

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 articles that were published in 1923 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 reason for this widespread interest in this issue plausibly is the high incidence of bilingualism and the appreciation that knowing about the way in which bilingualism affects cognition is a prerequisite for creating the circumstances that foster any of its beneficial effects on cognitive functioning while at the same time preventing any adverse effects it 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 affects nonlinguistic cognitive domains as well. In this entry the influence of bilingualism on language (verbal cognition) will first be discussed and, next, its effect on various aspects of nonverbal cognition.

Bilingualism and Language

That bilingualism affects language can be concluded from the results of myriad studies showing that a bilingual's two languages constantly interact with one another instead of there being solid mental firewalls between them. It appears that even a purely unilingual communicative setting does not prevent the other language from being simultaneously active and influencing the way in which the contextually appropriate language is processed. This holds for both language comprehension (e.g., Marian & Spivey, 2003) and language production (e.g., Colomé, 2001). 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 (doing so would inevitably lead toward the conclusion that bilinguals' language use is inferior). Contrary to such a "fractional" view of bilingualism, a "holistic" (Grosjean, 1989) or "multi-competence" (Cook, 2003) view of bilingualism acknowledges the inherently interactive nature of the bilingual language system. This more realistic view holds that the frequent use of two languages produces a specific linguistic competence, one that differs from the competence of a monolingual speaker-listener but that is by no means inferior to it. Grosjean clarified this idea with an analogy derived from the domain of sports: "When compared individually with the sprinter or the high jumper, the hurdler meets neither level of competence, and yet when taken as a whole the hurdler is an athlete in his or her own right" (Grosjean, 1989, p. 6).

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

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there might be two reasons for this. The first relates to the fact that many researchers in applied linguistics have been especially interested in L2 learning, and particularly in the earliest stages of this process. 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. The second reason suggested by Laufer is that much of the work on L2 learning has been 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 the L2 was acquired rather than on what happened to the L1 in the process. Whatever the reasons for the relative lack of studies looking at a cross-language influence of L2 on L1, evidence is accumulating that the L1 is influenced by later languages, be it L2 or any other later language, and that such an influence affects all linguistic domains: phonology, morphology, syntax, lexicon, conceptual representation, and pragmatics (Pavlenko, 2000).

Language interaction in bilinguals is manifest in accented speech, that is, the production of particular linguistic elements that differ from the way monolingual speakers would produce these elements. In addition, it is manifest in accented comprehension, that is, in deviations from the way in which monolingual listeners or readers process analogous language input. Examples from the domains of phonology, grammar, and semantics will be presented below. (Note that 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.) Two possible sources of these accents are considered in the literature. One is parallel activation of representations of linguistic elements in a bilingual's 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 one and the same 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

In a series of studies, 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 of these studies the researchers measured the so-called "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 it is 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 it is for the French monolinguals.

Flege (2002) attributed phonological accents of this type to two L2 speech learning processes that both result in representations of phonetic categories in bilingual memory that differ from the representations of the corresponding categories in monolingual memory. One of these processes, “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 be operative 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).

Grammatical Accents

A grammatical accent in bilinguals’ language processing can, for instance, be witnessed by looking at the way bilinguals parse structurally ambiguous sentences for which the preferred solution differs between their two languages. Consider the Spanish sentence *Alguien disparó contra el hijo de la actriz que estaba en al balcón* (‘Someone shot the son of the actress who was on the balcony’). In sentences of this type, either the head of the complex noun phrase (*el hijo* ‘the son’) or the second noun in this phrase (*la actriz* ‘the actress’) can be the subject of the relative clause (*que estaba en al balcón*). Spanish favors a “high-attachment” solution of this construction, assigning *el hijo* the role of subject of the relative clause. Conversely, English favors a “low-attachment” analysis, in which *la actriz* is assigned this role.

Dussias and her colleagues (e.g., Dussias, 2003; Dussias & Sagarra, 2007) examined how Spanish–English bilinguals parse sentences of this type. The results suggested an influence of the other language on the way bilinguals analyze them and, furthermore, 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, in both the L1- and L2-speakers of Spanish, the Spanish sentences were analyzed according to the English-like parsing strategy. In a further study Spanish sentences only were presented, in either an L1 Spanish or an L2 English immersion environment, to Spanish-L1–English-L2 bilinguals and to Spanish monolingual control subjects. The bilingual participants immersed in L1 Spanish behaved like the monolingual Spanish control subjects, favoring high attachment. In contrast, the bilingual participants immersed in L2 English preferred the low-attachment solution that is favored in English.

