Teaching about Bilingualism
in Introductory Cognitive Science Courses

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Abstract

Until recently, research on language and its cognitive interface focused almost exclusively on monolingual speakers of a single language and typically speakers of English as the native language. In the past decade, the recognition that more of the world’s speakers are bilingual than monolingual has led to a dramatic increase in research that assumes bilingualism as the norm rather than the exception. This new research investigates the way in which bilinguals negotiate the presence of two languages in a single mind. An important insight is that bilingualism provides a tool for examining aspects of the cognitive architecture that are otherwise obscured by the skill associated with native language performance. From this perspective, bilinguals are model subjects of study for cognitive scientists who wish to identify constraints and plasticity in learning and the way in which competition is resolved across cognitive systems. In what follows, I outline a few of the core topics that might be included in an introductory cognitive science course or psychology of language course.¹

Is there a critical period for learning a second language?

¹ A note on who is bilingual. The cognitive literature on bilingualism takes a liberal perspective on who is bilingual to consider anyone who uses two or more languages actively as a bilingual. Few bilinguals are truly balanced in the sense that they typically have one language that is more dominant than the other. Note that the dominant language is not necessarily the native language. Distinctions are drawn between early bilinguals who acquired both languages in childhood and late bilinguals who acquired the second language after puberty. Likewise, second language (L2) learners can be at early stages and therefore less proficient in the L2 or at more advanced stages of acquisition and quite proficient in the L2.
Perhaps the most enduring observation about second language learning is that it is easy for children and
difficult for adults. Indeed, on the 125th anniversary of the journal *Science* (Kennedy & Norman, 2005),
one of the 125 critical questions identified as a priority for the next 25 years of scientific research was the
biological basis of second language learning. Traditionally, the evidence for a biologically sensitive
period for language was taken to support an account of language acquisition in which there is declining
plasticity associated with those areas of the brain hypothesized to be dedicated to language (e.g.,
Lenneberg, 1967; Johnson & Newport, 1989). It’s very easy to demonstrate the effects of late acquisition
of an L2 by playing speech from the current governor of California or another non-native speaker.
Regardless of how educated the person is, how many years he or she has been immersed in the L2
environment, there are at least traces of the native language.

The facts themselves are relatively clear. Younger learners do better than older learners with respect to
acquiring native-like mastery of grammatical structures and are less likely to speak the L2 with an accent.
This material lends itself well to demonstrating that things are often not as simple as they seem. It’s
effective to begin with data on the accuracy of grammaticality judgments (e.g., Johnson and Newport,
1989) or on the perceived accentedness of speech (e.g., Piske, MacKay, & Flege, 2001). In each case,
there is a marked effect of age of acquisition. The apparent limits on achieving grammatical proficiency
have also been replicated in studies that are less reliant on meta-linguistic knowledge but that track the
time course of brain activation using event related potentials (ERPs). For example, Hahne and Friederici
(2001) showed that late L2 learners who were relatively proficient in the L2 revealed sensitivity to
semantic violations in sentential context that was similar to native speakers but did not show similar
sensitivity to syntactic violations. Demonstrating the absence of brain activity for subtle syntactic
structures in the L2 is compelling in showing that these effects are present regardless of how we measure
them. What is less clear is how to account for the decline in performance with increasing age.

Critics of the critical period concept (e.g., Birdsong, 2005) point to a number of features of the age of
acquisition data that fail to support a strictly maturational account that supposes that the language
acquisition device is no longer available by puberty. For example, the age of acquisition function
continues to decline after puberty suggesting that factors other than loss of brain plasticity may be
important. Furthermore, there are some late learners of a second language who are able to achieve native-
like proficiency. The existence of even a few such remarkable learners does not imply that the mechanism
of L2 learning is identical to L1 but does suggest that age alone is not a sufficient limiting factor. In
addition, studies that assess L1 as well as L2 performance show that there is an inverse relationship:
individuals who begin to acquire the L2 late are more likely to maintain the L1 and may therefore suffer
competition between the two languages that affects the likelihood of learning the L2.

