Speaking, Writing, and Thinking: linguistic relativity and research

Hablar, escribir y pensar: relatividad e investigación lingüística

Michael A.R. Biggs
University of Hertfordshire, UK

Abstract

We note that our writing systems suffer from the same problem of linguistic relativity as our spoken languages, i.e., that our first language influences how we think. This is known inaccurately as the Sapir-Whorf hypothesis or Whorfianism, which seems to make paradoxical any original thinking or paradigm shifts. We compare this problem to Wittgenstein's concept of aspect-blindness. Our review shows that Boas, Sapir, Whorf, and Wittgenstein all claimed that language guides our habits of thought, but equally, all rejected the strong version of linguistic relativity called linguistic determinism. Using examples from Wittgenstein's notational praxis, we argue this apparent paradox of originality can be addressed by objectifying our metaphors using non-conventional notations and images, thereby revealing them, and allowing us to break out of our conceptual habits and aspect-blindness. The outcome is a sketch theory of notation that addresses the problem of linguistic relativity for research and original thinking.

Keywords: linguistic relativity, determinism, Wittgenstein, Whorfianism, research.

Resumen

Notamos que nuestros sistemas de escritura sufren el mismo problema de relatividad lingüística que nuestros idiomas hablados, es decir, que nuestro primer idioma influye en cómo pensamos. Esto se conoce erróneamente como la hipótesis de Sapir-Whorf o whorfianismo, lo que parece hacer paradójico cualquier pensamiento original o cambio de paradigma. Comparamos este problema con el concepto de "ceguera de aspecto" de Wittgenstein. Nuestra revisión muestra que Boas, Sapir, Whorf y Wittgenstein afirmaron que el lenguaje guía nuestros hábitos de pensamiento, pero igualmente rechazaron la versión fuerte de la relatividad lingüística llamada "determinismo lingüístico". Utilizando ejemplos de la praxis notacional de Wittgenstein argumentamos que, esta aparente paradoja de la originalidad, puede abordarse objetivando nuestras metáforas usando notaciones e imágenes no convencionales, revelándolas y permitiéndonos romper con nuestros hábitos conceptuales y ceguera de aspecto. El resultado es un esbozo de teoría de la notación que aborda el problema de la relatividad lingüística para la investigación y el pensamiento original.

Palabras clave: relatividad lingüística, determinismo, Wittgenstein, whorfianismo, investigación.

Introduction: Linguistic Relativity

When Wittgenstein said, "if the lion could talk, we could not understand him", the issue was that the lion's world is so different from ours that, even if he could mobilise the language that we speak, he could not express his world by means of it (Wittgenstein, 1953, p. 223). This ineffability is a consequence of an evolutionary theory of language development, as articulated for example by Boas, in which the development of language arises in connection with the world in which it finds its application. As a result, a society develops the vocabulary and structures it needs for its everyday transactions. This theory explains why, for example, there are some societies in which there are no words for higher numbers, and that the concept of higher numbers is not developed. Boas tells us that people in these societies have no difficulty in understanding higher numbers, only that in their everyday lives they do not need words for them.

> It seems very questionable in how far the restriction of the use of certain grammatical forms can really be conceived as a hindrance in the formulation of generalized ideas. It seems much more likely that the lack of these forms is due to the lack of their need (Boas, 1911, p. 64).

However, this evolutionary approach is more fundamental than simply the development of a lexicon related to needs, because it is not only our vocabulary that influences our engagement with the world, but also our grammar. For example, in the Hopi language there are basically only two tenses: the equivalent of a past tense which describes all those things that have already come into being, up to and including the present, and an equivalent of the future tense for all those things that are yet to become (Whorf, 1956, p.

