

BILINGUALISM  
Kenji Hakuta  
School of Education  
Stanford University

Prepared for the New Encyclopedia of Neuroscience.

KEYWORDS

Age of acquisition  
Aphasia  
Bilingualism, active and passive  
Bilingual, early, late and adult  
Bilingual, sequential and simultaneous  
Bilingual Memory  
Bilingualism  
Critical period  
Immigration  
Independence and interdependence  
Language dominance  
Language proficiency  
Lexical access  
Literacy  
neuroimaging  
Psycholinguistics  
Seminlingualism  
Social Status

# BILINGUALISM

Kenji Hakuta

Stanford University

## **Synopsis**

Bilingualism (multilingualism) is a common human characteristic. Understanding the bilingual individual from the perspective of the cognitive neurosciences requires an appreciation of the conditions that accompany the use of multiple languages in society: its relationship to social status, compartmentalization of functions of languages, literacy, immigrant generation, and other historical circumstances. Bilingual individuals also vary in significant ways with respect to age of acquisition, language proficiency attained, participation in a bilingual speech community, and the particular languages involved. Current knowledge of psycholinguistic processes and brain organization that address differential representation of bilingualism is summarized.

## **Introduction**

Bilingualism (multilingualism) refers to the co-existence of more than one language system within an individual, as contrasted to monolingualism. The question of how the two languages interact at the cognitive and behavioral levels has been of longstanding interest to psycholinguists as well as to neurologists, clinicians and educators. There has been great anticipation that developments in cognitive neuroscience could shed further light on important fundamental questions in the understanding of bilingualism.

Bilingualism as an individual condition is nested within a distribution of broader societal circumstances that cause language contact. There are many different

manifestations of this variability. Bilingualism may be the result of growing up in a bilingual community, such as a bilingual neighborhood of an immigrant community in New York. But that is different from bilingualism that results from growing up in an officially bilingual country such as Canada, where its two official languages are separated by geographical regions. Bilingualism that is accompanied by literacy in both languages is different from bilingualism in which schooling is available in one language (the one that also carries social prestige) but not the other. While the interest of the cognitive neuroscientist in bilingualism may be in understanding the neural bases of the distribution of the two linguistic systems in the bilingual, the reality is that research subjects and clinical patients invariably come from a sampling from the social distribution. It is thus necessary to begin an understanding of bilingualism from its social bases.

### **Societal Characteristics**

Social scientists have studied the properties, distribution and stability of bilingualism in many societies and settings over time. The following are some key characteristics that may influence the bilingualism of individuals growing up within them:

#### Social status

Whether the two languages of the bilingual hold equal or different status within the community will have consequences on the stability of the bilingualism over time, across generations. In the English-speaking parts of Canada, for example, bilingualism is commonly attained by English speakers choosing to learn French in order to gain access to the privileges of bilingualism. These communities gain a second language without compromising the first language. At the same time, there are immigrant communities in

Canada for whom English is a second language, schooling is available in English, and there is no societal value associated with the home languages of these individuals. For most of these bilinguals, the native language will have a limited range of use (often the homes, neighborhoods, and religious institutions) and it is not likely to survive in future generations. The differential status of the languages will produce bilingualism with different levels of strength and stability, even though these individuals are considered bilingual. Fully developed bilingualism in the absence of social status is mostly a transitional phenomenon.

### Compartmentalization

Bilingualism often exists in circumstances where the functions of the two languages are differently distributed across social and cognitive domains, and therefore the bilingualism is compartmentalized. Schooling is a major domain where the language of immigrant communities is not represented. Under such circumstances, the language repertoire of bilinguals is asymmetrical. Academic words are not developed in the language used only outside of schooling and academic contexts. Measurements of bilingualism using academically-oriented tasks, such as a standardized test or a verbal IQ test, may yield results that are questionable in validity for the language that is not used in school.

