It is an often-stated and, I think, well-established idea in the physical sciences that the ‘mathematical words’ used to express an idea are often as important as or, in certain circumstances, more important than the ideas being expressed. ‘Notation matters’ is the watch phrase and it reflects the belief that better ways of encapsulating an idea lead to better ideas (see *e.g.* S.S. Chern’s [*Differential Geometry; Its Past and Its Future*](http://math.harvard.edu/~hirolee/pdfs/2014-fall-230a-icm1970-chern-differential-geometry.pdf)). Basically, the mathematical words used either enable or limit the thoughts that can be conceived or expressed.

The poster child for this is belief is the emergence of vector calculus as the language used in field theories. The physical idea that no magnetic monopoles exist in nature is much harder to see in component form

\[ \frac{\partial B\_x}{\partial x} + \frac{\partial B\_y}{\partial y} + \frac{\partial B\_z}{\partial z} = 0 \]

than in the more compact

\[ \vec \nabla \cdot \vec B = 0 \; .\]

The same argument seems to be widely held in computing. Certain programming languages (LISP or one of its dialects) are often said to shape how a programmer actually thinks about programming. Proponents of object-oriented or functional programming maintain that it is easier to express algorithms in these paradigms because they allow the programmer to abstract more complex ideas thus being able to focus on the logic without being bogged down in the day-to-day syntax.

These ideas have plenty of anecdotes supporting them (and, perhaps, some scientifically gathered and analyzed data) and it is natural to wonder if the same holds true for natural languages; does one’s mother tongue limit the thoughts that one can think?

The simple answer is no. The mathematical experience teaches us that new ideas can be expressed with the old words but the result is that we often do so by adding new words to encapsulate these ideas. In terms of the example above, the compact expression $$\vec nabla \cdot \vec B$$ allows one to think more broadly about the magnetic field in the abstract but the ‘clunky’ coordinate expression is what one uses when one wants to actually compute something.

Nonetheless, philosophers and linguists are not inclined to trust experiences from mathematicians and scientists and they’ve looked into this point on their own. After all, the traditional overlap between thought and speech traces its origin back to the ancient philosophers, who regarded the ability to speak as a hallmark indicating that man is a rational animal. However, the modern renaissance seems to date from 1940 with the work of Benjamin Lee Whorf.

In his article [*Does Your Language Shape How You Think?*](https://www.nytimes.com/2010/08/29/magazine/29language-t.html), Guy Deutshcer of the New York Times, discusses Whorf’s 1940 article entitled *Science and Linguistics* that claimed that language imposes a different form of reality on one set of speakers versus another. As Deutshcer relates, Whorf asserted that if a language didn’t have a word for a concept, the concept would be unknown to speakers of this language. It is hard to believe that this assertion was really what Whorf believed or, if so, that it was taken seriously as there is a *reductio ad absurdum* argument that would deduce that sentences with multiple words used to express complex ideas would never be needed or used, except to make new words.

Nevertheless, Deutshcer provides some interesting ‘refutations’ of the [Sapir-Whorf thesis](https://www.thoughtco.com/sapir-whorf-hypothesis-1691924) (Edward Sapir was Whorf’s teacher). For example, some languages, like Chinese, don’t have a formally delineated future tense whereas English does. And yet to two sentences “Are you coming tomorrow?” (more Chinese-like) and “Will you come tomorrow?” (less Chinese-like) are equivalent, suggesting that considerations about the future for a native Chinese speaker are not different from those whose native tongue is English, even if they express themselves differently. Likewise, English didn’t have a single word equivalent for *schadenfreude* but English-speakers still indulged in that behavior and that word has essentially been incorporated into English.

Despite the fact that Whorf’s main conclusions seem to have been wrong, the notion that language shapes thoughts in addition to thoughts shaping language does seem to have some truth. Deutscher quotes the linguist Roman Jakobson as saying that “languages differ essentially in what they must convey and not in what they may convey”. To get a sense of what that means, he presents the sentence “I spent yesterday with a neighbor.”, which in English leaves the sex of the neighbor entirely unspecified whereas German, French, or Spanish require the speaker to specify a gender.

Joshua Hartshorne, writing for Scientific American, explores some other aspects in his article [*Does Language Shape What We Think?*](https://www.scientificamerican.com/article/does-language-shape-what/) He presents the interesting case of the Pirahã, who have no precise counting words just general notions. When asked to exchange say seventeen rocks for equivalent number of sticks, the Pirahã can match the objects one-to-one but they can’t count out seventeen sticks abstractly to prepare the exchange in advance. Does this behavior suggest that since they don’t have a word for the abstract idea of seventeen they don’t know what seventeen is? Hartshorne doesn’t think so – neither do I. They just don’t have any abstraction for the counting process. This is a common problem that English speakers encounter for incredibly large numbers. I don’t know what a trillion dollars looks like or can buy but I do know how to abstractly denote it in symbols.

In her article [*Does Language Affect Thought?*](https://www.philosophytalk.org/blog/does-language-affect-thought), Karen Lewis also explores the Sapir-Whorf thesis. The primary example she discusses centers around mass nouns. Mass nouns are nouns like mass, water, snow, meat, beer versus count nouns such as chair, pencil, one fish, two fish, red fish blue fish. According to Lewis, Whorf maintained that the Hopi had no mass nouns as so they perceived the world differently than we do. She cites several experiments that suggest that while the presence or absence of mass nouns in a language influences how the world is linguistically categorized there is no evidence that the language influences how the speaker conceptualizes the world.

That said, there it is clear that language shapes the attitudes, emotions, and preconceptions of its speakers. In languages with gendered nouns, the adjectives used to describe these nouns depend on the gender of the noun.

<For example, in one such study, [Boroditsky and colleagues] tested native speakers of Spanish and German by asking them to name (in English) the first 3 adjectives that came to mind to describe each of 24 objects (named in English) on a list. The 24 objects each had opposite genders in each language. In general, the participants came up with adjectives that were more stereotypically masculine if the word for the object was masculine in their language and more stereotypically feminine if it was feminine. For example, for the word “key”, which is masculine in German, German speakers said things like hard, heavy, jagged, metal, serrated, and useful. At the same time, the word for key is feminine in Spanish and Spanish speakers came up with adjectives like golden, intricate, little, lovely, shiny, and tiny. – Karen Lewis>

What can we conclude from all these examples (and the others found in the articles cited above)? I think the safest thing to say is that the language we speak doesn’t inhibit us from thinking new thoughts for which we don’t have pre-existing words. But it can shape how we feel, how quickly we process thoughts, and how we express ourselves. In a nutshell, underneath we are all the same even if you express ourselves quite differently.

This month’s column falls slightly on the whimsical side and not only because of the presentation style has, on occasion, a bit of a smirk, but also because of the content, or at least some of it, tends to provoke a sense of whimsey. But before taking off into flights of fancy, the groundwork for this column – the various ways that language and thought interact – needs to be well under foot.