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Language and the perception of Space, Motion and Time

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Abstract

This literature review analyzes articles on the perception of space, motion and time across speakers of typologically different languages (L1s). The purpose of this analysis is to explore evidence of native language influence on speakers' perception and conceptualization of these cognitive domains. The analysis revealed that although languages may not encode all the cognitive aspects of space and motion, there is no difference among speakers with regard to the conceptualization and perception of these two domains. On the other hand, language-specific encodings of time seem to influence the speakers' perception of this domain, so it was concluded that language may affect abstract thought in general. Possible consequences for second language acquisition are discussed.

Every individual is at once the beneficiary and the victim of the linguistic tradition into which he has been born - the beneficiary inasmuch as language gives access to the accumulated records of other people's experience, the victim in so far as it confirms him in the belief that reduced awareness is the only awareness and as it bedevils his sense of reality, so that he is all too apt to take his concepts for data, his words for actual things. (A. Huxley, 1894 - 1963)

The purpose of this literature review is to explore the concepts of time, space and motion as encoded in various languages in an attempt to indicate how differences in linguistic encoding may reflect upon the speakers' conceptual representation of these notions, as suggested by the literature in Cognitive Linguistics and Cognitive Psychology. The most important controversy regarding the thinking/speaking dyad is whether these are distinct cognitive processes or, on the contrary, act synergistically in order to shape our experience and understanding of the world. Although there are no ultimate answers to this dilemma, findings from studies on the topic suggest that language learning is a phenomenon that seems to go far beyond acquisition of form, structure and meaning, and that language-specific encodings of reality may affect people in their every-day lives. The following section analyzes how space and time are encoded across typologically different languages.

LANGUAGE-SPACE/TIME SYMBOLISM

Although space has the same physical properties all around the world, the location of the human body and of objects within geographical confinements is encoded in different ways cross-linguistically. For instance, to locate and give directions, English employs an egocentric coordination system (the human body is taken as reference): *the house is on your left hand-side*, *turn right*, *turn left*. Other languages such as Tseltal Mayan (spoken in the region of Chiapas, Mexico) have an allocentric orientation system (Papafragou, 2007) that makes use either of objects or of geocentric coordinates based on the inclination of the land to express direction (Landau, Dessalegn, & Goldberg, 2010): *uphill*, *north from me* (Papafragou, 2007). As described in Munnich, Landau, and Dosher (2001), the notion of contact/support with respect to a reference object is also expressed differently across languages; thus, English distinguishes between *on* and *above*, while Japanese uses the same word for both space and contact support: *ue*, which means *top*. Conversely, German distinguishes between the idea of support involving attachment and that of support without attachment (*an* as in *the picture on the wall*, versus *auf* as in *the cup is on the table*), while English doesn't make this distinction, *on* being used in both instances. Additionally, the relationship between an object and its container is encoded differently in English as compared to other languages. English speakers distinguish between support (*put on*) and containment (*put in*), while Korean speakers for instance express only the notion of *tightness of fit*. They use the word *kkita*, meaning *to fit objects*

together tightly for both support and containment, but they also employ the word *nehta* to show that two objects fit together loosely. English, on the other hand, uses *in* for both instances. Furthermore, the notion of immediate support and non-support does not have to be encoded in Japanese and Korean, the information being used only in contexts where it is required (Munnich et al., 2001).

The encoding of movement through space is also subject to cross-linguistic variation. Motion of an object from one place to another is expressed in terms of the Source-Path-Goal schema: it involves a source, or starting point; a sequence of contiguous locations that connect the starting and ending points, or a path; and a direction, or ending point (Lakoff, 1987). While this schema characterizes motion in many languages, variation exists in how path and manner of motion are expressed. Based on these differences, Talmy (1985) proposed a binary categorization of languages: satellite-framed languages, or S-languages (Germanic, Slavic, Celtic, Finno-Ugric), and verb-framed languages, or V-languages (Romance, Turkish, Japanese, Korean, Greek, Semitic, Basque). Although expressing path is necessary in order to render the trajectory of a moving object, manner remains optional, with verb-framed languages tending to lexicalize it less than satellite-framed languages (Slobin, 2004). For instance, English expresses manner in the main verb, so it cannot incorporate path in the main verb at the same time, while French does the opposite: it encodes path in the main verb (preferably), and articulates manner in satellite constituents such as gerunds, prepositional phrases and adverbs. Therefore, an English speaker would say s*he ran out of the room*, while a Turkish or Romance speaker's corresponding utterance would resemble *she exited the room running* (Munnich et al., 2001). The manner/path distinction does not imply that path languages lack manner verbs. As Papapfragou and Selimis (2010) argued, the distinction between path and manner languages is rendered by restriction on the use of manner verbs in path languages. Thus, in satellite languages, manner verbs can be used with various path modifiers, while in many path languages, manner verbs, with some exceptions, cannot be used in bounded (culminated) events (Papafragou, Hulbert, & Trueswell, 2008): *the bird flew* (unbounded); *the bird flew to its nest* (bounded).