### Literacy

Literacy is a significant proxy for cultural capital and socioeconomic status of an immigrant group. Whether bilinguals have education (and thus literacy) available in both languages is telling of the relative status of the two languages in their society. The size of the mental lexicon is one area of language where growth continues through the lifespan,

and reading is a key means through which vocabulary growth occurs. Thus, the literacy history of the bilingual individual is important not just as a proxy to socioeconomic status, but in understanding the linguistic environment of the bilingual individual.

Bilinguals who come from immigrant backgrounds can differ significantly in the extent to which they may have attained literacy in their home language prior to immigration.

Limited literacy may be due to lack of access to schools in their country of origin, or in some extreme cases, a home culture such as the Hmong of Southeast Asia, which does not have a developed system of literacy.

### Immigrant generation

The phenomenon of language shift refers to immigrant communities as they move in successive generations from primary dominance in their heritage language to bilingualism, and then to dominance or monolingualism in the new language. This shift is rapid in most immigrant environments, and has been well-documented in the United States. With the exception of the monolinguals who are linguistically assimilated as well as some of the first-generation immigrants who remain isolated, most of the others would be considered bilingual, even though their proficiencies would vary considerably. The first generation is characterized by considerable variation in second language proficiency, which is usually predicted by their age of immigration and educational opportunities. Second generation bilinguals usually have the highest degree of proficiency in the two languages, especially those who are recruited to serve as translators for their parents. The third generation will contain significant variation in the heritage language proficiency, with a considerable proportion of individuals who have passive or limited ability in the language, often limited to the domain of their home. Since immigrant groups tend to

come in successive cohorts over a period of time, any given sampling from a seemingly homogeneous group (such as an ethnic category “Hispanic”) will still contain considerable variation with respect to immigrant generation, and certainly variation in language proficiency.

#### Historical circumstances other than immigration.

In many parts of the world, bilingualism occurs for reasons other than immigration through which languages come into contact. Bilingualism also occurs through an interest in learning a language that can provide access to communication and global resources, a status that English holds today. Bilingualism can also occur through conquest or colonization, as contrasted with voluntary immigration, in which an occupying force imposes its language onto the community. Such is the case with indigenous languages in the Americas or the Aboriginal languages in Australia. These are all circumstances of bilingualism that require special analysis and attention with respect to the bilingual individuals contained therein.

#### **Individual Considerations**

The bilingual literature often classifies bilingual individuals independently from their societal conditions. This does not allow for an appreciation of the fact that the sampling for bilinguals of a given characteristic at the individual level may be different depending on the societal condition from which the sample is being drawn. A bilingual who is literate in both languages is relatively easy to find in some contexts, and quite difficult to find in others, and so studies conducted with bilinguals in these two different settings may have very different sample characteristics because they are sampled from different sectors of their society. The following are considerations of bilinguals at the

individual level that have been prominent in the literature, but are best framed by the societal conditions in which they occur.

### Age of Acquisition

The chronological age at which an individual is exposed to a second language has important consequences for the level of bilingualism attained. Some individuals, known as simultaneous bilinguals, are bilingual from birth and grow up in families where the two languages are used interchangeably. In cases of simultaneous bilingualism, one might ask the question of whether either of the languages was more dominant (in most circumstances, that would be the mother's language), although this information may be difficult to obtain objectively.

In the case of sequential bilinguals, the individual may begin learning the second language at different ages. Typically, the literature distinguishes between early bilingualism (before age 5), late childhood bilingualism (between ages 5 and 15) and adult bilingualism. However, there is considerable variability in the actual cutoff points used. Very few studies distinguish between bilingualism in the various stages of adulthood, although this may become an important distinction as bilinguals become increasingly studied in the aged population.

Age of exposure to the second language is necessarily correlated with the degree of development of the first language. Early bilinguals are considered to be learning a second language prior to the full grammatical development of the first, and therefore the two developing systems will interact more actively. Late bilinguals have an established grammar in their first language, but their literacy skills are still in the process of development, and thus schooling becomes an important mediating factor. Adult

bilinguals vary considerably in their level of formal schooling, and therefore may exhibit considerable variability in their circumstances of bilingualism based on socio-demographic characteristics. All of these conditions will lead to differing levels of proficiency in the two languages.

