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## Beyond the Classroom: Bilingualism, Cognitive Skills, and Health

*The authors discuss the effects of bilingualism on cognitive skills, such as problem-solving, task switching, and ignoring irrelevant information, and health, including the onset of dementia during aging. They also examine the types of cognitive skills that are and are not likely to benefit from bilingualism.*

### Questions

There are many questions that teachers might want to ask about bilingualism:

- Is there a critical period of life during which language is most easily learned; consequently, at what age should children start learning a second (or third) language?
- When teaching a new language, should we intersperse communication across old and new languages, or immerse children in a new language to the exclusion of communication in the old language?
- Should we insist on keeping active the native languages of immigrant children?
- Finally, what are the effects of bilingual education beyond the classroom, including effects on basic cognitive skills and health?

These questions bear on the decisions educators make about when, whether, and how to implement bilingual education in both the classroom and the general curriculum.

Historically, the psychology literature has painted a splattered and complex picture and has been biased by researchers' agendas, making it difficult for psycho-

logists to provide meaningful guidance to teachers. Part of the reason psychologists have failed to reach a consensus about major curriculum decisions, such as whether to use English immersion programs, stems from methodological flaws in the studies and reviews aimed at answering these questions. For example, Greene (1997) carefully examined Rossell and Baker's (1996; see also Baker & de Kanter, 1981) bilingual education literature review, which compared bilingual education to English immersion programs, during second-language acquisition, and found two major problems with the review.

- After carefully examining each of the 38 studies in the Rossell and Baker review, Greene concluded that only 11 of the original 38 studies were methodologically sound.
- Rossell and Baker used a non-rigorous review methodology – they counted the number of studies showing positive and negative effects.

Because more than half of studies in their review showed negative effects, Rossell and Baker concluded that English immersion is preferable to bilingual education. In contrast, using just the properly designed and controlled studies, and using more precise

meta-analysis methodology, Greene showed overall positive benefits of bilingual education on reading and math ability. Recently, Krashen and McField (2005) reviewed six meta-analyses of English immersion programs and found that all six showed positive benefits for bilingual education during second-language acquisition.

In this paper, we discuss the effects of bilingualism on cognitive skills, such as problem-solving, task switching, and ignoring irrelevant information, and health, including the onset of dementia during aging. We focus on the history of bilingualism research, recent evidence about the cognitive and health consequences of bilingualism, possible reasons that bilingualism impacts intellectual functioning, and pedagogical implications of second-language acquisition and maintenance. Finally, we examine the types of cognitive skills that are and are not likely to benefit from bilingualism.

### Research History

Psychologists became interested in bilingualism during the 1920s. The main goal at that time was to understand why bilingual children were performing more poorly at school than monolinguals (May, Hill, & Tiakiwai, 2004). Early research ended up confirming existing stereotypes that being bilingual meant being a lower-class citizen. In actuality, bilinguals often were immigrants or lived in economically depressed rural regions, where they did not receive a rigorous education. It comes no surprise that they performed worse than their monolingual peers, who came from families of higher socio-economic status.

Compounding these issues of bias, bilingualism itself was rather poorly defined at that time; scientists treated language status as a dichotomous variable, and failed

to acknowledge that language ability is graded and multi-dimensional. Tests of “mental capabilities” often were administered in the researchers’ primary language, not the language with which participants felt most comfortable. One of the most spectacular examples of this rather loose attitude toward the methods of scientific inquiry is a study from the 1930s, in which children were classified as monolinguals or bilinguals based on the sound of their name (Pintner, 1932). The unfavorable view on mental abilities of bilinguals was still rather strong in the 1950s, when Darcy (1953), after reviewing earlier studies, came to conclusion that bilinguals always perform worse than monolinguals on verbal tasks, as well as on a majority of performance-based tasks. (A comprehensive review of the literature on this topic can be found in Peal & Lambert, 1962.)