Crosslinguistic differences also operate at the level of temporal reasoning. Since our reality is construed in a space-time continuum and time is an abstract concept, duration is expressed by means of spatial metaphors across most languages, but the way time is spatialized varies depending on spatio-temporal metaphors, on cultural artefacts and on

individual disposition, age and experience (Boroditsky, Fuhrman, & McCormick, 2010). As expressed in the aforementioned study, time can be perceived as static or flowing, as fixed or continuous, as horizontal or vertical, as moving from left to right, from right to left, or from front to back. For instance, both English and Mandarin speakers use horizontal/front-back spatial metaphors to talk about time (Boroditsky et al., 2010). Thus, in English, one can *look forward* to an event *ahead*, one can *put the bad times behind*, or travel *back* in time. Similarly, Mandarin speakers use horizontal metaphors (*qián*, for *front*, *hòu* for *back*) to refer to temporal instances; however, Mandarin also makes frequent use of vertical metaphors (*shàng* for *up*, *xià* for *down*). In order to express earlier events Mandarin speakers use the spatial metaphor *up*, while the metaphor *down* is employed to lexicalise later ones. Although English speakers do employ vertical spatial metaphors to express time (e.g., *to hand down knowledge from generation to generation*), these metaphors are not used in English as often as they are used by the speakers of "vertical-time" languages. In fact, the aforementioned vertical spatial expression in English also has a horizontal counterpart, namely, *to pass on knowledge from generation to generation*, an expression that seems to be used more broadly: the phrase *hand down* has 18,200,000 "Google" results, while *pass on* has 116,000,000 hits. (The search engine "Google" was used due to its popularity among Internet users.)

In order to refer to a large amount of time, as Casasanto et al. (2004) suggested, the expression *for a long time* is used in English, while in Spanish the equivalent is *mucho tiempo*, which means *much time*. Although Greek does have terms that convey the meanings *long* and *short* (*makris* and *kantos*), they are not preferred in temporal contexts: to say a *long meeting*, for instance, a Greek speaker would employ the word *megalos* (large), or *poli* (much). In fact, the Greek way of expressing duration may confuse English speakers. For instance, the expressions *megali nychta*, or *megali schesi* in Greek (literally meaning *big night*, *big relationship*, respectively) have the connotation *significant* for English speakers, who use a different spatial metaphor, *long*, to express a great length of time (Casasanto et al., 2004).

In conclusion, although languages share the same basic views on motion, space and time, they also manifest cross-linguistic variety that operates at a metaphorical level. This diverseness may be either the outcome of disparity in conceptual representations among speakers of different tongues (people think differently, so they express themselves differently), or the cause of these differences (people speak differently,

therefore they think differently). The next section discusses some well-known theories on the effect of language on cognitive processes such as thinking and perception.