The most commonly asked question related to the age of the learner is whether there is a biologically-conditioned critical period for second language acquisition, parallel to the critical period hypothesis for native language acquisition. The central part of the hypothesis is that there is a period of readiness during which limited input is sufficient for complete development, and a corollary that no amount of input outside the period is sufficient for normal development. There appears to be an unquestionable decline in second language attainment as a function of the age of exposure to the second language, particularly in the area of phonology. However, there is thus far no convincing evidence for a qualitative difference in the outcome of second language acquisition that occurs within and outside of the critical period. Since most of the research conducted thus far has used varying psycholinguistic and sociological measures of language proficiency, there is great anticipation that evidence from brain localization and activity can shed light on this most interesting problem.

### Language Proficiency

Bilinguals can be differentiated with respect to levels of proficiency in their languages. Grammatical proficiency can involve attainment of native-like control in the linguistic arenas of phonology, morphology, syntax, semantics, or pragmatics.

Grammatical proficiency usually involves a scale in which native-like control is an absolute threshold – for example, the control of English regular and irregular past tense

marking on verbs. The most commonly examined areas of grammatical proficiency are in the areas of phonology, morphology and syntax. Caution is necessary in using native-like control as a standard when there is considerable social and dialectal variation in the standard itself. South Asians, for example, are often exposed to a variety of English that is known as “World Englishes” that has many linguistic and social characteristics that are quite different from standard English. Also, many immigrant students in the United States are exposed to non-standard varieties of English in schools, such as African-American Vernacular English or Black English.

Another arena of proficiency is in the aspects of language involving literacy. Measures of literacy typically show variability even within a native monolingual population, and many measures are constructed in order to produce a normal distribution of performance. Performance on measures of literacy in the two languages of the bilingual can produce vast discrepancies resulting from formal educational experiences.

Balanced bilinguals are individuals considered equivalent in their proficiencies in the two languages. Many researchers consider this to be an idealized state that is not attained by most bilinguals, and bilinguals need to be identified with respect to their language dominance. It should not be assumed that the native language is dominant in sequential bilinguals, especially among first- and second-generation immigrants who are schooled in their second language. An additional complication arises from the fact that dominance may depend on the domain of language that is sampled.

Semilingualism refers to a state where proficiency in both languages is considered incomplete. Because the grammatical aspects of language are considered to be part of the innate competence of individuals, those with incomplete proficiency in these aspects in

both languages are generally considered to be linguistically impaired, assuming that dialectal differences can be ruled out. In the domain of literacy, it is generally accepted that literacy attained in one language predicts literacy attained in the other language, provided that learning opportunities are provided. Thus, failure to attain age-appropriate levels of literacy in either language is a well-noted phenomenon and worthy of serious investigation.

### Active vs. Passive Bilingualism

Bilinguals can vary considerably in the extent to which they use their two languages, independent of proficiency. This may be an important consideration, to the extent that responses on psycholinguistic and neurolinguistic tasks of subjects depends on the effects of practice or the recency of use of the language. For example, an adult immigrant who moves to a region where there is no sizeable speech community of speakers of the native language may have a high level of proficiency, but very few opportunities for use. Or an individual who is married to someone of the same linguistic background is more likely to maintain use of the language than someone who marries outside their linguistic group. The study of bilingualism that does not consider the level of active use of the two languages and simply looks at levels of proficiency may miss out on an important source of variation on performance on linguistic tasks. Sociolinguists who have studied bilingual speech communities have identified individuals who may rarely speak the language, or who may have lost some of the language, but are nevertheless considered to be members of that speech community and self-identify as such.

