MOTIVATED, MESSY MATHEMATICS

DAVID WAGNER

"The truth about stories is that that's all we are" (King, 2003, p. 2). Thomas King is a prolific interpreter of Indigenous experience in Turtle Island territory (often referred to as North America) who identifies himself as having Cherokee, German, and Greek background. He warned: "you have to be careful with the stories you tell. And you have to watch out for the stories you are told" (p. 10). King began a series of five public lectures broadcast across Canada with this acknowledgement of the power of stories and continued by contrasting an account of an Indigenous creation myth with the Judeo-Christian creation myths in the book of *Genesis*:

> In Genesis, all creative power is vested in a single deity who is omnipotent, omniscient and omnipresent. The universe begins with his thought, and it is through his actions alone that it comes into being. In Native creation stories deities are generally figures of limited power and persuasion, and the acts of creation and decision are shared with other characters in the drama. In Genesis we begin with a perfect world but after the Fall we are forced into a chaotic world of harsh landscapes and dangerous shadows. In our Native story, we begin with water and mud and move by degrees and adjustments to a world rich in diversity, complex, wonderful and complete. (King, 2003, p. 24)

Creation stories and other myths are important not because people believe their technical accuracy but because they are stories that describe order in the universe (Mills, 2020). They explain relationships and give us models for action and interaction. Susan Staats (2019), in her move to re-mythologize mythology as a step towards re-mythologizing mathematics, noted how myths and related genres "tell us about social processes of social reproduction, and sometimes serve as the basis of social critique or social action" (p. 795). Creswell (2020) noted similarities between myth and theory: "Just like myth, we see that theory is an interpretative act that explains the workings of life" (p. 431). In comparing creation stories across cultures, it is important to avoid using one as a standard for judging the other. Instead, the value of comparing is to see different ways of thinking about relationships in the world.

This article is centred on stories and particularly on *founding* stories (creation stories). First, I celebrate David Pimm's contribution to mathematics education as a research field. I see him as one of the founders of the field of mathematics education and more particularly of the body of work on communication in mathematics classrooms. Second, I reflect on David's formative role in my induction into the field, as he was the scholar who supervised my Master's and PhD work.

When I was almost finished writing this article, I read again one of David's earliest contributions to the field, presented at the fourth International Congress on Mathematics Education, in Berkeley in 1980, and elaborated in *For the Learning of Mathematics* in 1983. Not surprisingly, much of what I had to say in this article aligns with things already said by David. In his 1983 protest of the avoidance of history in the teaching of mathematics, he cautioned against masking the contexts in which mathematical concepts and theories were constructed:

> A polished, logical presentation of mathematics (that is, a-historic, prepared with hindsight) shows none of the difficulties, errors, guesses, stumblings which went into its creation and attainment of its present. (Pimm, 1983, p. 14)

David warned that to avoid history is a choice that shapes the conception of mathematics. He invoked René Thom's (1973) warning that "whether one wishes it or not, all mathematical pedagogy, even if scarcely coherent, rests on a philosophy of mathematics" (p. 204). Teachers who ignore historical stories of the creation of mathematics mask the nature of the concepts they claim to honour.

In this article, I reflect on two theories that are used in mathematics education research to analyze and explain communication, both of which I have used extensively: systemic functional linguistics (SFL) and positioning theory. I both identify their attention to story and structure my reflection itself around stories. I position the founding (creation) stories of the two theories within the story of my own induction into the field of mathematics education.

I think founding stories in scholarship are important for two reasons. First, as David pointed out, the stories that describe how theories were developed situate the concepts in the theories. They give sense to the concepts. Second, the stories may help seasoned scholars connect with mathematics teachers who have their own reasons for becoming interested in mathematics education research and scholarship. This second reason inspired me to reach out and ask my mathematics educator colleagues to recall the publications that first excited them when they were inducted into the field. When I asked this question, I received many long emails from colleagues expressing joy in reflecting back on how they were drawn into this research field. The stories have power.

Entering the discourse

The first story in this article is my own induction story into the field of mathematics education. My nine years of teaching high school mathematics, first in Canada, then eSwatini, and then back in Canada again alerted me to the highly cultural nature of mathematics teaching, which I had previously assumed was culture- and values-free. The opportunity to contrast cultural contexts of teaching mathematics prompted me to reflect on the societal impact of a respected discipline that pretended to be free of cultural particularities. My reflections propelled me to do a Master's degree to connect with others making similar observations, and immediately thereafter into doing a PhD.

