



Bilingualism and Cognition

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Scientific interest in the effects of (individual) bilingualism on cognition dates back to at least the first quarter of the 20th century, as illustrated by two early articles on the relation between bilingualism and mental development (Smith, 1923) and between bilingualism and intelligence (Saer, 1923). In addition to engaging scientists, the question of whether and how bilingualism affects cognition also concerns policy makers, educators, and parents of bilingual families. The widespread interest in this topic presumably stems from the desire to create circumstances that foster beneficial effects of bilingualism on cognitive functioning while at the same time preventing any adverse effects bilingualism might have. In one domain of cognition, namely, language representation and use, the influence of bilingualism is ubiquitous, affecting all components of the language system, but there is also plenty of evidence to suggest that bilingualism also affects nonlinguistic cognitive domains. In this entry the influence of bilingualism on both language (verbal cognition) and some aspects of nonverbal cognition is discussed.

Bilingualism and Language

Many studies have shown that a bilingual's two languages constantly interact with one another. It appears that even a purely unilingual communicative setting does not prevent the contextually inappropriate language from also being active and influencing the way in which the target language is processed. This holds for both language comprehension (e.g., Marian & Spivey, 2003) and language production (e.g., Starreveld, De Groot, Rossmark, & Van Hell, 2014), even when a bilingual's two languages do not share any orthographic or phonological relationship (e.g., English and Chinese; Wen, Filik, & Van Heuven, 2018), and when one language is spoken but the other is a sign language (Morford, Kroll, Piñar, & Wilkinson, 2014). The inevitable consequence of the inherently interactive nature of the bilingual language system is that the linguistic expressions of bilinguals differ from the analogous expressions of monolingual speakers. In other words, bilinguals do not equal two monolinguals in one person, and the linguistic expressions of monolinguals should not be considered the norm against which the language of bilinguals is evaluated. Contrary to such a "fractional" view of bilingualism, a "holistic" (Grosjean, 1989) or "multicompetence" (Cook & Li Wei, 2016) view of bilingualism acknowledges the inherently interactive nature of the bilingual language system. This more realistic view acknowledges that the frequent use of two languages produces a specific linguistic competence, one that differs from the competence of monolingual speaker-listeners but that is by no means inferior to it.

Most studies on language interaction (also called "crosslinguistic influence" or "transfer") in bilinguals have looked at the influence of the native, first language (L1) on using the second (L2), ignoring the possibility that L2 may also influence L1. Laufer (2003) suggests one reason is that many researchers in applied linguistics have been especially interested in L2 learning, and particularly in its earliest stages. Crosslinguistic influences during these early stages of learning are almost entirely from the stronger L1 to the still weak L2 rather than from L2 to L1. A second reason she suggests is that much work on L2 learning has been



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motivated by the question of how members of immigrant communities can come to master the dominant language of the host community, the immigrants' L2, as rapidly as possible. Consequently, research primarily focused on how L2 was acquired rather than on what happened to L1 in the process. Whatever the reasons for the relative lack of studies examining an influence of L2 on L1, the available evidence indicates that such influence exists in all linguistic domains: phonology, lexicon, morphology, syntax, conceptual representation, and pragmatics (Pavlenko, 2000).

Language interaction in bilinguals is manifest in multiple phenomena. Among them are accented speech and accented comprehension, that is, the production of particular linguistic elements that differ from the way monolingual speakers would produce them, and differences in language comprehension processes as compared with monolinguals listening to or reading analogous language input. The word "accent" is used in a broad sense here, referring to differences in both language production and language comprehension in bilinguals as compared with monolinguals, and to differences in all linguistic subdomains, not just phonology.

One possible source of accents is parallel activation of representations of linguistic elements in bilinguals' two language subsystems, even when they have selected one of their languages (the "target" language) for current use. Because the language system of monolinguals only stores linguistic units belonging to a single language, such parallel activation does not occur when monolinguals process language. According to this view, the representation units themselves do not need to differ between monolinguals and bilinguals. For instance, the representation of the English phoneme /t/ and the stored meaning for English *cat* in an English–French bilingual are identical to the representation of English /t/ and the stored meaning of English *cat* in a monolingual English speaker. The second possible source of bilingual speech accents is that bilinguals may have developed memory representations of specific linguistic units that differ from the representations of the corresponding units in monolingual memory. For instance, bilinguals may have developed representations that merge a pair of corresponding representations in monolingual speakers of their two languages. The former source of accents may be regarded a difference in processing or "performance"; the latter a difference in knowledge or "competence."