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A breakthrough came in the 1960s, when Peal and Lambert (1962) conducted a study in which they compared two carefully selected groups of children speaking French and English. When selecting participants, factors like socio-economic status and level of fluency in both languages were taken into careful consideration. In the context of earlier research, the results were surprising: Bilingual children

outperformed monolinguals on the majority of tasks, measuring both verbal and non-verbal skills. Peal and Lambert explained this bilingual advantage by claiming that bilingual children are better at concept formation and cognitive flexibility. Further research supported Peal and Lambert’s conclusions. For instance, Kessler and Quinn (1980; 1987) found a bilingual advantage on problem solving and creativity tasks.

### Recent Evidence

Since the seminal study by Peal and Lambert (1962), bilinguals have been found to outperform monolinguals on variety of other tasks that tests that measure – most generally – effectiveness of attention, or the ability to focus on one thing and ignore another. In a series of experiments (reviewed in Bialystok, 2001), monolingual and bilingual children were asked to complete tasks that required flexibility in thinking, such as using the word “moon” to refer to daytime and focusing exclusively on grammatical aspects of sentences like “Apples grow on noses,” ignoring the absurdity of the meaning. In both these tasks, bilingual children make considerably fewer mistakes than monolingual children.

Preschoolers and young children show great difficulty switching between tasks, such as from matching objects by shape to matching by color (Bialystok & Martin, 2004; Cepeda, Cepeda, & Kramer, 2000). Despite their repeated attempts to switch to a new task, and despite having knowledge of the new task, many preschoolers become stuck and unintentionally continue performing the first task, a problem called perseveration. Recent evidence shows that bilingualism moderates perseveration (Bialystok &

Martin), helping to develop task control at an earlier age.

A bilingual advantage has been found on tasks that measure “theory of mind,” a reasoning ability related to successful social interaction. In theory of mind tasks, children are shown objects that appear to be one thing (e.g., a rock), but actually are another thing (e.g., a sponge). After the actual nature of the object is revealed, children are asked whether their peer, upon first seeing the object, will think that the object is a rock (i.e., what it appears to be), or a sponge (i.e., what it actually is). Compared to age-matched monolingual peers, bilingual preschoolers are more likely to say “a rock,” demonstrating that bilingual children develop theory of mind, or the ability to put themselves in somebody else’s shoes, at an earlier age than monolinguals (Bialystok & Senman, 2004).

Older adults show some bilingualism benefits as well, demonstrating that the bilingual advantage extends well beyond childhood (at least in older adults who maintain use of multiple languages). For instance, young and old monolingual and bilingual adults were asked to pay attention to the color of a stimulus and ignore its location (Bialystok, Craik, Klein, & Visvanathan, 2004). Sometimes participants needed to press the same response key for each possible response (e.g., the same key for “red” and “left”), an easy task, and sometimes they had to press different keys for each task (e.g., one key for “red” and a different key for “left”), which created confusion. The results demonstrated that older bilinguals were almost as successful at ignoring the irrelevant aspect of a stimulus as young adults. In contrast, older monolinguals were slower and less accurate than their age peers.

Recent evidence suggests that bilinguals outperform monolinguals on memory tests. In one study, bilinguals were more successful at remembering episodic information, or the source from which they learned a fact, than their peers (Wodniecka, Craik, & Bialystok, 2007). Even more striking, older bilinguals show similar levels of recollection as younger monolinguals, suggesting that bilingualism may help offset age-related memory decline. In this study, the older bilingual group included individuals who acquired a second language in their 20s, which suggests that individuals can benefit from becoming bilingual and actively using both languages, even if they learn a second language later in life. At this point, it remains unclear whether regular practice using multiple languages is necessary to continue bilingualism benefits.

The cognitive benefits of bilingualism have been observed not only in children and older adults, but also in younger adults. Spanish-Catalan bilingual young adults were better at inhibiting irrelevant information and switching between tasks than their monolingual peers (Costa, Hernández, & Sebastián-Gallés, 2007).