At the same time, there are particular syntactic constructions that are very difficult to learn in an L2 as an
adult. In English, we don’t use articles that mark nouns as grammatically feminine, masculine, or neuter.
Learning to speak German, Spanish, or French, requires that we learn to match the gender of the noun
with the appropriate article. This task is difficult or nearly impossible for many late L2 learners.
Similarly, case marking in German, subject-verb agreement in English for non-native speakers of English
are constructions that are notoriously difficult to acquire in the L2. When late L2 learners are asked to
make conscious judgments about these aspects of the L2 grammar, they can often do so with a reasonable
level of accuracy, even when they have no ability to process the same constructions in real time (e.g.,
Jiang, 2004). While some of the obstacles to full L2 attainment have been identified, the mechanisms
responsible for these constraints are not fully understood. Some argue that transfer from the L1 to the L2 is
the main factor determining L2 performance (e.g., MacWhinney, 2005) whereas others assume that
particular linguistic structures place demands on language processing that are independent of the L1 itself
(e.g., Pienemann, 1998). The literature on the critical period is rich with creative approaches to the problem that make for
interesting discussion in the context of an undergraduate course. Since we can’t experimentally
manipulate language exposure, most of this work relies on accidents of nature or nurture. In the domain of L1 acquisition, these include studies of feral children and deaf adults who as young children were denied access to speech by virtue of their deafness and to sign language by virtue of their circumstances. Although these extreme situations are rare, they provide important converging evidence for claims about language learning. A recent study taking this approach examined a small group of French adults who, as children, had been adopted from Korea and then abruptly isolated from their native language with no subsequent exposure to Korean (Pallier, Dehaene, Poline, LeBihan, Argenti, Dupoux, & Mehler, 2003). The critical result was that regardless of their age at the time of adoption (they were between 3 and 8 years old), as adults their performance was similar to that of age-matched French adults who has been exposed only to French since birth. They showed no particular sensitivity to Korean and both behavioral and neuroimaging testing suggested that there was little evidence that the initial exposure had lasting consequences. Their response was similar, although not identical to native French speakers, suggesting again that it is possible to acquire native-like processing of an L2, although there may be some differences between L2 and L1 learning. Given the circumstances surrounding their early years and the relatively small sample of adoptees who could be tested, there are reasons to be cautious about the conclusion that a second language can effectively replace the first language, even after the first year or two of childhood. Other studies have shown that overhearing another language during childhood has some enduring consequences, particularly for the acquisition of native-like phonology, even when the person does not fully become bilingual (e.g., Au, Knightly, Jun, & Oh, 2002). But the benefits of childhood overhearing may require exposure to continued input and a goal for ongoing research is to understand how these selective consequences occur.

An important theme that emerges in the research on age of acquisition is that different aspects of language may be differentially sensitive to the age of initial exposure. How the language system is initially tuned to the presence of two languages is a topic on which there is a great deal of current research activity. Bilingual learning babies are exposed to a broader range of speech inputs than monolingually exposed babies and the statistical properties of those inputs often conflict (see Werker & Fennel, in press). A particularly nice feature of the research on infant speech perception is that it illustrates the way in which ingenious experimental designs can be exploited in cognitive science to reveal the knowledge of nonverbal research participants.