Phonological Accents

Flege and his collaborators have shown a phonological accent, in both L1 and L2, when bilinguals produce speech sounds (e.g., Flege, 2002). In some studies they measured the "voice onset time" (VOT) of consonants spoken by bilinguals and monolinguals in the context of a larger language fragment. The VOT is the time between the release of the air and the moment the vocal cords start to vibrate when a speaker produces a consonant. The VOT for one and the same consonant may differ between languages. For instance, the consonant /t/ is spoken with a longer VOT in English than in French and Spanish. This fact gives rise to the question of how bilingual speakers of two languages that exploit different VOT values in producing one and the same consonant utter this consonant. Flege and his colleagues have shown that the VOT values of such consonants differ between monolinguals and bilinguals. Specifically, when spoken by bilinguals these consonants take on VOT values that are intermediate between those of the same consonants spoken by monolingual speakers of the two languages concerned. For instance, if English–French bilinguals and English monolinguals are asked to pronounce the speech fragment *two little dogs*, the VOT of the /t/ sound in *two* is shorter for the English–French bilinguals than for the English monolinguals. Conversely, if English–French bilinguals and French monolinguals are asked to pronounce the speech fragment *tous les chiens*, 'all dogs', the VOT of the /t/ sound in *tous* is longer for the English–French bilinguals than for the French monolinguals.



Flege (2002) attributed these phonological accents to two L2 speech learning processes. One of these, “phonetic category assimilation,” is thought to lead to representations that merge closely similar L1 and L2 sounds into a single phonetic category in memory. The second, “phonetic category dissimilation,” is thought to operate when an L2 sound is very different from all L1 sounds stored in memory. A separate representation for the new L2 sound is then formed in memory, but the position it takes up in phonetic space differs from the position occupied by this sound in monolingual speakers of the language concerned. Furthermore, while inserting a phonetic category for this new sound into the phonetic space, it pushes away one or more of the categories that represent L1 sounds from their original positions (causing an accent).

Though category assimilation and dissimilation provide a plausible explanation of the phonological accents in bilingual speech production, an account in terms of parallel activation of two analogous L1/L2 phonetic categories (e.g., a French-like /t/ and an English-like /t/) appears equally plausible, at least for both early bilinguals and late proficient bilinguals. Early bilinguals can already *perceive* the difference between certain pairs of closely similar L1 and L2 phonetic categories from 10 to 11 months onward (e.g., Sundara, Polka, & Molnar, 2008) and late proficient bilinguals can also do this (Flege, 2007). This discrimination ability clearly points toward the existence of separate phonetic representations for similar L1/L2 sounds because it is hard to see how a difference between two such speech sounds can be perceived at all if they share one and the same representation. The very existence of such pairs of representations for speech sounds that are similar in L1 and L2 renders an interpretation of accented speech sounds in terms of their parallel activation plausible (see De Groot, 2014).

Grammatical Accents

A grammatical accent in bilinguals can, for instance, be witnessed by looking at the way they parse sentences that are (temporarily) structurally ambiguous in one of their languages but not in the other, or sentences that are structurally ambiguous in both languages but for which the preferred solution differs between these languages. An example of the first type of ambiguity is the English sentence *The leader defeated in the election resigned one day later* (Rah & Adone, 2010), where *defeated* can either be the simple past of the transitive main verb or the passive participle of a reduced relative clause, the nonreduced form being *who was defeated*. In other languages, such as German and Dutch, the relative clause construction always takes a nonreduced form so no temporary ambiguity exists. An example of the second type of ambiguity is the English sentence *Someone shot the son of the actress who was on the balcony*, where either the head of the complex noun phrase (*the son*) or the second noun in this phrase (*the actress*) can be the subject of the relative clause (*who was on the balcony*). Though both structural solutions occur in English, English favors a “low attachment” analysis of this type of sentences, where the second noun in the complex noun phrase (*the actress*) is most often the subject of the relative clause. In other languages, such as Spanish, this ambiguous structure also exists (*Alguien disparó contra el hijo de la actriz que estaba en el balcón*), but the “high attachment” solution is more often correct and preferred. That is, *el hijo* is most often (initially) assigned the role of relative-clause subject, forcing a reanalysis of the sentence if later on this solution turns out to be the wrong one (when *estaba* is encountered). The central question in this line of research is whether bilinguals parse such ambiguous constructions differently from monolingual speakers of the two languages in question, thus evidencing a grammatical accent.