### Reasons

What is the source of the observed bilingual advantage on cognitive skills? One explanation suggests that when a bilingual prepares an utterance in one language, the other language is never “switched off” or waiting for its turn. This is supported by evidence from psycholinguistic experiments that both languages are always active to some degree. People who know and use more than one language can switch languages without intention or conscious recollection. Very often a bilingual becomes aware of this

unexpected switch only after noticing the surprised faces of their listeners. The fact that such situations occur at all can be taken as evidence for the simultaneous activation of both languages. At least at the early stages of speech production, perhaps the bilingual mind activates translation equivalents in both languages. In this model, language production can be conceptualized as a race (Logan, 1988) or – using a more vivid metaphor – a battle, in which both languages are poised to seize power. This battle usually takes a fraction of a second, an era in mind-time.

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Arguments in support of the “race” or “war” hypothesis have been provided by several psycholinguistic experiments. In one of them (Wodniecka, Bobb, Kroll, & Green, 2007), English-Spanish bilinguals named pictures in either English or Spanish. We asked participants to name pictures in one language, and then we repeated the pictures again, and asked participants to name them either in the same language as before, or in the other language. We also included a set of new pictures that were not named earlier. The time it took participants to name repeated pictures in the second language was longer, compared to when the first language was repeated. More importantly, the time to name repeated pictures in the second language was the same, and sometimes a bit longer, as the time to name completely new pictures. This result can be taken as evidence that there is competition

between the two languages, and the conflict needs to be resolved by modulating relative activation of the languages. Because most of the time our mind makes the right decision (that is, the winner in the battle is the intended language), this suggests that there must be a mechanism that makes “the enemy withdraw its forces.”

This proposed mechanism can explain the bilingual advantage observed in many studies discussed above: Bilinguals have massive practice using control mechanisms that help them negotiate the ever-present conflict between languages. Thus, they also are faster and more efficient at switching between tasks and modulating attentional control, compared to monolinguals. Bilinguals’ superior performance on these tasks could be caused by increased ability to inhibit the undesired response (Anderson, 2005) and/or increased activation of the desired response (Cepeda & Munakata, in press). Green (1998) has argued that bilinguals recruit the same conflict-control mechanisms both when controlling competing languages and when performing other activities that require control (e.g., ignoring irrelevant distracting information). According to this argument, bilingual benefits observed in non-language-based cognitive tasks are side effects of bilinguals’ frequent practice modulating speech production in each of their two languages.

### Delaying Dementia

In case improved problem solving and reasoning skills are insufficient reason to learn and use a second language, throughout your life, bilingualism has been shown to have a sizable public health benefit – protection against the onset of dementia (Bialystok, Craik, Freedman, 2007). Knowing and using multiple languages, on an everyday basis, might delay

some aspects of inevitable cognitive decline related to aging. The dementia-delay finding is perhaps the most spectacular bilingualism effect that has been demonstrated, to date.

Bialystok, Craik, and Freedman (2007) investigated the records of patients who were referred to a memory clinic with cognitive complaints. In the final analyses, they considered data from 184 patients; the group consisted of 132 patients who were diagnosed with Alzheimer's disease and 52 individuals with other forms of dementia. About half the patients were monolingual (the only language they knew was English), and the other half were bilingual, with a variety of different non-English first language backgrounds, most immigrants to Canada from Europe after World War II. The researchers looked at several variables, including: The age of first visit to the clinic, the age of onset of symptoms of dementia, and the rate of cognitive decline. The mean age at which symptoms of dementia occurred in the monolingual group was 71.4-years-old, and in the bilingual group – 75.5-years-old. The bilingual advantage was statistically significant, even when factors such as years of formal education, socio-economic status, gender, and immigration experience were taken into account (some of the monolinguals also were immigrants to Canada). According to Dr. Freedman, "There are no pharmacological interventions that are this dramatic."