My initial interest in the cultural nature of mathematics arose from my problematization of a myth—that mathematics is culture-free and transcultural. It took an unusual series of events to denaturalise this myth for me, aided by the transposition of my mathematics teaching through significantly different contexts. Early in my reading of mathematics education research, I was most interested in the work of scholars who were writing about the things I had noticed. Ubiratan D'Ambrosio addressed the cultural aspects of mathematics (*e.g.,* D'Ambrosio, 1994) and Ole Skovsmose addressed the "formatting power" of mathematics education, that is, the impact of its myths on society (*e.g.,* Skovsmose, 2000).

David's attention to language extended my thinking. It challenged me to recognise and seek to understand phenomena that I had not yet noticed in my professional reflective practice. David's work showed me that socio-cultural phenomena in mathematics education are enacted through language choices. I was interested in how the language of mathematics and mathematics education obscured subjectivity and normalized particular ways of seeing and acting on the world. This continues to be my most compelling research interest. Although I know David recognised my interest and played a significant role in shaping it, I cannot recall particular conversations about it. My strongest memory from our interactions is his patient, quiet, listening face. Of course, he replied to what I said, but those details I do not remember. From a trip to the United Kingdom he brought me back some books by Norman Fairclough, who worked with language in ways that met my interests. David himself was not using Fairclough in his own work, but he had identified this scholarship to address *my* interests. This act shows how David listened.

Fairclough's attention to language and power led me to become interested in two theories of communication that have been useful to me over the years: Systemic Functional Linguistics (SFL) and Positioning Theory. Fairclough drew on SFL to identify the way language choices set up power relations. While SFL focussed on language, I became interested in another theory because of its focus on relationships. A connection to positioning theory arose from my interactions with my academic sister, Beth Herbel-Eisenmann (we are David's "children" in the sense that he supervised both of our PhDs). After I met Beth at a conference in 2004, we read and discussed the book that launched positioning theory, *Positioning Theory,* edited by Rom Harré and Luk van Langenhove (1999).

Systemic Functional Linguistics (SFL)

SFL positions three metafunctions of language practice as working together inseparably: interpersonal, ideational, and textual (*e.g.,* Halliday & Matthiessen, 1999/2006). I have found that most research that uses SFL in mathematics education focusses on the text (the textual metafunction) and the way it reciprocally represents and formats human interaction (the interpersonal metafunction). This focus seems to avoid the ideational metafunction.

"Ideationally, the grammar is a theory of human experience; it is our interpretation of all that goes on around us, and also inside ourselves" (Halliday & Matthiessen, 1999/2006, p. 511). This idea that distinction-making develops through words is powerful. My sense of theory sees the explanatory aspect as central: theories *explain* the phenomena they represent. For example, when speaking mathematically, one might use a passive voice. The theory of SFL helps me see this as a choice. The choice of the passive voice relates to the textual metafunction. To say that the choice obscures human subjectivity relates to the interpersonal metafunction. I find that the documentation of the choice and its effect becomes most interesting when it is explained in terms of human stories—the ideational metafunction. Such explanations help me think about why someone would want to obscure human subjectivity and might place such moves in a tradition that has developed particular roles in society, perhaps supported by such moves.

Martin and Rose (2007) identified four categories of ideation. *Taxonomic relations* comprise "social categories" and identity: "we can make explicit the social world that [someone] constructs in the story" (p. 77). *Nuclear relations* exist by collocation: words that go together to make a genre. *Activity sequences* bring together processes to comprise a known story. This has clear connections to positioning theory's interest in storylines, which I will address below. *Grammatical metaphor* uses grammar to position something in a certain way, as a process, a quality, or a thing. Martin and Rose explained the centrality of grammatical metaphor to obscured subjectivity: "In general the drift in meaning, by means of grammatical metaphor, has been from reality as processes involving people and concrete things, to reality as relations between abstract things" (p. 110). The move to abstraction is often identified as a characteristically mathematical move.