Dussias and her colleagues examined how Spanish–English bilinguals parse sentences of the second type. The results suggested an influence of the other language on the way





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bilinguals analyze them and that the context of testing may modulate this effect: When testing took place in a predominantly English-speaking environment in the USA, both Spanish L1/English L2 and English L1/Spanish L2 bilinguals generally favored low attachment over high attachment irrespective of the language of the presented sentences, English or Spanish (Dussias, 2003). In other words, the Spanish sentences were analyzed according to the English-like parsing strategy, demonstrating an accent in Spanish. In another study (Dussias & Sagarra, 2007), Spanish–English bilinguals immersed in L1 Spanish and presented with Spanish sentences behaved like the monolingual Spanish control subjects, favoring high attachment. In contrast, Spanish–English bilinguals presented with Spanish sentences but immersed in L2 English preferred the low attachment solution that is most common in English, thus showing a grammatical accent in L1. In short, bilinguals appear to prefer the parsing procedure that is most common in the language they are currently exposed to most. This in turn suggests that the two grammatical-knowledge structures that enable the two different parses are activated to different degrees across different language contexts.

Semantic Accents

Languages differ from one another in the way their vocabularies carve up conceptual space and the physical world. For instance, both Russian and English have separate words for glasses and cups (*stakany* and *chashki* in Russian), but the exact reference of these words differs between these languages: Paper cups are called *stakanchiki* (small glasses) in Russian (Pavlenko, 2005). Variation in the expression of concepts across languages exists for many semantic domains, perhaps all, and it occurs across both distantly related and closely related languages (Majid, Jordan, & Dunn, 2015). One of the best-known examples of differential word-to-concept mapping across languages concerns the semantic domain of color concepts. Languages vary widely in the number of color words they possess to describe the color spectrum and, of course, the number of color words used in a specific language has consequences for the exact reference of each of these words: The smaller the number of color words, the larger the range of hues referred to by each of them.

The consequence of this cross-language variability in color terminology for color categorization and representation in bilinguals has been examined since around 1960. One study concerned a detailed investigation of color naming in Navaho–English bilinguals and Navaho and English monolinguals (Ervin, 1961). Ervin first performed a detailed contrastive analysis of the color systems of Navaho and English. This analysis revealed, for instance, that *litso*, the closest Navaho translation of *yellow*, is the favored response of monolingual Navaho speakers to hues across a much larger part of the color spectrum than the range of hues exciting *yellow* in monolingual speakers of English. Assuming an influence from the colors' names in the nontarget language, Ervin expected the response probabilities in the target language to differ between the bilinguals and monolinguals. For instance, when presenting a yellowish color patch and inviting a color response in Navaho, the bilinguals were expected to produce fewer *litso* responses than the monolingual Navaho controls. These and other predictions from the contrastive analysis were borne out by the data.

Ervin explained these results in terms of coactivation in bilingual memory of the representation of the presented color's name in the nonresponse language. For example, a Navaho–English bilingual may say *tatLqid* ('green') to a color patch that most Navaho monolinguals would call *litso* ('yellow') because the common English name for the depicted color (*green*) is coactivated with *litso*. Coactivated *green* then activates *tatLqid* via a connection between these two words in memory and *tatLqid* emerges as the response. An alternative account of such semantic accents is in terms of differences in the conceptual representations of color words between bilinguals and monolinguals. This is how Caskey-Sirmons and



Hickerson (1977) explained the results of a similar study wherein English L2 speakers with various Asian languages as L1 were tested. Specifically, these authors assumed that, in the course of acquiring L2 English, broader conceptual representations of color words had been formed by merging the concepts associated with L1 color words and those associated with these words' closest L2 translations. But also here an interpretation of the results in terms of co-activation of lexical representations in the nontarget language cannot be ruled out (De Groot, 2014), and a similar indeterminacy may apply to the different behavior of monolinguals and bilinguals in tasks that probe bilingual conceptual representation in other semantic domains (e.g., Ameel, Malt, Storms, & Van Assche, 2009, a study that examines the representation of common household objects).