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 the two languages: Paper cups are called *stakanchiki* (small glasses) in Russian (Pavlenko, 2005). One of the best known examples of differential word-to-concept mapping across languages concerns the way separate languages have lexicalized the color spectrum. Languages vary widely in the number of color words they possess to describe this 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.

Since around 1960 a couple of studies have been published on the consequence of this crosslinguistic variability in color terminology for color categorization in bilinguals. One of these studies 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. Furthermore, the commonality of Navaho monolinguals' *litso* responses at its peak (that is, at the point that represented the focal color *litso*) was much larger (89%) than the commonality of English monolinguals' *yellow* responses at its peak (34%). Assuming an influence from the colors' names in the non-target language, Ervin expected the response probabilities in the target language to differ in bilinguals as compared with monolinguals. For instance, she expected that more Navaho–English bilinguals than English monolinguals would respond with *yellow* upon the presentation of focal yellow and the instruction to respond in English. Similarly, when presenting focal *litso* and inviting a response in Navaho, bilinguals were expected to produce fewer *litso* responses than monolingual Navaho controls. These predictions were borne out by the data, as were those derived from other differences between the color systems of Navaho and English as revealed in the contrastive analysis.

Ervin explained these results in terms of coactivation in memory of the representation of the presented color's name in the non-response 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*. *Green* then activates *tatLqid* via a connection between these two words in memory and *tatLqid* emerges as the response. An alternative account of these 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 come into being that merged the concepts associated with L1 color words and those associated with these words' closest L2 translation.

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 theory 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. According to this idea, the fact that Navaho and English split

up the world of colors differently causes monolingual speakers of Navaho to think about, and perhaps perceive, colors differently from monolingual speakers of English. The theory not only applies to nominal concepts 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).

Studies on the relation between language and thought have typically compared the performance of monolingual speakers of two languages that differ from one another in one selected aspect, such as grammatical tense, gender, or number. Bilingual studies on linguistic relativity are sparse. Yet bilingualism has the potential to contribute importantly to this debate because it may be that “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 them 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 the 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”)? Recent bilingual studies on linguistic relativity suggest 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.

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 linguistic competence). In this 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 similar studies had generally shown a disadvantage for bilingual children as compared with monolingual peers, the bilingual children now performed significantly better than the monolingual children on the vast majority of all tests and subtests, 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 valued and 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 the 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, for instance, by not matching the bilingual participants and their monolingual controls on age, socioeconomic status, and amount of education (see Hakuta & Diaz, 1985, for a review). It may have been the case that the earlier studies tested bilingual children that tended to be younger or of a lower socioeconomic status, or less educated than the monolingual controls partaking in those studies. In all these respects, Peal and Lambert’s study compared favorably with the earlier ones.

Bilingualism and Executive Control

Since Peal and Lambert’s (1962) seminal investigation, detailed knowledge has been gathered about the aspects of cognition in which bilinguals excel. To conclude this entry, one of these aspects will be singled out here, namely, the skill of executive control (also called “attention control” or “cognitive control”). As already pointed out above, 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 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, that is, processes and mechanisms that take care of the control of action in general. If true, the requirement to incessantly control their two languages must have boosted 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 prediction came true in several studies, using different experimental tasks. It was for instance confirmed in a series of studies by Bialystok and her colleagues (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004) in which bilinguals and monolingual controls performed the so-called “Simon task,” a perceptual-motor task that assesses the participants’ ability to inhibit or ignore irrelevant information (an ability that requires executive control).

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 this inevitable development toward bilingualism as the norm that, in the process, human’s average cognitive skills will be lifted—as is suggested by the current research on the relation between bilingualism and nonverbal cognition.

SEE ALSO: Bilingual and Monolingual Language Modes; Complexity in Multilingual Systems; Crosslinguistic Influence and Multilingualism; Foreign Accent; Linguistic Relativity and Second Language Acquisition; Multicompetence; Multilingualism and Metalinguistic Awareness; Organization of the Second Language Lexicon; Spoken Word Production in Second Language Acquisition; Spoken Word Recognition in Second Language Acquisition

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