143f.). This grammatical characteristic tends to direct attention towards certain features of the lived experience – towards the existential difference between what has already-become, and what has yet-to-come-into-being. This contrasts with our European conception of the past and the future as located relative to our position in the present. Through this metaphorical "positioning", our grammar implies a spatial arrangement in which the past lies behind us and the future stretches out ahead. We seem to be on a moving conveyor of time that transports us through this space as though the present were the spot on the conveyer where we stand. Whorf, a Hopi specialist, claimed that although it was not difficult to overcome a lack of cultural vocabulary such as higher numbers, it is difficult to surmount concepts such as the spatialization of time that is implied by the grammar of our European languages. He likened this difficulty to being stuck in a rut (Whorf, 1944, p. 200). It takes effort to overcome the channelling influence of the rut on our journey of thought, but it is not impossible. Wittgenstein also thought we were limited by our language, our grammars, and our habits of thought, and he too thought that escaping their influence was difficult but not impossible. He compared it to a fly that is trapped in a fly-bottle (Wittgenstein, 1953, pt. I-§115) – an object that even Austrians seem never to have heard of, but presumably functions like a lobsterpot that allows the lobster in but makes it difficult for it to find its way out. Notably, the lobsterpot, and presumably the fly-bottle, do not have doors, only a problematic exit. In the same way, Boas, Whorf, and Wittgenstein did not think we are prisoners of our language, or that escape is impossible; only that finding our way out is problematic. This difficulty is called *linguistic relativity,* i.e., we form our concepts relative to our first language.

In its strong form, the idea that our linguistic grammar influences our conceptual grammar has given rise to *linguistic determinism,* in which we are prisoners, and it is impossible to think outside of the limits of our language. This is sometimes referred to as the Sapir-Whorf hypothesis, or Whorfianism, which incorrectly labels them all as linguistic determinists. Boas, Sapir, and Whorf are all actually linguistic relativists.[1] Although Wittgenstein doesn't mention linguistic relativity, his concept of aspect-blindness fits very well with what the three linguists claim as the instrumentality of linguistic structures on thinking. Each sees language, not so much as imprisoning, but as guiding us to think in particular ways. Boas describes these as "channels", Sapir talks about carved "grooves", Whorf talks about "a rut" in our thinking, and Wittgenstein talks of our thinking being "bewitched by language". These are all habits or ways of thinking, guided in part by our language and in part by the cultural practices that accompany our language. Together, these form tramlines – a grammar of concepts and therefore of what is conceivable. Just as the lion lives in his own world, which our language cannot express, so we too live in a particular world of our own language-led making, not in "the real world". We are usually aware that our natural language, for example English or Spanish, mediates our expression of the world, but we are usually unaware of the extent to which the grammar of our concepts also mediates our thinking and our experiences.

---

1 E.g., An inaccurate definition provided by Oxford Languages reads: "a hypothesis, first advanced by Edward Sapir in 1929 and subsequently developed by Benjamin Whorf, that the structure of a language *determines* a native speaker's perception and categorization of experience." Online Google definition of "Sapir-Whorf Hypothesis [accessed 28 July 2023, my emphasis].

> The fact of the matter is that the 'real world' is to a large extent unconsciously built up on the language habits of the group. No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached (Sapir, 1929, p. 209).

Linguistic relativity is a significant problem in the field of research because it is implicated when we move from conceptualisation of World-A to a conceptualisation of World-B, i.e., we expect that our existing language will be inadequate for the full expression of the contents and relationships in World-B. Some of this problem can be resolved by the creation of neologisms, but if we take linguistic relativity seriously, we should also expect that our existing grammar may present a limitation to our ability, not merely express the new World-B, but at its most extreme, to even conceptualise what that new World-B might be like. This is what Wittgenstein means by the limits of language. "I cannot draw the limits of my world, but I can draw limits within my world" (Wittgenstein, 1975, p. 178). We therefore need to take seriously the implications of linguistic relativity for original concept development at the frontiers of research.

Wittgenstein describes the language in which we are enculturated as making us blind to alternative aspects and ways of seeing. Aspect-blindness is a habit of conceptualisation arising from the grammar of our language, and the social habits and rules that are built up in our culture. He thought that when we encounter philosophical problems and puzzles, they often arise from a misunderstanding of language and he questioned whether the temptation to say "it must be like this", arises from the nature of the real world or the nature of our language.

> Aspect-blindness will be akin to the lack of a 'musical ear'. The importance of this concept lies in the connexion between the concepts of 'seeing an aspect' and 'experiencing the meaning of a word'. For we want to ask 'what would you be missing if you did not experience the meaning of a word?'" (Wittgenstein, 1953, p. 214).

