month-old bilingual infants. *Proceedings of the National Academy of Sciences* 106, 6556–6560.	The authors examined whether the bilingual advantage can be found very early in development. In a series of eye-tracking studies, 7-month-old bilingual infants were better than same-age monolingual infants at switching the direction of their anticipatory looks for a visual reward in response to a change in the visual or auditory cue. This finding demonstrates that being exposed to two languages from birth leads to very early executive control benefits.	**D**
2009	Bialystok, E. & M. Viswanathan (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition* 112, 494–500.	The authors compared three groups of 8-year-old children (monolinguals, bilinguals of immigrant background in Canada, and bilinguals of non-immigrant background in India) to investigate the generality of the bilingual advantage over the influence of immigration status. The three groups were matched on SES and memory abilities, but both groups of bilingual children outperformed monolinguals on an executive function task that required cognitive flexibility and inhibitory control, with no differences between the two bilingual groups. This study contributes to the field by showing that the bilingual advantage documented by past research (e.g. BIALYSTOK 1999) overrides the influence of factors correlated with bilingualism, such as immigration experience.	**D**

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2010	Bialystok, E. (2010). Global-local and trail-making tasks by monolingual and bilingual children: beyond inhibition. *Developmental Psychology* 46, 93–105.	In a series of studies, **Bialystok** tested monolingual and bilingual 6-year-old children on two non-verbal tasks that have not been previously investigated: the global–local and the trail-making tasks. Bilingual children consistently outperformed monolinguals on conditions that have been typically considered to be cognitively demanding (i.e. incongruent trials where there is a conflict between different dimensions of the stimuli), but also on conditions considered to be less effortful (i.e. congruent trials that did not require inhibition). These findings refine our understanding of the nature of the bilingual advantage by demonstrating that it is not limited to inhibitory control but extends to other aspects of executive function such as monitoring, switching and updating.	**D**
2010	Adesope, O. O., T. Lavin, T. Thompson & C. Ungerleider (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research* 80, 207–245.	Recent decades of research on bilingualism in children show diverse outcomes. In order to clarify the reliability and strength of these outcomes, **Adesope et al.** conducted a meta-analysis of 63 studies that examined the cognitive effects associated with bilingualism in children. Results showed that the experience of speaking two languages yields cognitive benefits in the areas of attentional control, working memory, abstract and symbolic representation skills, and metalinguistic awareness.	**A, B, C, D**

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