Bilingualism and Nonverbal Cognition

Bilingualism and Linguistic Relativity

The above discussion on how languages differ in the way they map words onto concepts implicitly introduced the notion of "linguistic relativity," that is, the idea that language influences thought or, more precisely, that differences between languages in the way they encode aspects of the surrounding world cause speakers of different languages to think differently about the world. The theory not only applies to nominal concepts such as color but also to grammatical concepts such as tense, number, and gender. For example, the fact that verb forms in English but not in Indonesian contain tense markers (information about the time of the event or action described by the verb: past, present, or future) is thought to result in different time cognition in speakers of English and Indonesian. Benjamin Lee Whorf (1897–1941) is regarded as the major advocate of this view, which is known as the Sapir–Whorf hypothesis (after Whorf and his mentor Edward Sapir).

Bilingual studies on linguistic relativity are still sparse, though their number is growing because of the awareness that bilingualism has the potential to critically inform the linguistic relativity debate. It may do so because "bilinguals are the only ones to experience directly the effects of linguistic relativity" (Pavlenko, 2005, p. 437). Do bilinguals experience different conceptual worlds when they speak their one or other language (a form of bilingualism that in the older literature is known as "coordinate bilingualism")? If so, is each of these identical to the conceptual world of monolingual speakers of the languages concerned? In the case of sequential bilingualism (where L2 acquisition starts after L1 acquisition), are there intermediate states prior to an end state of experiencing two conceptual worlds and, if so, what are they? Or is it perhaps the case that bilinguals have developed a blended conceptual world shared by the two languages and different from the conceptual world of monolingual speakers of either language (known as "compound bilingualism")?

Research suggests that some structural contrasts between a bilingual's two languages become reflected in conceptual representations that differ from those of monolingual speakers of these languages (e.g., Bassetti, 2007, a study on the effects of grammatical gender differences between Italian and German on the mental representation of objects; Athanasopoulos & Kasai, 2008, a study that examined the effect of grammatical number differences between English and Japanese on object representation). At least one bilingual study, testing the grammatical tense contrast between English and Indonesian (Boroditsky, Ham, & Ramscar, 2002), suggests that bilinguals can switch between two language-specific modes of thinking and that this mental reset can be triggered by just a modicum of language. Recent studies on the conceptual representation of color similarly point at the flexibility of bilingual cognition by showing that bilinguals' responses in a color discrimination task varies with the usage frequency of either language (e.g., Athanasopoulos, Damjanovic, Krajcivova, & Sasaki, 2011).



Bilingualism and Intelligence

Until well beyond the middle of the 20th century the view prevailed that bilingualism is detrimental for intelligence and cognitive functioning in general. A study by Peal and Lambert (1962) marked a change from this view to the opinion that, under specific conditions, bilingualism is in fact beneficial for intelligence and cognition, including some aspects of linguistic competence. In that study 10-year-old French–English bilingual and French monolingual children from middle-class French schools in Canada’s Montreal region were administered a number of tests that measured their verbal and nonverbal intelligence. Whereas earlier studies had shown a disadvantage for bilingual children as compared with monolingual peers, the bilingual children in this study performed significantly better than the monolingual children on most tests, both the ones that measured verbal intelligence and those measuring nonverbal intelligence. The bilingual advantage was, for instance, manifest in tasks that assessed concept formation ability and mental flexibility, and the bilingual children showed a more diversified set of mental abilities than the monolingual children.

To account for the discrepant results, Lambert (1977) highlighted one potentially crucial feature of the Peal and Lambert (1962) study, namely the fact that in the Montreal region both French and English are socially highly respected languages. Therefore, the acquisition of English by children with French as their home language does not involve the risk of French getting corrupted as a consequence of a social pressure not to use it. This form of bilingualism, where an L2 is added onto an L1 that does not suffer a cost, has been coined “additive bilingualism,” and it is this form of bilingualism that is advantageous for cognition. The counterpart of additive bilingualism is “subtractive bilingualism.” In this form of bilingualism, for one reason or other (e.g., national and educational policies), the use of L1 is discouraged, with the effect that it is gradually replaced by L2. This form of bilingualism is detrimental for cognitive functioning. Plausibly, the earlier studies had accidentally tested bilinguals of the subtractive type. A further possible cause of the deviant results is that many of the earlier studies lacked experimental rigor, not properly matching the bilingual participants and their monolingual controls on relevant variables such as age, socioeconomic status, and amount of education (see Hakuta & Diaz, 1985, for a review). In all these respects, Peal and Lambert’s study compared favorably with the earlier ones. Recent research confirms this analysis (e.g., Nicolay & Poncelet, 2015).