At its simplest, aspect-blindness is simply perspectival, and by adopting a different point of view, one can overcome this blindness. But more intractable conceptual limits are presented by the combination of language and our embodiment as human beings. We can never adopt the lion's perspective – our ability to see some aspects is constrained by the limits of our possible thought as embodied human beings. Wittgenstein proposes the concept of "seeing an aspect" as a kind of therapy for the apparent paradox that we are trapped by our language and patterns of thought, and therefore we cannot see anything new. If we can find a technique that allows a new aspect to dawn on us, then we may be able to step out of the rut in our thinking and conceive of the world differently, even if this difference is always less than the lion's. This is a hopeful message for the problem of research and of "thinking outside the box" because the outcomes of research need to stay relevant to us as human beings and to have an application. Our task in the research field is to maximise meaningful solutions. Therefore, to be constrained to the context of our lived experience is actually constructive. Returning to Wittgenstein's example; the lion needs to develop its own language that expresses its own lived experience (well, perhaps it has already, and it roars!).

Linguistic Relativity and Research

Working in research, at our disciplinary frontiers or in the interdisciplinary space, presents numerous challenges but one that is little documented is this apparent paradox of how one can conceptualise the new, given the constraints of linguistic relativity. It is an inevitable consequence of the evolutionary theory that new discoveries will require the development of new terminology and the naming of new entities. Kuhn regarded this naming process as sufficiently self-evident that it could be mobilised as part of his description of everyday scientific progress. "*Clearly* we need a new vocabulary and concepts for analysing events like the discovery of oxygen" (Kuhn, 1962, p. 55 [my emphasis]). However, the conceptual frameworks or conceptual grammar within which these names have their application, and which Kuhn called "paradigms", are resistant to invention or change partly owing to the constraints of conceiving of the new. We need tools or techniques that enable us to see beyond what we already know, and to think in ways that were previously unthinkable. Unlike new entities, which can be named by newly coined substantives, conceptual frameworks are sets of relationships requiring more complex descriptions that stretch our existing capabilities, and legitimation and authorization is required for them in both the scientific and linguistic domains.

> The birth of a new concept is invariably foreshadowed by a more or less, strained or extended use of old linguistic material; the concept does not attain to individual and independent life, until it has found a distinctive linguistic embodiment (Sapir, 1921, p. 16).

In response to this need, hundreds of new words need to be approved annually for inclusion in the lexicon. Some of these neologisms are the outcome of new thinking in research areas that require new technical vocabulary for their expression. Of course, some also reflect the bottom-up drive of colloquial use entering the mainstream. In England, *The Oxford English Dictionary* [OED] is updated quarterly, and in its March 2023 update there were 186 new entries plus many revisions to existing entries, in an overall context of approximately 600,000 entries in the dictionary. Most countries and linguistic jurisdictions host an equivalent gatekeeper that is responsible for the legitimation of new words. In Spain, the Real Academia Española updates the *Diccionario de la Lengua Española* [DLE] on an annual basis. In the 2022 update there were 390 new entries, including revisions to previously existing entries.

One can witness this process of our language responding to need, in the development of new words in technology – for example, with greater computing capacity comes a need to describe larger and larger units. What was previously measured in kilobytes and megabytes is now measured in gigabytes and terabytes. But what happens when we need to talk about even larger quantities? According to *The International System of Units* (9th edition, pp. 199f.), "quetta-" (10^{30} bytes) was added to the lexicon in 2022 as the approved prefix for the greatest unit of measurement (e.g., a quettabyte). The expression 10^{30} is a written description of an isolated attribute (quantity). The new compound substantive "quettabyte" allows us to objectify it. Although a quettabyte is a large quantity

of data, it may occupy a small physical space, i.e., our common association of quantity with size or volume is an accident of the grammar of our language in which spatial metaphor and objectivism is common, as we saw in the case of time (Lakoff, 1987, p. 162ff.). Substantiation already invites us to a misleading conceptualization of a quettabyte as a very large object.