In 2011 in Lisbon, I participated in the one-week pre-congress institute hosted by the International Systemic Functional Linguistics Congress. The five full-morning sessions led by J.R.R. Martin described the development and theory of SFL and included practical exercises as examples. Martin is probably the most recognised active scholar in SFL. He pointed to M.A.K. Halliday as the founder of the theory. It is interesting to me that the situations Martin described as having motivated the development of SFL are not usually part of the literature describing the theory. For example, in *An Introduction to Functional Grammar,* Halliday and Matthiessen (2014) did not identify the particular problems or challenges Halliday was addressing as he developed SFL theory. The larger context (the ideation) of the communication acts of SFL theorisation were obscured. The authors did not describe the conflicts between functionalist and structuralist linguistics and the worldviews these approaches reflect. But in these morning sessions in Lisbon, Martin described the theory in relation to the contexts in which Halliday developed it.

The word that stood out for me most in Martin's practical exercises in the pre-congress institute was *motivated.* Martin led participants through exercises of identifying lexical and/or grammatical distinctions. From our discussions, I came to understand that the key to the theory is that distinctions are motivated. When considering any set of alternative wordings, Martin always talked about motivated distinctions.

This is how language develops. People who are communicating feel compelled or motivated to identify a distinction. They find ways to convey this distinction with new words or new forms of words. For example, the fact that the English language traditionally distinguishes gender with its pronouns in certain cases and does so with a binary approach means that sometime in the history of the language people found it important to make such distinctions—to specify the gender of people pointed out by pronouns. Eventually the distinctions became ubiquitous and came to be expected in references to individuals. For some time, this expectation made it difficult to refer to someone without referring to their gender. However, in recent years we have experienced a move to eliminate this distinction by using pronouns that are not gender-specific. An individual can use word choice to make a distinction or obscure a distinction, but it takes significant consensus among active groups of users of a language to change the discourse.

I suggest that theory and concepts develop similarly. The context in which Halliday developed the theory of SFL motivated him to do things the way he was doing them. Distinctions between structural and functional linguistics are likewise motivated. I recall discussing the political implications of these orientations with Martin, in relation to which of these approaches is more Marxist.

Just as I have found the ideational metafunction to be underdiscussed in the literature, I find attention to the importance of motivated distinctions lacking. The stewards of the theory often propagate lists of categorizations (distinctions) that drill down to great detail. These distinctions include grammatical categories and theoretical categories (*e.g.,* the three metafunctions), but little in the way of reflection on why these distinctions might be motivated.

Now I wonder what we are missing by ignoring motivation in mathematics. I am talking about micro-motivations, motivations that underpin a person's wish to say or write something, a motivation to break one's silence and address what is happening. I am not talking about motivation in the psychological sense of a general willingness to do mathematical tasks assigned by teachers. Clearly, David's call to highlight the context in which mathematical ideas emerge is relevant to the importance of micro-motivation:

> What is missing from the formal presentation in the customary *Satz-Beweiss* [theory proving] manner […]? Firstly, one lacks any discussion of the problem background. What questions were the mathematicians involved in trying to solve? How were they viewing the problem, and in what way is this theorem a solution? Theories arise in response to problems and absorbing theories should not be central to mathematics education. (Pimm, 1983, pp. 13–14)

David's activism here reminds me of a Grade 11 class (the penultimate year of high school in Canada) I taught in 1999. I always began a unit of study focussed on a big idea. This was going to be a unit on trigonometry—coterminal angles, the unit circle, and so on. I had decided to start the unit with this group task: "If you were responsible to design a way to put angles on the Cartesian plane, how would you do it?" After about five minutes of small group discussion a student stood up and demanded, "If we are going to decide on the best way to do this, we need to know why someone would want to put angles on the Cartesian plane!" This demand drew the full class immediately into discussion in which they implored me to explain why mathematicians would want to do this. Every answer I gave provoked a new question of why. The interrogation consumed the whole class period, which worried me a little at the time because I had only planned for about ten minutes of discussion. However, I later found that the rest of the unit went by very quickly. The students seemed to interrupt me every time I tried to explain a new concept in the unit. They said it was obvious, and they referred back to our first-day discussion. They completed exercises in short order, again, finding them easy. The unit took half the usual time and the students performed the usual assessments better than any of my previous classes for this unit of study. I see this experience as an example of the explanatory power of motive. For concepts and methods that had taken considerably more class time in my previous teaching, this group of students, who thought of the concepts in terms of the *why* or the motivation behind the concepts, had relatively little trouble.

