Communications

Registering surprise

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In response to Kotsopoulos's communication in the last issue about her reading of Hayfa's paper from **26**(2), there are a couple of observations I would like to make. The first concerns the notion of 'register' as a technical linguistic term, which dates back at least to Reid (1956), although it was subsequently developed by Halliday among others (*e.g.*, Halliday *et al.*, 1964) In this latter book, the authors mention the existence of technical registers, such as for science or mathematics The key issue, however, is one of language variation and varieties of a single natural language:

> varieties according to users (that is varieties in the sense that each speaker uses one variety and uses it all the time) and varieties according to use (that is, in the sense that each speaker has a range of varieties and chooses between them at different times). The variety according to user is a DIALECT; the variety according to use is a REGISTER. (p 77)

The most extensive account of which I am aware of mathematics registers (and how they develop or can be developed) came in a plenary talk given by Halliday entitled *Some aspects of sociolinguistics* to a 1974 UNESCO symposium held in Nairobi on interactions between linguistics and mathematical education Halliday (1974/1978) was at pains to point out that a register is a sub-structure of a natural language, *e g.*, English or Arabic, related to a social function or purpose. In Halliday's own words,

> We can refer to a 'mathematics register', in the sense of the meanings that belong to the language of mathematics (the mathematical use of natural language, that is: not mathematics itself), and that a language must express if it is being used for mathematical purposes. (p. 195)

In other words, for Halliday, the mathematics register does not include mathematical notations: these are trans- or supra-linguistic. I believe Halliday is intending to exclude from the mathematics register anything other than what Hayfa in her article confusingly calls "the verbal register". Symbols such as 6 or × 2 are not part of any natural language, even though human groups have developed ways to say them aloud as if they were elements of a particular natural language. (Transcribers regularly use mathematical notation in transcripts, as if it were what the person actually said: but no one can ever say '6' or sin(*x*) - in English, what they say is 'six' and 'sine x' or 'sine of x'.)

Hayfa's article uses 'register' in a non-technical sense, indeed one I suspect translated, I presume, from French. Personally, I do not know whether 'le registre' also has a linguistic use, but there is at the very least an issue of translation here (the title of Balacheff's document, *Cadre, registre et conception* cited in Hayfa's FLM piece bears this out, I feel). The thing that particularly caught me, though, about Kotsopoulos's response to Hayfa was that although she (to my mind correctly) drew attention to the fact that Hayfa was not using the word 'register' in this linguistic sense, at least not without it having to carry a significant and unexplored metaphoric load, she herself went on to use not only the apparently adjectival terms in front of *register* (namely, "verbal, geometric, algebraic and analytic" (p. 21)), but also to talk about Hayfa's "the register of the reasoning" In the quotation from Hayfa's article (p 39), which Kotsopoulos quotes, Hayfa seems to paraphrase "register" as "language". The rest of Kotsopoulos's communication was spent querying whether the form of the tasks influenced the form of the solution (an interesting question), but one couched in the very terms that her opening sally found fault with.

For me, the question is what force there is in talking about register other than simply 'notational form', say, or some other descriptive term (does 'semiotic representation', for instance, convey more than simply 'type of mathematics'?) What do we gain? And, especially for me, what is the gain in talking of the 'reasoning' as if it were in a particular register (in Halliday's sense), under the control of the user in response to the context.

References

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Semiotic resources for doing and learning mathematics

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A response to Hayfa, **26***(2)* and *Kotsopoulos,* **26***(3)*: Hafya's recent article suggests that in Lebanon at least, the language used in textbooks constrains the conceptualisations students are likely to develop for the concept of vector. She ends her article with an interesting question:

> Is it possible to find, and thereafter to use, a more suitable language that permits an adequate conceptualization of the vector? (p. 40)

She uses 'language' in a broad sense, to include:

> graphical representations (figures, drawings); algebraic (operations) and sentences used in the statements of definitions, theorems, properties and problems (p. 40, note 10)

Hayfa refers to these various aspects of mathematical discourse as "registers". Her question assumes a number of things:

1. a relationship between language used in mathematics classrooms and the nature of the conceptualizations students develop, such as, in this case, their conceptualization of the vector
2. some languages are more suitable than others
3. some conceptualizations (*e.g.*, of the vector) are more adequate than others
4. it is desirable to find and use the most suitable language.