The development of neologisms addresses emerging gaps in the lexicon of available terms but leaves these conceptual ruts of grammar untouched. Neither OED nor DLE address this limitation. We encounter difficulties when we try to think about something if we do not have a name for it: "the limits of my language mean the limits of my world" (Wittgenstein, 1961 [1922], sec. 5.6). When we named the quettabyte we objectified it, i.e., we feel that we could "get there" through a description of where it can be found in our metaphorical "space" of numbers, even though it is an isolated attribute and a quantity that is so large that it could not possibly be objectively experienced (Lakoff, 1987, Chapter 11). However, this difficulty does not necessitate linguistic *determinism*, in which one cannot have thoughts for which one does not have words, but instead that our words guide us into a particular way of thinking, a rut, from which it is difficult to extract ourselves. The rut in our path encourages us to continue in the same way and in the same rut as all the other users of that path, thereby reinforcing the linguistic and cultural assumptions that we have already adopted. However, with some effort, perhaps involving a speaking- or writing-therapy that lets us see our predicament more clearly, we can surmount the rut and find a new path.

New ways of thinking such as paradigm shifts, demand that we exit our metaphorical ruts, not just because they inhibit fresh perspectives on our destination but because our destination has changed. A paradigm shift identifies a new destination that cannot be reached by following our habitual rut. We need to take the road less travelled by, and that will make all the difference.[2] This spatial metaphor of the rutted road reinforces the claim that the lion inhabits a completely different world from us – a world that we cannot access unless we step out of our established language and ways of seeing. More than that, we would need a whole new set of concepts, a different conceptual grammar, and to be enculturated in it, before this alternative way of seeing would make any sense to us. Paradigm shifts are not merely the addition of a layer of translation but a different conceptual grammar.

> We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation (Sapir, 1929, p. 209).

So, given what the linguistic relativists Boas, Sapir, and Whorf have each said about the way that language predisposes us, non-deterministically, towards certain modes of thinking; would it be possible to bypass language and to think therapeutically with images, or with some other non-verbal notations like those of music or mathematics? Wittgenstein

---

2 Alluding to, but misquoting Frost's 1916 poem "The Road not Taken."

gives us the impression that he is trying to escape the temptations of language in just such a way – by supplementing his writing, particularly in his middle period in the 1930s, with drawings and thought/writing-experiments which cannot be spoken in words. A quick skim through his *Philosophical Grammar* will confirm his frequent use of images and novel signs. Indeed, he admitted that a pivotal moment in his philosophical development was provoked by his colleague Sraffa, who made a dismissive Neapolitan gesture to him. Wittgenstein was arguing that a proposition must have the same logical form as whatever it describes, and Sraffa asked, "what is the logical form of *that?*" (Malcolm, 1958, p. 57f.). The gesture was a wordless, "unspeakable" communication. One can find other unspeakable, wordless content "written" by Wittgenstein in his manuscripts, including smells, music, facial expressions and likenesses, logical relationships, foundational concepts in mathematics, moods such as sadness, and many more. These cases reveal the limited repertoire of what can be conveyed through speaking and conventional writing, and how much depends on our shared understanding of embodied experience as human beings, on our gestures, actions, and on our "form of life" that lies outside the boundaries of what we can merely say (Wittgenstein, 1953, p. 174). Sraffa's gesture can be understood but cannot be said or written down. It must be performed. Performance is one of many inputs to our understanding in addition to speaking and writing.

> Think of this too: I can only see, not hear, red and green, – but sadness I can hear as much as I can see it. Think of the expression "I heard a plaintive melody". And now the question is: "Does he hear the plaint?" And if I reply: "No, he doesn't hear it, he merely has a sense of it" – where does that get us? One cannot mention a sense-organ for this 'sense' (Wittgenstein, 1953, p. 209).

Thus, if we are serious about wanting to break out of our conceptual limitations and the ruts in our thinking, we should be looking more pro-actively at the places where conventional writing and annotation seem to be inadequate. To some extent we recognise this when we authorise the process of the extension of our lexicon through the invention of new words – but this leaves untouched the two distinct, but related problems mentioned above: modifications to our grammar, and limitations to our conceptual understanding.

Considering grammar first, Kuhn gives several examples including Copernicus, Newton, Einstein, etc., in which a crisis precipitated a significant conceptual shift (Kuhn, 1962, sec. VII). But crises are also indicative of the kind of major restructuring of our thinking that occurs even in everyday life. We have probably all experienced that terrible moment when we realise that we are not as clever as we thought, or perhaps somebody doesn't like us as we thought they did, etc. Each of these causes a complete re-framing, and this re-framing consists in a re-evaluation of the historical evidence. It is not so much that our past is changed by these revelations, but that our interpretation of the evidence is changed. The observational data that was presented to Copernicus, Newton and Einstein was not different from before, it was the interpretation that each made of that evidence. We see the world differently, not only in the sense of "see" as "to understand", but also in the sense that we see different features as now being salient.