While there could be value in developing research approaches to understand students' and teachers' motivation in the moment, my thoughts here focus on pedagogical implications of taking motive seriously. This kind of pedagogy would place mathematical concepts within the problems that motivated their conception, as in the trigonometry example I described above. Further, this kind of pedagogy could construct situations designed to inspire motivated action from students. For example, a teacher might give students a task to inspire them to develop more efficient methods, or a teacher might develop classroom procedures that reflect mathematization such that students would question the particular choices for mathematization (*e.g.,* Wagner, 2022).

David's way of interacting also underlines his interest in this kind of motivation. The characteristic of David that I most appreciate is the way he listens to each person attentively, as if he expects the person to say something deeply interesting. He listens for motive and asks questions to tease out the moves that people may be wanting to make with their words. For example, as recounted above, when David brought me the Fairclough books, he showed his attentiveness to the phenomena that I was noticing in mathematics education and facilitated my reflection by identifying a body of scholarship that would help me in this.

In my view, David's stance—his attentive, expectant listening—underpins his promotion of informal talk in mathematics learning contexts, particularly talk that involves "negotiation of meanings and sharing points of view about mathematics" (Pimm, 1987, p. 46). David has emphasised the importance of purpose: "The pupils need to have some idea of *why* they are being encouraged to talk, for among other things, without knowledge of the purpose, criteria cannot be brought into play about adequacy and explicitness of the account" (p. 48).

Colleagues and I have been documenting mathematics students' language use for situations involving prediction. We are drawing on the language-as-resource metaphor (*e.g.,* Planas & Setati-Phakeng, 2014) and the theory of translanguaging (García & Wei, 2014) to understand how students express their meaning. The language-as-resource metaphor identifies all language repertoires as being potential resources, including a range of national languages and a range in degrees of formality. Translanguaging challenges the neat boundaries people often imagine around languages (and registers, we add). This relates to the way David promoted informal talk. Karla Culligan and I (Wagner & Culligan, 2020) identified distinction-making and register-fitting as two important kinds of language skill. The skill of distinction-making comes up when students (or others) use all their language resources to make meaning in situations where they want to show that one thing is different than another. They draw upon mathematics registers (formal language generally), other registers (informal language), gestures, the language of instruction, their mother tongue, and hybrids of these languages. We also recognised that there is value in developing students' skill in moving to formality and fitting the register, for mathematics registers are developed specifically for making the kinds of distinctions that are useful and powerful in mathematical situations. Further, the way a person fits expected genres greatly impacts their positioning in an interaction.

But distinction-making requires motive. The whole idea of motive and purpose is anathema to the myth of objective, culture-free mathematics, as I described it above. Teachers have motives for introducing a task and students have motives when they respond. Their motives may not be easy to identify but they underpin choices. The reality that we cannot have direct access to people's motives but only to the *expression* of motive, namely the language choices people make, drives my continued research interest in language choices. Though I am most interested in the circulation, exercise, and negotiation of power in this world, I see from David's influence that language is the site of most of these negotiations and exercises of power. I see the importance of language and discourse as forces even in the most physical violence, both structural and explicit.

To think more about motive, I consider a conversation in which students were asked to talk about the number of diagonals in different polygons, as David discussed in *Speaking Mathematically* (Pimm, 1987, p. 84). He used the incident to exemplify particularities of a mathematics register, namely the importance of understanding the distinction between everyday and mathematical uses of a word—*diagonal,* in this case. By contrast, the construction of the task suggests to me a teacher's wish to motivate students to make distinctions among types of polygons when making a general rule for counting the diagonals—particularly the distinction between convex and concave polygons. The number of diagonals in a convex n-gon is $n \times (n - 3) \div 2$, but this generalisation does not hold for concave polygons. Students may have other motives. Some students may acquiesce to the teacher's direction. Others may use the mathematics context to make other moves in their relationships. I think, for example, of the story recounted by Daniel Chazan in which a fight from the hallway was continued in the classroom but now using the medium of mathematics (Chazan & Ball, 1999). The point here is that there is a mix of motives at work in any context of mathematics learning, including the context of the constructed mathematical concept. Mathematics is messy in this way, but I suggest that such messes are productive. King (2003) reminded us that Indigenous creation stories point to the productive power of such messiness.