Bilingualism and Executive Control

Since Peal and Lambert’s (1962) seminal investigation, detailed knowledge has been gathered about aspects of cognition in which bilinguals can excel, such as in executive control (also called “attention control” or “cognitive control”). When bilinguals use one of their languages, the other language is simultaneously active as well. In order to select the targeted language, “language control” must be exerted, that is, the contextually inappropriate language must be suppressed or ignored and the contextually appropriate language must be selectively attended to. It is generally assumed that language control is effectuated by more general processes and mechanisms of executive control, which take care of the control of action in general. If true, the requirement to incessantly control their two languages may boost bilinguals’ ability to exert executive control in general and, consequently, bilinguals should be better than monolinguals when they perform nonverbal tasks that require executive control.

This hypothesis has been confirmed in many studies (see Bialystok, Craik, Green, & Gollan, 2009, for a review). There is even evidence to suggest that this bilingual advantage can protect lifelong bilinguals against the onset of Alzheimer’s disease, plausibly by contributing to cognitive reserve (Craik, Bialystok, & Freedman, 2010). That domain-general control



mechanisms regulate language control is also suggested by the finding that bilingual experience induces changes in structure and function of the brain regions responsible for executive control (e.g., Abutalebi et al., 2012). Recently, however, the view that bilingualism fosters executive control has come under attack because of the increasing number of studies demonstrating similar behavior of monolinguals and bilinguals in many tasks that are thought to index executive function (e.g., Paap & Greenberg, 2013; Valian, 2015). A plausible reason for the inconsistent results across studies is the large variability among both the bilingual populations tested and the tasks used to index executive function. Possibly, the advantageous effect of bilingualism on executive function only applies to specific bilingual populations (e.g., lifelong bilinguals using both languages each day, both actively and passively) and to specific aspects of executive functioning.

Bilingualism has become an omnipresent phenomenon in the modern world and it may not take long before monolingual speakers can hardly be found anymore. It is a promissory side-effect of a development toward bilingualism as the norm that, in the process, a human's average cognitive skills may be lifted—as is suggested by the current research on the relation between bilingualism and nonverbal cognition.

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SEE ALSO: Crosslinguistic Influence in Second Language Acquisition; Early Bilingualism; Multicompetence; Multilingualism and Metalinguistic Awareness

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Suggested Readings

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Abstract: Bilingualism affects various aspects of verbal and nonverbal cognition. The first part of this entry discusses the influence of bilingualism on language representation and use—verbal cognition. The second part demonstrates its effect on various aspects of nonverbal cognition. The effect of bilingualism on language shows from many studies exhibiting the ubiquitous interaction between bilinguals' two languages, even in purely monolingual communicative settings. The mutual influence of the two languages is evident in both production and comprehension, in all linguistic subdomains (e.g., phonology, syntax, semantics), and occurs across both pairs of similar and dissimilar languages. A consequence of the inherently interactive nature of the bilingual language system is "accented" language, that is, differences in the linguistic expressions and comprehension processes of monolinguals and bilinguals. This phenomenon is illustrated with examples of phonological, grammatical, and semantic accents, and two possible sources of accented bilingual language are considered: differences between the representations of specific linguistic units in monolinguals and bilinguals, and cross-language activation of linguistic representations in bilinguals. Concerning the effect of bilingualism on nonverbal cognition the question is first posed how linguistic relativity—the idea that the different ways in which languages encode the surrounding world cause their speakers to think about the world differently—affects bilinguals' conceptual worlds. Next, the relation between bilingualism and intelligence is discussed, recent evidence suggesting that bilingualism is advantageous for intelligence and cognitive functioning in general. The final section focuses on the relation between bilingualism and one specific aspect of cognitive functioning: executive control.

Keywords: Bilingualism and Executive Control; Bilingualism and Intelligence; Bilingualism and Linguistic Relativity; Bilinguals' "Accented" Language Use; Language Interaction in Bilinguals; Parallel Activation in Bilingual Memory