Considering conceptual understanding, the same can be said when we change our notational convention, i.e., we become able to annotate something that we could not previously annotate. When we learn how to write music, we become able to capture something complex that, otherwise, we would have to remember.[3] The music becomes objectified in the score, and patterns such as repetitions may not need to be written out. We can extend the written notation and push its limits in novel ways such as those used by Stockhausen. We can even create graphical scores and, owing to them being documents, we can apply pictorial rules to them, whilst still maintaining that they should be interpreted as music, as is the case with David Bedford. Annotation therefore gives us the possibility of manipulating the physical object; of literally mirroring, reversing, inverting – that is, we create spatial possibilities for what was previously only in the metaphorical "space" of the musical performance sound. Something ephemeral such as music, or something abstract such as an idea, or something sensory such as the experience of a colour, can be objectified through annotation on paper, thereby inviting spatial, objective manipulation, duplication, erasure, etc. On the one hand, this annotation can be seen merely as a creative tool, but on the other hand it reveals and clarifies our conceptual boundaries, and potentially offers tools to overcome some of those limitations. Music does not have a spatial dimension, but by converting it into a written score, by creating a document that has extension, it can be manipulated, transformed, and interpreted spatially.[4]

Examples of notational creativity from Wittgenstein include music, but more often involve enquiring into our basic grammar of mathematics, that is to say, our unspoken assumptions about counting. He gives us a visualization of what we mean by 2+2=4 followed by an alternative visualization showing that 2+2+2=4.[5]

 or
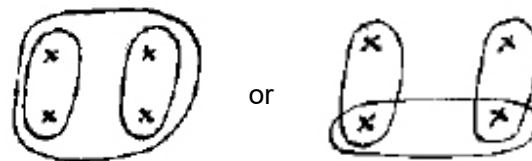
Another example shows that division by 3 may lead to more than one outcome.[6]

 or

---
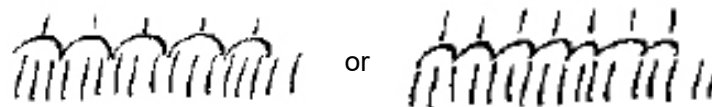
3   It is alleged that Mozart memorised and later transcribed the whole of Allegri's *Miserere* after hearing a performance.
4   This is the principle behind Fugue Machine in which a simple line of musical notation can be traversed (in visual space) at various speeds and in various directions, thereby creating effects reminiscent of Bach.
5   Wittgenstein (1956) I-§38 p.52
6   Wittgenstein (1956) II-§78 p.101

These examples reveal that the underlying, unspoken grammar of our counting-concept includes many unspoken rules such as "count each point only once", "do not omit points", "count points but not intervals", etc. These may seem trivial and obvious, but in music we speak as much about the interval as the note, for example "a minor third". As counting moves into the social sphere this normally unspoken grammar can become hidden:

> People pile up logs and sell them, the piles are measured with a ruler, the measurements of length, breadth and height multiplied together, and what comes out is the number of pence which have to be asked and given [...] Very well; but what if they piled the timber in heaps of arbitrary, varying height and then sold it at a price proportionate to the area covered by the piles? And what if they even justified this with the words: "Of course, if you buy more timber, you must pay more"? How could I show them that – as I should say – you don't really buy more wood if you buy a pile covering a bigger area? – I should, for instance, take a pile which was small by their ideas and, by laying the logs around, change it into a 'big' one. This might convince them – but perhaps they would say: "Yes, now it's a lot of wood and costs more" – and that would be the end of the matter. – We should presumably say in this case: they simply do not mean the same by "a lot of wood" and "a little wood" as we do; and they have a quite different system of payment from us (Wittgenstein 1956 part I-§§143 & 149).

Although we may reject these practices as illogical, in Europe it is common to pay a 16-year-old worker a lower hourly rate than a 21-year-old for the same task, and supermarket meat is often treated in ways that increase the water content in order to confuse value-for-money calculation by consumers.