I think of two implications of messy contexts of mathematical interaction. Explicit attention and discussion about motive amongst teachers and students facilitates distinction-making. Students construct and learn mathematics when they are motivated to make distinctions. Distinction-making is the heart both of languaging in SFL and of mathematical development. Thus, an implication for teachers is to structure messy, motive-rich contexts for developing mathematics. For researchers, I see potential value in documenting the range of motives that teachers and students bring to (potential) mathematics learning situations.

Positioning theory

Positioning theory focusses on how people interact by identifying three phenomena that interrelate: positioning, storyline, and communication act. The relationship among these phenomena is often depicted with a triangle or triad. Any interaction follows an already-established pattern of development. Davies and Harré (1990) and others called such patterns *story lines.* The unitary term *storyline* has become most common since then. People in interaction use a storyline they know to make sense of the *communication acts* they experience in an interaction to assign *positions* to the people in the interaction. The storylines and positioning are chosen by interlocutors based on the communication acts they experience. Simultaneously, the storylines and positioning chosen by the people guide their communication acts. With colleagues, I have elaborated the model to highlight its dynamics—how communication acts, positioning, and storyline reciprocally feed each other (Herbel-Eisenmann, Wagner, Johnson, Suh & Figueras, 2015).

I note that the interpersonal metafunction in SFL relates closely to positioning, and the textual metafunction in SFL relates closely to communication acts. The ideational metafunction relates closely to storyline and both are underdiscussed in the application of their respective theoretical homes. For example, until recently most research using positioning theory in mathematics education has focussed on the way communication acts and positioning reciprocally represent and shape each other. Storylines are underdiscussed. There are, however, some recent exceptions to the paucity of consideration of storylines in mathematics education. Herbel-Eisenmann *et al.* (2016) and a series of articles in a *Canadian Journal of Science, Mathematics and Technology Education* special issue (*e.g.,* Chorney, Ng & Pimm, 2016) identified persistent images of mathematics in the media. At the first Positioning Theory Symposium, Beth Herbel-Eisenmann and I critiqued the theory, pointing to confounding double use of "positioning" both to name the classic triad and to name one element in the triad (Wagner & Herbel-Eisenmann, 2015). It was David who initially pointed out this oddity to us. Positioning's double-role betrays the theory's obsession with one element in the triad.

Now, I reflect on origin stories for positioning theory. I emphasize that the extensive writing about positioning theory has describe the theory but until recently has not told stories of its emergence. Its storyline is obscured. Rom Harré, who was instrumental in the development of the theory, described its formation in an address at the first Positioning Theory Symposium in 2015 in Bruges. Although he described the theory emerging out of his interactions with feminist Bronwyn Davies when she was a graduate student, it was clear to me that the story he told there was probably not the same story Davies would tell. Though I had not yet met Davies, I sensed that Harré was depicting Davies in ways that she would not use to describe herself. I found it ironic that Harré's description of his work with Davies did not recognise that Davies may have a different account of the positioning in their interactions because, in this address and previous writing, Harré emphasised that positioning theory recognises that there is no normative reading of an interaction. Positioning is negotiated and people in the same interaction may be using different storylines or different positioning to understand the situation.

Harré's death in 2019 prompted a number of retrospectives of his work. Some of these retrospectives described the development of positioning theory but they focussed on what got published, not on the motives and relationships behind the publications. McVee *et al.* (2018) showed how the feminist work of Davies and the work of Michael Bamberg on narrative emerged from the initial conceptualisations of positioning in the early 1990s (Davies & Harré, 1990; Harré & van Langenhove, 1991) and diverged from the group that referred to positioning theory as a coherent one. Yet even the apparently coherent theory was questioned by Jørn Bjerre (2021), whose analysis of Harré's writing about positioning led to the conclusion that "although Harré is the central author, the fact that the individual texts are as much the creations of his various co-authors may be interpreted as an expansion of his authorship in different directions, and the co-authors become part of the construction of who Harré became as an author. Thus there now exist several versions of Harré" (p. 252).

Bjerre highlighted a tension in the theory between static and dynamic conceptions of the self. To illustrate, in the less contentious parts of Harré's account of the emergence of the theory, he described his work with Davies as focussing on the connection between "possibilities of action and actual performances", which explained why people usually "did what they were sought to do, what they thought their rights were". He described how Davies communicated a sense of women being trapped by expectations. With Bjerre's distinction in mind, the question is whether people are trapped by expectations (the static self) or free to negotiate positioning (the dynamic self).