**Cross-language activity**

Proficient bilinguals rarely make the error of speaking words in the unintended language. That observation might be interpreted to mean that each language can be switched on and off at will so that the bilingual can function as a monolingual depending on the appropriate context. However, bilinguals can also code switch from one language to the other, even midsentence, with other speakers who are similarly bilingual, suggesting that the lexicon and grammar of the two languages is continuously available. And of course, in an extreme form of bilingualism, some individuals who are proficient in two languages can learn to perform simultaneous translation, a skill that necessarily requires that both languages be active. Understanding how the activation of the two languages manifests itself when bilinguals listen to speech, read text, and produce words and sentences, has been a central focus of the recent research (e.g., Costa, 2005; Van Heuven, Dijkstra, & Grainger, 1998; Spivey & Marian, 1999). At the same time, the control that bilinguals possess that enables them to exploit cross-language activity without suffering from it has been examined for what it might tell us about executive function more generally. A very exciting line of recent research shows that bilingualism confers a set of positive consequences for cognitive control that can be seen in young bilingual children (see Bialystok, 2005, for a review), in elderly bilinguals who have spent a life negotiating the interactions between their two languages (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004), and even in young adult bilinguals (e.g., Costa, Hernandez and Sebastián-Gallés, 2008). I first consider the evidence on language nonselectivity and then, in the next section, discuss the
claims about how the parallel activation of the bilingual’s two languages might hold consequences for cognition more generally.

Most students will confirm the phenomenology of having their native language in mind when first exposed to a second language. The form of the L1 that’s available is typically the translation equivalent of the L2 words. This is an instance in which the research on language processing nicely supports the phenomenology. As learners become more skilled in the L2 and better able to conceptually process the L2 directly, reliance on the L1 translation diminishes (e.g., Kroll & Stewart, 1994; Talamas, Kroll, & Dufour, 1999), suggesting that reliance on the translation equivalent is only a temporary stage during initial L2 learning. However, the translation equivalent is not the only manifestation of L1 activity during L2 processing and cross-language activation is not confined to the experience of learners at very early stages of L2 acquisition.

A series of studies on visual and spoken word recognition shows that both the orthographic and phonological properties of words in the two languages are active and influence performance even when bilinguals are highly proficient in each language and even when they are attempting to recognize words in one language alone (see Dijkstra, 2005, for a review). The logic of this work has been to exploit lexical properties that are shared across languages, rendering the visual or spoken input language ambiguous. For example, in languages like Dutch and English, there are many cognates and interlingual homographs or false friends. Cognates are translation equivalents with similar or identical orthography and similar phonology whereas interlingual homographs are words that are lexically similar in both languages but with language-specific meanings (e.g., the word hotel, a cognate, has the same meaning in Dutch and English whereas the word room, an interlingual homograph means cream in Dutch). If a proficient bilingual can use the intended language at will, then performance should resemble that of a monolingual because the language not in use becomes irrelevant. In the past decade, studies of both visual and spoken word recognition have reported compelling evidence to demonstrate that bilinguals do not function as monolinguals in each of their languages (e.g., Marian & Spivey, 2003; Schwartz, Kroll, & Diaz, 2007). When form and meaning converge, as is the case for cognates, there is typically facilitation in processing. When form and meaning conflict, there is often, although not always, interference. Furthermore, these interactions can be observed not only in the L2, which is often a bit slower and more open to contextual influences than the L1, but also in the L1 itself so that bilingual word recognition in the native language is affected by knowledge of the second language. They are also seen in bilingual word production, a task that would seem to be more under the speaker’s control and therefore less likely to be open to intrusions from the language not in use (see Costa, 2005 and Kroll, Bobb, & Wodniecka, 2006 for reviews).

And what if the bilingual’s two languages are less similar than Dutch and English or Spanish and English? The cross-language interactions persist even when only the phonology can be similar, as in the case of different-script languages like Japanese and English (e.g., Hoshino & Kroll, 2008). Perhaps the most dramatic example of this sort of cross-language activity has been reported for bimodal bilinguals who speak one language but sign the other (e.g., Emmorey, Borinstein, Thompson, & Gollan, 2008). The presence of interactions across modalities suggests that the bilingual’s two languages are open to each other at a relatively abstract level of representation.