LANGUAGE-THOUGHT INTERACTION

Little is known about the language-thought interaction. Some theories of language and cognition have suggested that the human mind incorporates universals that constitute the realm from which languages select what will be encoded into their lexical and grammatical inventory. From that perspective, a language learner has to map the sounds in the language onto the pre-linguistic concepts present in the mind. This approach is known as the "universalist" view of language. An opposing view was expressed by Whorf (1956). Drawing on Jung's taxonomy of psychic functions (sensation, feeling, thinking and intuition), Whorf viewed thinking as a function which is to a large extent linguistic and called this "the linguistic relativity principle." The principle suggests that the grammars of different languages refer their speakers to different kinds of linguistics observations, which will in turn lead to different views of the world. In Whorf's view, language does not determine thought (as some of his critics have believed), but mediates it. Thinking itself represents only one of the psychic functions, so it does not influence perception in general, but only the part of it that is mediated by language. A moderate view was expressed by Slobin (1991) who proposed that language may influence thought during "thinking for speaking." In other words, it is possible that language-specific grammatical, syntactic and semantic requirements determine the online distribution of attention (Papafragou et al., 2008). That would imply that there are differences in the early allocation of attention across speakers of different languages just before they prepare to describe events. This latter view was also upheld by Landau et al. (2009), who suggested that language regulates non-linguistic representations during a specific task, but does not operate permanent changes in cognitive representations.

Although views on the language-thought interaction are divided, there seems to be a general agreement among researchers that language influences thought, though it is not clear whether this influence is temporary, as in "thinking for speaking," or permanent. It may also be that language has an effect on our understanding of only some concepts. Possible L1 effects on the speakers' perception and conceptualization of motion and space are discussed in the next section.

THE INTERACTION BETWEEN LANGUAGE, MOTION AND SPACE

Studies on the representation of motion and space seem to suggest that the linguistic encoding of these notions does not reflect their whole conceptual representation. More specifically, when attending to motion events for linguistic purposes, the eyes of satellite-framed language speakers follow the object's trajectory, while the eyes of verb-framed language speakers focus on the manner of motion (Papafragou, Massey, & Gleitman, 2001; Papafragou et al., 2008). For instance, by recording the eye movements of the participants in their cross-linguistic study, Papafragou et al. (2008) found that the cross-language differences between Greek (a verb-framed language) and English (a satellite-language) affected the speakers' focus of attention while watching motion events (depicted on 12 short clip-art animations) during two tasks: preparing verbal descriptions (a linguistic task) and memorizing the events (a non-linguistic task). They found that the participants' eyes shifted to different aspects of the events during the two activities: when describing the events, the speakers focused on those aspects of motion naturally encoded in their language, but when observing the scene freely for the memorization task, both groups paid attention to the same details regardless of their native language. Differences emerged again when motion stopped, with the participants allocating attention to those details in the motion event that were not typically encoded in their language. Thus, when observing the stationary event for later recollection, the Greek speakers focused more on either manner or path, while the English participants studied the path more. However, when examining the scene for memorization, there were no differences between the speakers of the two languages. Additionally, although typology did not seem to affect the general allocation of attention during the linguistic tasks, the order in which path and manner were attended to differed, with the Greek speakers tending to attend to path end-points first, and then to the manner areas of the sentence (Papafragou et al., 2008).

These results were confirmed by Munnich et al. (2001) who found that the discrepancies between typologically-different languages (Japanese and Korean; and English) were reflected in the language task, in which the participants named the location of an object around a reference object, but not in the memory tasks, requiring the participants to recall the spatial relationship they observed after a short interval. Thus, the authors found that axial terms were used in the same fashion by the Japanese and the

English speakers during both the linguistic and the non-linguistic tasks as predicted by the similarity in encoding axial space properties. However, the contact and support representations indicated clear differences in the language task, with the Japanese speakers using contact terms symmetrically on all sides of the reference object, and the English speakers employing them only on the top side of the reference object. On the other hand, when studying the expression of axial representation with English and Korean speakers, the study indicated no differences between the two languages, but when analyzing the notion of *support*, the findings suggested that the English speakers constantly encoded it using *on* for support and *above* for lack of it, while the Korean speakers were not consistent in encoding this difference. (As mentioned before, Japanese and Korean do not encode the notions of support/non-support unless required). On the other hand, the memory task indicated that the English and the Korean/Japanese speakers had represented the concept of *contact* in their minds.