In our presentation at the Positioning Theory symposium in 2015, Beth Herbel-Eisenmann and I said that the focus on positioning is "one of the most powerful features of positioning theory because it enables emancipation from powerful discourses; in a mathematics classroom (or anywhere), there is no exterior structure that 'forces' particular interactions" (Wagner & Herbel-Eisenmann, 2015, p. 2). The most common references to positioning in mathematics education consider the way people position themselves in relation to mathematics. Attention to positioning using this theory that focuses on immanent interaction may be helpful for individuals dealing with a monolithic discipline they cannot change. However, I now want to problematize our celebration of the value of the theory. I build on the slavery metaphor invoked by our use of the word *emancipation*. Helping someone free themselves from chains does not necessarily imply emancipation. Emancipation requires smashing slavery, overturning the system. Emancipation requires change to the myths, the storylines. Both are important: freeing individuals and systemic emancipation.

Which storylines bind students most destructively in mathematics? I turn to David's 'The silence of the body' (Pimm, 1993) in which he identified "costs involved in becoming skilled" (p. 35). He recognised that "Mathematics has much in common with other ritual activities: the mystique, the incantations, the initiates and the masters" (p. 35) and asked, "As with songs, novels and pictures, poems and plays, and other art forms, there is always the question 'What is the song about?'" (p. 35). David exposed mathematics as coldly masculine: "Words and phrases such as rigour and rigid, mathematics is hard, the power of mathematics [...] can be heard as arising from a male sexuality, and the concern with loss of rigour arising from its accompanying fears" (p. 37).

If mathematics is as masculine as David described it in 1993 (I think it may well be), then what are the implications for mathematics students who identify as feminine or with diverse gender identities? This question should motivate significant work for mathematics education researchers and mathematics teachers. We must identify the gendered storylines associated with mathematics. Heather Mendick (2005) has begun this work in her identity-oriented account of the gendered nature of 15 binary oppositions commonly associated with mathematics and mathematics learning, including fast / slow, competitive / collaborative, independent / dependent, active / passive, natural ability / hard work, real understanding / rote learning, and reason / calculation. Then we must find ways to counteract the stories that position boys with one side of the binary and girls with the other. This is work for mathematics teachers, mathematics education researchers, and teacher educators who can support the teachers in this work. We should also consider the social implications of a masculine mathematics and the possibilities for alternative constructions that are not gendered.

There are other stories that underpin the mathematics to which we have become accustomed (some of which probably intertwine with myths of masculinity). And there are stories that underpin the mathematics education research to which we have become accustomed? All these stories warrant exposure and reflection. Again, this reflection should motivate research action. What are the implications of the stories? What are alternatives? How might alternatives be enacted?

Why do we ignore story?

I close with thoughts on why we might ignore story. We, scholars in general and mathematicians in particular, have benefitted from the aura of objectivity in our disciplines, which underwrites our resistance to identifying our subjectivity. We are happy to be analytical because analysis defines our disciplines and lends us authority, but we may worry that recognition of subjectivity could undermine the aura of our authority.

The focus on analysis while ignoring motive and story relates to the construction of mathematics. David and others have helped us see that mathematics is constructed by humans. This runs counter to a common perception that mathematics sits with the god(s), pre-existent and perfect. This common perception was critiqued by Tobias Dantzig in 1930—"the structure of mathematics appears to the layman as erected not by the erring mind of man but by the infallible spirit of God" (p. 188)—and continues to be critiqued by, among others, Bill Barton (2008), who referred to typical school mathematics as "near-universal, conventional mathematics" (p. 10).

To emphasise the significance of differing portrayals of mathematics as clean and free of culture and history versus mathematics as messy and situated in human interactions, and to situate this significance in the larger myths that compete for dominance in our society, I re-present a paraphrase of King's (2003, p. 24) account of Indigenous creation stories in comparison to Judeo-Christian stories (quoted at the beginning of this article) replacing the creation myths with mathematics philosophies:

> [In school], all creative power is vested in a single [mathematics] that is omnipotent, omniscient and omnipresent. The universe [is written in the language of mathematics]. [But novice and expert mathematicians] are generally figures of limited power and persuasion, and the acts of creation and decision are shared with other characters in the drama. [In school we imagine] a perfect world but are [left to wonder how to deal with] a chaotic world of harsh landscapes and dangerous shadows. [With situated mathematics we can] move by degrees and adjustments to a world rich in diversity, complex, wonderful and complete.