### **Linguistic Considerations**

The similarities and differences between the languages of bilinguals introduce an important set of considerations. Linguists have noted varying amounts of interference across languages that can be characterized with respect to their differences, noting for example the difficulty of Japanese learners of English in mastering the /r/ and /l/ sound distinction or the plural marking on nouns. Languages can vary along the lines of historical relationships, as well as at varying levels of their structural features. For example, Japanese, Turkish and Tamil are considered similar in grammatical characteristics in spite of their distance with respect to historical relationships. Yet historical relationships can be enormously important in areas such as the lexicon because linguistic borrowing due to language contact is a relatively common occurrence.

The study of second language acquisition has also been guided by the question of linguistic transfer from the first to the second language. Second language acquisition is considered to be more efficient if the two languages are grammatically similar than when they are different. Although there is debate as to the comprehensive nature of language transfer, it is undisputable that linguistic similarity will determine to a large extent to rapidity of the learning process – English speaking adults who are learning Italian, German, Spanish or French will progress at least twice as rapidly as if they are learning Russian, Bulgarian, Arabic or Korean under comparable conditions, and with comparable levels of aptitude in learning a second language. On the other hand, linguistic theories that emphasize the common underlying principles of human language, such as the Chomsky-inspired approaches to universal grammar, make special note of the similarities that can also be found among second language learners in spite of differences in their native language.

## **Psycholinguistic perspectives**

The major question dominating psychological studies of bilingualism has been how the two languages are represented -- the two poles being independence and interdependence. These questions have been asked in the context of the domains of language comprehension and language production, with considerably more experimental research in the area of comprehension. A related question is how organization might vary as a function of language dominance or degree of proficiency in the two languages.

A key emerging generalization appears to be that the bilingual's two languages are usually interdependent, with evidence for a shared storage system. This evidence is strongest in the area of word identification, where considerable experimental work in lexical access suggests that both languages are activated simultaneously during word recognition. For example, investigations of cognates are revealing, because these words appear in both languages. Experiments have found bilinguals to recognize cognates as being words faster than non-cognate words, presumably because both lexicons are being accessed simultaneously. Studies of semantic priming in word recognition also support the notion of linguistic interdependence. In these tasks, subjects are asked to make lexical decisions of words that are immediately preceded by a semantically related or unrelated word. In mixed language presentations, there is semantic facilitation even if the priming word is in a different language than the test word, again suggesting that both languages are simultaneously active.

Studies of episodic memory, particularly for word lists presented in either language, suggest that bilinguals organize information principally along semantic dimensions, although they are able to remember the language of presentation especially

depending on the condition of the task. Studies of semantic memory in which incongruence between the stimulus and word is explored (such as the Stroop Test in which subjects are asked to name the color of the ink of words signifying congruent or incongruent colors – e.g., the word “red” printed in red or green ink) show significant cross-language interference, also suggesting a principal effect of cross-language interdependence.

A key area of exploration lies in the conditions of the task and context that might modulate these basic findings. Computational modeling of bilingual cognition is still in the early stages, with some promising attempts to model linguistic interdependence, independence, and interference. Such models may prove to be useful to bridge theoretical models of representation with the task and context demands of bilingualism.

Differences between bilinguals and monolinguals are an area of some interest, especially by those concerned about the possible positive or negative effects of bilingualism on cognition. Developmental research suggests that bilingualism in children may result in accelerated development in the executive function areas of attention and inhibition, but not necessarily in the area of general cognition. However, there is evidence that bilinguals are slower than monolinguals in tasks such as lexical decision-making, presumably because of a larger combined lexicon.

### **Brain Localization**

Evidence of language localization in the left hemisphere and in particular in the Broca’s and Wernicke’s areas for specific functions is supported by the accumulated aphasia literature. Some deviations have been noted, particularly a greater degree of right hemisphere involvement in the less dominant language.