These results indicate that much more happens in the mind than is encoded in language, which would mean that linguistic differences do not necessarily imply cognitive diversity; however, language may still influence visual representations at least, as suggested by findings in Lam's (2001) study on implicit/explicit visual depictions of motion scenes in Japanese, English, German and Spanish soap operas. The study found that the visual descriptions of these scenes in the verb-framed languages (Spanish and Japanese) were more implicit than the ones in the satellite-framed languages (English and German): the implicit-to-explicit ratio in the former group as represented in their soap operas was found to be three times higher than in satellite-framed language soaps. This finding could be explained with reference to Slobin's (1996) assumption indicating that in verb-framed languages some ground or path elements are purposefully left out in order to avoid redundancy, but these avoided elements can still be inferred by the native speakers of these languages. On the other hand, in satellite-framed languages path is stated explicitly, so there is no need to infer it.

In conclusion, there seems to be disparity between language encodings on the one hand and cognitive representations of the spatial categories of motion, contact and support on the other, but this difference does not seem to reflect cognitive representations. While languages are selective in encoding these concepts, these linguistically unexpressed properties still play an important role in spatial memory across speakers of typologically

different languages. A different trend though can be observed when talking and thinking about time.

THE INTERACTION BETWEEN LANGUAGE AND TIME

The time/thought interaction has different dynamics across languages and this diversity seems to affect the way people conceive temporality. This may be due to the fact that time is too abstract a concept to be fully grasped cognitively, and thus spatial metaphors used to represent temporality do shape speakers general understanding of time, as suggested by findings in empirical studies on this topic.

One of these studies by Boroditsky (2001) analyzed spatio-temporal metaphors and how they affect the way people think of/perceive time. The study comprised three experiments that involved Mandarin L1/English L2 speakers (the mean age when they started to learn English being 12.8 years) and native English speakers. In the first experiment, after being presented with a vertical or horizontal spatial prime, the participants were asked a true/false target question about time. Half of the target questions were used to test immediate effect of spatial metaphors, so a horizontal spatial metaphor was employed (e.g., *January comes after December*). The other half were designed to test the long-term effect that the metaphorical encoding of time has on speakers, so adverbs of time such as *earlier* or *later* were used instead of metaphors (e.g., *January comes later than December*). Both the English and the Mandarin speakers needed less time to answer the target questions after horizontal primes than after vertical ones, which means that spatial metaphors are used in both languages to understand and represent temporal aspects. With the purely temporal questions though, the English speakers answered questions faster after the horizontal primes, while the Mandarin speakers answered faster after the vertical primes (Mandarin often uses vertical metaphors to encode time.) The Mandarin speakers indicated vertical bias even though they were thinking in English, which suggests that language habits influence temporal thought regardless of the language one is currently using (Boroditsky, 2001).

The second experiment had the same structure as the first one, namely, the primes were pictures with descriptions that were either horizontal or vertical; all the target sentences contained the word *earlier* or *later* and the participants were adult bilingual Mandarin/English speakers. The results indicated that the vertical bias was greater for the participants who started studying English later in life, but it was not influenced by the length of

their exposure to English. The most important finding though is represented by the third part of this experiment, in which the participants, native English speakers, were taught to use vertical spatial terms such as *above*, *below*, *higher than*, *lower than* (e.g., *computers were invented above cars*). After receiving training to think about time vertically, they completed the task used in the first part of this study, with the results being similar to those of the Mandarin speakers, not to those of the untrained English speakers.

The findings in the experiments discussed above were further confirmed by two more recent studies: Boroditsky (2008) and Boroditsky (2010). In the former study the participants had to employ three dimensional space metaphors in order to locate time, which allowed the experimenters to test not only the use of axial metaphors (*horizontal* versus *vertical*) but also direction in order to express time (e.g., *is the future placed further up or further down?;* Boroditsky, 2008). The second experiment tested the participants' notion of past time with reference to axial spatial metaphors: *left*/*right* and *vertical*. Thus, the participants were shown two pictures of Woody Allen, with the second photograph remaining on the screen, and were asked whether the second photo showed the character at an earlier or at a later stage in his life. The participants made their choices by pressing two adjacent keys arranged horizontally on the left/right axis for some of the speakers, and vertically, with the *earlier* key at the top and the *later* one at the bottom. The findings suggested that both the English and the Mandarin speakers responded faster when the *earlier* key was on the left than when it was on the right, in accord with the direction of writing in both languages. However, only the Mandarin speakers responded faster in the vertical alignment with *earlier* on top (in accord with the use of vertical metaphors in Mandarin), while the English speakers were not affected by the vertical setting.