We propose that Wittgenstein's approach to speaking and writing about what is at the limits of language, and therefore of thought, exemplifies many of the problems that need to be addressed in research in order to facilitate original thinking. Wittgenstein's later works explore the possibility that both our form of life and our practices, including language use, can make us blind to alternative ways of understanding. He calls the inability to see alternatives "aspect-blindness", and the subsequent epiphany as the "dawning of an aspect". Although he never brought these together in an explicit theory of writing and annotation, we can see that extending notational conventions is an important tool for him to reveal aspects of our conceptualisations and understanding that are hidden by the way in which we speak about the world and the processes of philosophy (Biggs, 2021). The application of this insight, which comes from both Wittgenstein's limits of language, and from Boas, Sapir, and Whorf, is the notion that our language creates habits of thinking and ruts that are difficult to get out of. When we know we are operating at the limits of our language, such as in the area of new discoveries or at the intersections of disciplinary boundaries, where one professional vocabulary ends and another begins; in those interstitial and liminal spaces, there is an opportunity not only for the creation of new vocabulary, but also to get out of our rut. One of the benefits of interdisciplinarity is the non-territorial, non-disciplinary perspective that one gains on the existing mono-disciplines. Wittgenstein, Whorf, Sapir, and Boas all share concerns that we are linguistically influenced; we are led by the way we speak and write, into habits of thought that make us aspect blind to alternatives.

What this present sketch theory of notation suggests is that by transforming ideas into alternative non-linguistic or unconventional forms of annotation and representation, including imagery, we are able not only to reveal the rut that we are in, but also to provide tools to escape that rut. One of the tools that has been suggested here is to convert an ephemeral performance into a tangible, and therefore spatial, notation, so that we can manipulate that notation, objectively and spatially, in order to facilitate the dawning of a new aspect. As Kuhn says, when Einstein first talked about space being curved, his critics complained that this was an abuse of language because space was not that kind of thing (Kuhn, 1962, p. 149). But now it is quite common to see representations that visualise this metaphor,[7] and by objectifying the abstract, to free up our "what-if" capacity and our ability to get our feet out of the rut.

Conclusion: Speaking, Writing and Thinking

This chapter offers a sketch theory of notation in response to the problem of linguistic relativity presented by Boas, Sapir, and Whorf. It notes that they were not as sceptical about the ability for us to "think outside the box" as the inappropriately attributed Sapir-Whorf Hypothesis might suggest. Whorf advocated comparative linguistics as a means of revealing the way in which both syntactics and pragmatics affect semantics, i.e., our grammar and structures together with our praxis affect meaning and how we interpret the world. For Whorf, there is no universal system of language and so one's perception of the world is unavoidably mediated by the particular language and linguistic structures to which one is enculturated.

> Whorf was right in observing that concepts that have been made part of the grammar of a language are used *in* thought, not just *as objects of* thought, and that they are used to spontaneously, automatically, unconsciously, and effortlessly (Lakoff, 1987, p. 335 [emphasis in the original]).

Wittgenstein also addressed this problem of habitual ways of seeing the world which he called aspect-blindness. He thought such habits arise in our use of, and the apparently inevitable implications of, our language. "Philosophy is a battle against the bewitchment of our intelligence by means of language" (Wittgenstein, 1953, pt. I-§109). It is possible to break out of these habits (i.e., it is not deterministic) but we need some help and for something to change. Wittgenstein offers a therapeutic solution by showing that challenging our habitual metaphors can facilitate the required "dawning of an aspect" – an alternative perspective. In addition to issues of translation that are usually mentioned in relation to the problem of linguistic relativity, we have contributed a discussion of notation. We have highlighted that Wittgenstein was a frequent user of alternative and original notation,

---

7   E.g., https://wild.maths.org/einstein-and-curving-spacetime [accessed 28 July 2023].

which we claim formed an integral part of his therapeutic method. We have argued that the potential of notational innovation for conceptual innovation is particularly important in areas that transcend disciplinary boundaries, where terminology will be lacking, and where conceptual frameworks will be stretched.