If the bilingual’s two languages are both active, for even highly proficient bilinguals, we might wonder how that activity is resolved to allow fluent performance. Although the evidence on language nonselectivity in bilingual word recognition is robust, it can be criticized on the grounds that the out-of-

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2 Recent studies of language convergence (e.g., Malt & Sloman, 2003) provide support for the claim that skilled bilinguals are not monolingual-like in either of their two languages, but rather somewhere between. Both the L1 and L2 change in response to language contact (see also Myers-Scotton, 2002, for linguistic evidence on code-switching).
context nature of word recognition experiments may itself have induced the observed effects. Language is rarely processed at the level of single words and without contextual support, cross-language ambiguity may be more salient than it would be in typical sentence context. What is surprising in the recent research is that it is much more difficult than we might have thought to reduce or eliminate the presence of cross-language activity. Actual sentence context per se does not appear to be sufficient for this purpose. The same cognate facilitation observed in out-of-context word recognition experiments is also observed in sentence context, provided that the sentence is not highly constrained semantically (e.g., Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Schwartz & Kroll, 2006; Van Hell & De Groot, 2008). L2 users can learn to “zoom in” to their second language to process it selectively, but if they hear unrelated words from the L1 as background noise, the cross-language effects re-emerge (Elston-Güttler & Gunter, in press), again suggesting that the bilingual is always ready to process the two languages.

The problem of resolving competition across the bilingual’s two languages is not restricted to lexical ambiguity. Although much more research has examined cross-language interactions for words than for sentences, a set of recent studies shows that the grammars of the bilingual’s two languages are also open to one another in a manner that is far more permeable than what might have been predicted. One type of study asks whether there is syntactic priming from one language to the other. Previous studies within a single language have shown that speakers are more likely to produce a sentence using a particular grammatical structure if they have just produced a sentence using that structure (Bock, 1986). In the bilingual research, the question has been whether priming will be observed when switching languages from the prime to the target sentence. Although there are some exceptions, the general finding is that cross-language priming can be obtained (Hartsuiker, Pickering, & Veltkamp, 2004). Another type of study examines parsing preferences. Dussias (2003) has shown that native Spanish speakers who are immersed in an English language environment begin to adopt English parsing preferences when processing sentences in Spanish, their L1. While there are surely constraints on this sort of cross-language exchange, the presence of any of these influences, and especially those from the L2 to the L1, suggest a dynamic language system that changes in response to contact with other languages.

Cognitive consequences of bilingualism

If both languages are continually active and interacting with one another, then how does a bilingual select the intended language? And what are the consequences of spending a life making these sorts of decisions? One implication of the research on cross-language competition is that it should be more difficult for a bilingual than a monolingual to select the words and sentences to speak because there is potential competition across a larger number of alternative candidates. There is some evidence for this downside to bilingualism, particularly in the realm of word retrieval and vocabulary knowledge. Bilinguals are slower than monolinguals in simple word retrieval tasks such as picture naming and in producing a list of tokens from a common semantic category (e.g., Gollan, Montoya, Fennema-Notestine, & Morris, 2005; Gollan, Montoya, & Werner, 2002). Bilinguals are also more likely to generate tip-of-the-tongue states than monolinguals (e.g. Gollan & Acenas, 2004) and bilingual children are disadvantaged relative to their monolingual counterparts in the realm of vocabulary (see Bialystok, 2005, for a review). Although there are a range of alternative accounts for these effects, they are consistent with an interpretation of cross-language competition that delays retrieval.

In contrast to the costs observed in the realm of verbal performance, marked benefits have been reported for executive control. The requirement to juggle the activity of the two languages has been hypothesized to confer advantages to bilinguals who spend their lives resolving cross-language competition. A word of caution is in order because there is no direct evidence that provides a causal link between the presence of cross-language competition of the sort that we have reviewed and the resulting bilingual advantage. But it is tempting to speculate that having to learn to ignore irrelevant information, select between close alternatives, and frequently switch between the two languages has the consequence of creating more
general expertise in resolving conflict that then applies to other cognitive domains. The person whose work provides the core evidence on this issue is Ellen Bialystok, a cognitive developmental psychologist at York University in Toronto. Over the past 20 years, Bialystok and her colleagues have shown that bilingual children, sampled from a large number of different language pairings, outperform their monolingual counterparts in simple tasks that require irrelevant information to be ignored. At the same age when a monolingual child would still be taken in by the perceptual appearance of a situation, the bilingual child is better able to perform accurately (e.g., Bialystok & Shapero, 2005; and see Bialystok, 2005 for a review).