Much research on bilingual aphasia has focused on recovery patterns, such as whether recovery is parallel, or whether it is differential and selective. Tabulations of cases of recovery patterns report that about 4 in 10 cases show parallel recovery, with the remainder being about evenly split between stronger recovery in the first language and in the second language. Thus, all possibilities seem to occur in very roughly equal proportions. These patterns must all be interpreted with strong caveats about the varying quality of the linguistic assessment of the recovery as well as the descriptions of the bilingual history and proficiency of the subjects. Cases of nonparallel recovery are noted as indicating differentiated organization, although alternative interpretations are possible such as a “switch” mechanism between the languages.

Research using bilateral stimulus presentation such as dichotic listening that explore the question of hemispheric dominance suggest that language may be represented more bilaterally (i.e., more evidence of right hemisphere engagement) in bilinguals than in monolinguals, with the case being more so for the second language than the first language. This evidence is not conclusive.

Research using the most recently available neuroimaging techniques of positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) with bilinguals is showing promise in advancing the question of the independence and interdependence of the two languages. Specifically, these studies ask whether there are different or overlapping areas of activation when processing the respective languages of the bilingual.

In language production studies, bilinguals are typically asked to repeat words, generate words, or in some cases to provide narrative during the scan. The results show

that there are overlapping and focused areas of activation for bilinguals with high proficiency in both languages, regardless of whether they are early or adult bilinguals, supporting the interdependence view of bilingualism. However, among adult bilinguals with low proficiency in the second language, the pattern of activation is less focused and exhibits some degree of right hemispheric engagement. The studies strongly point to the importance of language proficiency as an explanatory condition for localization as well as an important control and subject selection criterion.

Studies of language comprehension are better able to control tasks for semantic and syntactic levels of processing. These studies, though fewer in number, suggest that semantic processing (judging whether sentences are meaningful) in the two languages show a similar pattern of results as those found in the production studies. However, in the area of syntactic processing (judging the grammatical content of sentences) the adult bilinguals showed more extended areas of activation in their second language even for those with high proficiency. Although these results are still quite preliminary, they point to the promise of neuroimaging methods in untangling what is possibly a three-way interaction between language proficiency, age of acquisition, and specific language function (semantics vs. syntax) in bilingual representation.

## **Conclusion**

The neuroscience of bilingualism shows great promise in addressing important issues in the mental representation of bilingualism that have been identified in the psycholinguistics and cognitive science. In turn, the study of bilingualism challenges all fields to be more specific in identifying and incorporating the diversity of the subject population. Language proficiency and age of bilingualism are both key variables in the

cognitive and neuroscience literature thus far, and both of these are determined in large part by social and cultural conditions. At a minimum, these background variables must be carefully documented and examined as part of the subject screening and data reporting in order to draw appropriate conclusions from research in the neurological paradigm.

## Further Reading

Bhatia, T. K. and Ritchie, W. C. (eds.) (2004). *The handbook of bilingualism*. Malden, MA: Blackwell Publishing.

Bialystok, E. (2001). *Bilingualism in development*. Cambridge: Cambridge University Press.

Fishman, J. (ed.) (1978). *Advances in the study of societal multilingualism*. The Hague: Mouton.

Hakuta, K. (1986). *Mirror of language: the debate on bilingualism*. New York: Basic Books.

Hamers, J. F. and Blanc, M. H. A. (2000). *Bilinguality and bilingualism* (2nd edn.). Cambridge: Cambridge University Press.

Kroll, J. F. and De Groot, A. (eds.) (2005). *Handbook of bilingualism: psycholinguistic approaches*. Oxford: Oxford University Press.

Lambert, W. E. (1972). *Language, psychology, and culture: essays*. Stanford, CA: Stanford University Press.

Paradis, M. (2004). *A neurolinguistic theory of bilingualism*. Amsterdam: J. Benjamins.

Romaine, S. (1995). *Bilingualism* (2nd edn.). Malden, MA: Blackwell Publishing.

Wei, L. (ed.) (2000). *The bilingualism reader*. London: Routledge.