A therapeutic break in conceptual habits can be achieved by a change of register or voice, i.e., into drawing or notational innovation. This disrupts our normal practice of writing and introduces a system of notation that has a pragmatics that operates quite differently. When notation changes, owing to its symbolic nature, we need cues as to the interpretation of the new signs. Wittgenstein's new signs are sometimes extensions of existing symbols or recognisable icons, which facilitates this problem of reference, but their frequent ambiguity is also therapeutic. The ruts in which we are stuck are imposed by our habitual understanding of our linguistic terms, i.e., that our thinking is held captive by our speaking and writing. Meanings and linguistic structures such as substantiation, incline us to fix certain concepts in ways that blind us to alternatives. This has implications not only for the interpretation of Whorf and Wittgenstein, but also for the epistemology of knowledge creation (Biggs, 2019). Both interdisciplinarity and paradigm shifts are inhibited by disciplinary cultures, languages, and assumptions. Strategies are necessary to climb out of these ruts, and we propose that extending and innovating notations can provide the shift that is required to "think outside the box".

> sometimes we understand a thing by translating into words – sometimes we understand a thing by drawing a picture (Wittgenstein cited in: Gibson & O'Mahony, 2020, p. 124).

Acknowledgements

References

Biggs, M. A. R. (2019). The Knowledge Creation Spectrum. In A. Sinner, R. L. Irwin, & J. Adams (Eds.), *Provoking the Field: International perspectives on visual arts PhDs in education* (pp. 15–24). Intellect.

Biggs, M. A. R. (2021). Wittgenstein's Picture-Investigations. In A. Basu, G. Stapleton, S. Linker, C. Legg, E. Manolo, & P. Viana (Eds.), *Diagrammatic Representation and Inference* (Vol. 12909, pp. 103–117). Springer Nature. DOI: 10.1007/978-3-030-86062-2_10

Boas, F. (1911). Introduction. In *Handbook of American Indian Languages* (Vol. 1, pp. 5–83). Bureau of American Ethnology.

Gibson, A., & O'Mahony, N. (Eds.). (2020). *Ludwig Wittgenstein: Dictating philosophy to Francis Skinner—The Wittgenstein-Skinner manuscripts*. Springer Nature.

Kuhn, T. (1962). *The Structure of Scientific Revolutions* (2nd edition, enlarged). University of Chicago Press.

Lakoff, G. (1987). *Women, Fire and Dangerous Things*. University of Chicago Press.

Malcolm, N. (1958). *Ludwig Wittgenstein: A Memoir*. Oxford University Press.

Sapir, E. (1921). *Language: An introduction to the study of speech*. Harcourt Brace.

Sapir, E. (1929). The Status of Linguistics as a Science. *Language*, *5*(4), 207. https://doi.org/10.2307/409588

Whorf, B. (1944). The Relation of Habitual Thought and Behavior to Language. *A Review of General Semantics*, *1*(4), 197–215.

Whorf, B. (1956). *Language, Thought and Reality: Selected writings of Benjamin Lee Whorf*. MIT Press.

Wittgenstein, L. (1953). *Philosophical Investigations* (G. E. M. Anscombe, Trans.). Basil Blackwell.

Wittgenstein, L. (1956). *Remarks on the Foundations of Mathematics* (G. E. M. Anscombe, Trans.). Basil Blackwell.

Wittgenstein, L. (1961 [1922]). *Tractatus Logico-Philosophicus* (D. F. Pears & B. McGuinness, Trans.). Routledge and Kegan Paul.

Wittgenstein, L. (1975). *Philosophical Remarks* (R. Rhees, Ed.; R. Hargreaves & R. White, Trans.). Basil Blackwell.

Prof Michael Biggs MA PhD FRSA FHEA is Emeritus Professor of Aesthetics at the University of Hertfordshire, UK; Chair of the Cross-Domain Panel at the Research Foundation Flanders (FWO), Belgium; Member of the Advisory Group of the National Research School in Architecture, Sweden; and a Member of the Honorary Committee of the British Wittgenstein Society. His interdisciplinary research focuses on the boundary of images and text, and how iconicity, notational conventions and grapholinguistics influence our recognition and interpretation of graphic signs. He has revised the graphics in Wittgenstein's published works for Blackwell, Suhrkamp and Oxford University Press, and is the graphical editor of the open source Bergen Nachlass Edition which was inscribed in the UNESCO Memory of the World programme in 2017.