Likewise, for the elderly who have spent an entire lifetime using two languages, bilingualism appears to confer a measure of protection against the normal declines in cognitive and attentional function. Elderly bilinguals outperform age-matched monolinguals on a range of tasks that measure attentional control but that are, themselves, nonlinguistic in nature (e.g., Bialystok et al., 2004). Bilingualism does not prevent cognitive aging, but it appears to slow the rate of cognitive decline. A recent paper even suggests that bilingualism may delay the onset of Alzheimer’s type dementia (Bialystok, Craik, & Freedman, 2007). Some of the attentional control paradigms that form the basis of this work, e.g., the Simon task, can be demonstrated easily in introductory classes (Simon & Ruddell, 1967) and of course bilingualism is not the only experience that can advantage these sorts of skills (see Bialystok, 2006, for a comparison of the effects of bilingualism and video game playing).

The initial interpretation of the bilingualism advantage for young bilingual children and for bilingual elderly was that these advantages in executive control were only likely to be revealed when cognitive and/or memory resources were otherwise limited. A number of recent studies have shown that even young adult bilinguals who are in top form with respect to cognitive resources, demonstrate advantages in executive control (e.g., Costa et al., 2008). What is not yet known is whether these benefits are related to the form of an individual’s bilingualism, to the structural demands imposed by the language pairing, or by how actively the two languages have been maintained. For example, whether a person is an early or late bilingual, lives in the native language environment or is immersed in the L2, or speaks two languages that are structurally distinct with respect to their written script or syntactic form, may contribute to the observed cognitive consequences. Likewise, there may be multiple consequences of bilingualism on different aspects of cognitive control. Bilinguals may be better able to resolve conflict across competing alternatives, but they also may be better able to attend to critical information that serves to differentiate the two languages. Ongoing research is focused on these issues and their neural basis (e.g., Abutalebi & Green, 2007).

Other topics and themes

With the development of neuroimaging methods, a question that immediately comes to mind is whether the bilingual’s two languages recruit the same or different areas of the brain. In an introductory course, I prefer to cover the neuroscience methods in the context of how they might contribute converging evidence to the substantive questions about language processing and language disorders rather than to focus simply on how language is processed in the brain. The patient data on bilingual aphasia is a fascinating topic that can also be used in teaching to address issues of language representation vs. cognitive control. If one were to identify a few major themes about bilingualism and the brain, they would be that the same neural tissue supports the processing of both the L1 and the L2, when there are differences they appear to be more likely to be due to differences in proficiency rather than to age of acquisition, and that L2 processing is likely to draw on additional memory resources and areas of the brain associated with cognitive control that are not required to the same extent in the more skilled L1 (e.g., Abutalebi & Green, 2007; Hasegawa, Carpenter, & Just, 2002; Rodriguez-Fornells, De Diego Balaguer, and Münte; 2006).
Another topic that has seen a recent resurgence of interest is the debate concerning linguistic relativity. The question about how language shapes thought has focused primarily on cross-linguistic comparisons of different native speaker groups (e.g., Boroditsky, 2001; Slobin, 1996). These cross-linguistic comparisons are often confounded with bilingualism because non-native speakers of English are often monolingual whereas non-native speakers of other languages are often bilingual. If the bilingual’s two languages interact in the manner suggested above, then some of the observed cross-linguistic difference may actually be a consequence of bilingualism.

Summary

As should be obvious from this brief overview, bilinguals are no longer considered to be an unusual population to be studied but rather a representative group of language users. Their performance can inform basic issues in cognitive science concerning the constraints and plasticity of learning and the manner in which language experience influence cognition. Although the basic mechanisms of language processing may be similar in bilinguals and monolinguals, the subtle interplay between the bilingual’s two languages provides a window to observe the interactions between language and thought in a way that is otherwise obscured in the performance of highly skilled native language users.

References


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