Kotsopoulos takes issue with Hafya's use of the term "register", preferring the term "semiotic representations". Taking Halliday's view of the mathematical register (as discussed by Pimm, preceding communication, p. 31, this issue), she asks a question of her own:

> Are semiotic representations simply alternative representations of the same ideas within the mathematical register? (p. 21)

In a recent analysis of the nature of mathematical discourse from a Hallidayan perspective, O'Halloran (2005) examines three different "semiotic resources" used in mathematics: language, symbols and visual images. These semiotic resources correspond well with Hafya's "registers", provided that her algebraic and analytic registers are combined. O'Halloran shows how these three sets of resources work in different ways: they have different grammatical structures. Furthermore, O'Halloran shows how much of the power of mathematics derives from the way these three sets of resources are interwoven, through a process she refers to as *intersemiosis*.

However, shifting from one set of resources to another is not straightforward. Mathematical symbols have developed to be good for expressing mathematical processes. The use of natural language in mathematics, however, tends to turn these processes into objects (O'Halloran, 2005, pp. 184-188). This analysis suggests that the different semiotic resources are not "simply" alternative representations, so, in reply to Kotsopoulos's question, they work in different ways. In mathematics classrooms, of course, time is spent rendering symbols and visual images into spoken words. Thus, the language in the textbook cannot be solely responsible for the particular directions in which students' conceptions develop.

A fundamental starting point for Halliday's analysis of how language works is the idea of *meaning potential*. By making selections from within a linguistic system, we deploy these meaning potentials to make meaning for ourselves. As Torkildsen (2006) observes, in a communication adjacent to Kotsopoulos's:

> Meaning is not a property that belongs to mathematical objects, meaning has to do with our relationship with mathematical objects. Learning about a mathematical object is precisely to gain meaning for mathematical objects. (p. 20)

It seems to me that the same point can be made about mathematical words, symbols or images (and vectors). The idea of a vector has no intrinsic meaning; the word 'vector' has no intrinsic meaning; an arrow on a page has no intrinsic meaning. Meaning has to do with our engagement with these things, and for me, that engagement is a social process, which may involve, for example, a teacher; classmates; friends; family members; or people seen on television. In her response, Kotsopoulos goes on to argue that, rather than seeking "greater clarity and purpose" (p. 21) for a language to use in teaching mathematics, it is more important to understand how students "[make] sense of the use of and purpose of words in mathematical contexts" (p. 21). I contend that it is possible to do both. It is worthwhile to examine the different systems of meaning potential available to students of mathematics; but such an examination must be related to some sense of how students make sense of what they encounter, and more fundamentally, to students' learning of mathematics.

Language is too complex for there to be simple answers to any of the questions raised by Hafya or Kotsopoulos. I suspect that the assumptions inherent in Hafya's question will only hold in a highly constrained system. It is likely, however, that highly constrained systems lead to highly constrained conceptions. Better, perhaps, for students and teachers to explore the meaning potential of language, symbols and visual images, to see what can be said and done and so to develop their relationship with mathematics.

References

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Kotsopoulos, D. (2006) 'Researching linguistic discrimination', *For the Learning of Mathematics* **26**(3), 21-22.

O'Halloran, K. (2005) *Mathematical discourse: language, symbolism and visual images*, London, UK, Continuum.

Torkildsen, E. (2006) 'A mathematics teacher's apology', *For the Learning of Mathematics* **26**(3), 20-21.

Children do have their own sense of truth from a very early age. As in the case of mathematical history this sense shifts over the years; it moves from being an individual matter based on action and perception to a more social participation through discussion and negotiation. It is sometimes assumed that these shifts take many years and that younger children are not perhaps capable of the finer demands of unegotistical logical attention. This is where the evidence of undirected conversations can be helpful.

(Dick Tahta (1995) 'It must be so', *Mathematics in School* **24**(3), 2-3.)