It is important to bear in mind that this finding is preliminary, and more research is necessary before definite conclusions can be drawn. For instance, one limitation of the study stems from the methodology used; the study was correlational, and although it allows one to conclude that there is relationship between linguistic

experience and the age of onset of dementia, there might have been some unknown factors that contributed to the significant relationship. Another important issue that needs to be kept in mind is that the study did not show differential rates of decline between bilingual and monolingual groups. To the contrary, the rate of decline from diagnosis onset was the same for both patients groups. Thus, based on this study, we cannot infer that bilingualism is a remedy for dementia. Nevertheless, the results provide an important first step in establishing the exact influence of bilingualism on cognitive decline with aging. Notably, the beneficial impact of bilingualism on cognitive decline has only been established in individuals who make frequent use of both languages, and cannot yet be generalized to second language users who alternate between using each language on a less frequent basis.

How can bilingualism influence dementia? Bialystok et al. (2007) suggests that psychological factors (e.g., lifestyle, educational choices, and social engagement) may cause biological changes, such as increased generation of neurons or synapses, or reorganization of brain networks. For example, these biological mechanisms may increase working memory strength (Cepeda & Munakata, in press), which undergoes developmental changes that are probably related to maturation of neural connections, thereby enabling the brain to better tolerate pathologies accumulated in the brain, such as dementia.

### Caveats

Most things in life have a price attached. As it turns out, bilingualism may cause some problems, despite its benefits. A recent set of studies (Gollan,

Montoya, Fennema-Notestine, Morris, 2005; Gollan, Montoya, Werner, 2002) showed that individuals who speak more than one language might have greater difficulty recalling words in each of their languages; they achieved lower scores than monolinguals in a task that required enlisting words from a given category. In addition, bilinguals have been found to experience the so-called "tip-of-the-tongue" phenomenon [where an individual remembers some aspects of a word (e.g., number of syllables or letters), but has difficulty retrieving the full word] more often than monolinguals (Gollan & Acenas, 2004). There are no known real-life implications from this deficit, but potentially it could mean that, on average, bilinguals speak less fluently than monolinguals.

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Recently, prominent findings of a bilingual advantage (Bialystok et al., 2004) have been called into question (Morton & Harper, in press), based in part on making comparisons between immigrant and non-immigrant populations. Morton and Harper attempted to replicate one previous bilingual-advantage finding, while also carefully matching many background factors and comparing Canadian sub-populations that were not recent immigrants. Their replication failed to find a language-based performance difference in one cognitive control task, suggesting that further research using similarly matched groups is warranted. Most importantly, the

Morton and Harper study suggests that even if the advantages of bilingualism are slightly smaller than previously thought, bilingualism does not appear to hurt cognitive skills.

### Pedagogical Implications

As we have argued throughout this article, learning and regularly using a second language can improve not only cultural knowledge, but also cognitive abilities like problem solving, reasoning, attention, and cognitive control. In addition, bilingualism may have effects on long-term health, including possibly delaying the onset of memory decline during aging caused by dementia. We speculate that becoming proficient in a second language might either help children already diagnosed with ADHD develop improved ability to control their actions or reduce the chances of developing ADHD. Similar speculation has been made before, by researchers who examined the prevalence of ADHD in bilingual children and found that increased proficiency in a second language was associated with reduced ADHD symptom severity (Toppelberg, Medrano, Morgens, & Nieto-Castañon, 2002). It remains to be seen whether cognitive skill deficits that are associated with ADHD, such as difficulty switching between tasks (Cepeda et al., 2000; Kramer, Cepeda, & Cepeda, 2001), also are reduced by bilingualism.

While biased researchers and poor experimental design have plagued bilingualism research in the past, well-controlled studies suggest that, at worst, bilingual education is unlikely to produce significant cognitive deficits, and sometimes bilingualism leads to important cognitive benefits. On balance, the scales seem tipped far toward recommendations that schools implement bilingual education, for all students, at an

early age, and that schools maintain bilingual education throughout the grade levels. To put it simply: Bilingualism probably improves cognitive skills and may delay the onset of dementia and reduce ADHD severity.

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