The concepts of time as *distance* and time as *quantity* also indicate cross-linguistic disparity among English, Indonesian, Greek and Spanish speakers, as suggested by findings in a study comprising three experiments by Casasanto et al. (2004). In the first experiment, the authors elicited from native speakers of Greek, English, Indonesian and Spanish phrases meaning *long time* and *much time*. Then, they compared the frequencies of these expressions to an online database, www.google.com. As expected based on the typologies of these languages, distance metaphors were more frequent than quantity metaphors in English and Indonesian, the opposite being true for Spanish and Greek. The second experiment tested whether space influences temporal thinking even when

people do not think for linguistic purposes. Thus, in a non-linguistic task, the participants watched lines growing, pixel by pixel, from left to right, on a computer screen. A prompt appeared right before each trial, indicating that participants should attend either to the line's duration or to its displacement. The participants used a mouse to click on an "X" sign on the computer screen, then moved the mouse to the right and clicked again when they considered the distance was similar to the displacement of the stimulus; to indicate duration, the participants clicked on an hourglass symbol, waited for the appropriate amount of time, then clicked again to indicate the time it took the stimulus line to grow.

In the third experiment the participants (from the same populations, but not the same speakers as in the second experiment) performed a similar task, but containers were used instead of lines; they estimated either the amount of water in the containers, or the amount of time that the container took to fill. The findings showed that all the participants estimated time equally well, but the cross-domain effects demonstrated differences across the four languages. Indeed, the English and the Indonesian speakers were greatly influenced by distance when performing time estimation, while this effect was insignificant with the Greek and Spanish speakers. Conversely, when analyzing the results for the *time as quantity* task, it was found that the English and the Indonesian speakers were not affected by volume on time estimation, while the Greek and the Spanish speakers were (Casasanto et al., 2004).

These findings indicate that the encoding of time reflects cross-cultural differences and this distinctness manifests itself even during the performance of non-linguistic tasks, which means that temporal reasoning itself is language-dependent. Thus, while the way people conceptualize space is the same cross-culturally despite differences in linguistic encodings, the way speakers of typologically different languages conceptualize time varies cross-culturally in accord with language-specific temporal encodings. Since time is encoded metaphorically across languages (usually by using space metaphors), these findings may further imply that language influences/reflects metaphorical representations in general, which may in turn be affected by culturally-specific perceptions of objects and things. That this may be so was suggested by Begley (2009). In an online article, the author pointed to two completely distinct descriptions of the same object, the Viaduct de Millau, by a French journalist and by a German journalist. In the French language, the word *bridge* is masculine while in German it is feminine, and this was clearly reflected in the two journalists' descriptive approaches. Thus, in perfect

accord with the grammatical gender of the object analyzed, the German writer perceived the bridge as a beautiful apparition, "floating above the clouds with elegance and lightness," while the French journalist saw it as an "immense concrete giant" (para. 1).

CONCLUSION

Considering all this information from the perspective of language acquisition, one may conclude that differences between native and non-native speakers operate not only at structural, but also at conceptual levels, at least in the case of abstract and metaphorical thought. In addition, although language does not seem to affect memory and the cognitive representation of notions such as space and motion, it does influence the online allocation of attention when speakers are preparing for a linguistic task. Since speaking plays an essential part in a communicative endeavour, one may conclude that the way we express ourselves does make us different, and this may also influence our linguistic preferences when acquiring a typologically-different second language. For instance, a native speaker of a verb-framed language (e.g., a Romance language) learning a satellite-framed language such as English may focus on the acquisition of path verbs and fail to attend to manner verbs in the first stages of acquisition. Additionally, a Korean or Japanese speaker may consider that prepositions expressing immediate support/non-support (*on*, *above*) are inconsequential in English since these notions do not have to be encoded in their native languages. Conversely, a native English speaker learning Korean may fail to learn (implicitly) that the relationship between an object and its container is important in this language and that the notion of *tightness of fit* needs to be clearly specified.

For all these reasons, studies in Applied Linguistics may need to use findings from adjacent fields such as Psycholinguistics and Linguistic Anthropology in order to understand what language acquisition entails at levels that go deeper than grammatical and lexical forms.

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