I suggest that David Pimm's legacy in the field of mathematics education is appreciative attention to the way people think mathematically and express their mathematics (imperfectly). David's legacy in the research community is appreciative attention to others in the field—what we notice about mathematics teaching and learning, and how we (imperfectly) express our observations.

References

Barton, B. (2008) *The Language of Mathematics: Telling Mathematical Tales.* Springer.

Bjerre, J. (2021) The development of positioning theory as a process of theoretical positioning. *Journal for the Theory of Social Behaviour* **51**(2), 249–272.

Chazan, D. & Ball, D. (1999) Beyond being told not to tell. *For the Learning of Mathematics* **19**(2), 2–10.

Chorney, S., Ng, O. & Pimm, D. (2016) A tale of two more metaphors: storylines about mathematics education in Canadian national media. *Canadian Journal of Science, Mathematics and Technology Education* **16**(4), 402–418.

Creswell, J. (2020) Theories as modern myths: giving up the pursuit of good theory to focus on good theorizing. *Journal for the Theory of Social Behaviour* **50**(4), 429–434.

D'Ambrosio, U. (1994) Cultural framing of mathematics teaching and learning. In Biehler, R., Scholz, R., Sträßer, R. & Winkelman, B. (Eds.) *Didactics of Mathematics as a Scientific Discipline,* 443–455. Kluwer.

Dantzig, T. (1930/2005) *Number: The Language of Science.* Plume.

Davies, B. & Harré, R. (1990) Positioning: the discursive production of selves. *Journal for the Theory of Social Behaviour* **20**(1), 43–63.

García, O. & Wei, L. (2014) *Translanguaging: Language, Bilingualism, and Education.* Palgrave Macmillan.

Halliday, M. A. K. & Matthiessen, C. (1999/2006) *Construing Experience Through Meaning: A Language-Based Approach to Cognition.* Continuum.

Halliday, M. A. K. & Matthiessen, C. (2014) *An Introduction to Functional Grammar* (3rd edition). Routledge.

Harré, R. & van Langenhove, L. (1991) Varieties of positioning. *Journal for the Theory of Social Behaviour* **21**(4), 393–407.

Harré, R. & van Langenhove, L. (Eds.) (1999) *Positioning Theory.* Blackwell.

Herbel-Eisenmann, B., Sinclair, N., Chval, K. B., Clements, D. H., Civil, M., Pape, S. J., Stephan, M., Wanko, J. J. & Wilkerson, T. L. (2016) Positioning mathematics education researchers to influence storylines. *Journal for Research in Mathematics Education* **47**(2), 102–117.

Herbel-Eisenmann, B., Wagner, D., Johnson, K., Suh, H. & Figueras, H. (2015) Positioning in mathematics education: revelations on an imported theory. *Educational Studies in Mathematics* 89(2), 185–204.

King, T. (2003) *The Truth About Stories: A Native Narrative.* Anansi.

Martin, J. & Rose, D. (2007) *Working with Discourse: Meaning Beyond the Clause* (2nd edition). Continuum.

McVee, M., Silvestri, K., Barrett, N. & Haq, K. (2018) Positioning theory. In Alvermann, D. E., Unrau, N. J., Sailors, M., & Ruddell, R. B. (Eds.) *Theoretical Models and Processes of Literacy* (7th edition), 381–400. Routledge.

Mendick, H. (2005) A beautiful myth? The gendering of being/doing 'good at maths'. *Gender and Education* **17**(2), 203–219.

Mills, J. (2020) Toward a theory of myth. *Journal for the Theory of Social Behaviour* **50**(4), 410–424.

Pimm, D. (1983) Why the history and philosophy of mathematics should not be rated X. *For the Learning of Mathematics* **3**(1), 12–15.

Pimm, D. (1987) *Speaking Mathematically: Communication in Mathematics Classrooms.* Routledge & Kegan Paul.

Pimm, D. (1993) The silence of the body. *For the Learning of Mathematics* **13**(1), 35–38.

Planas, N. & Setati-Phakeng, M. (2014) On the process of gaining language as a resource in mathematics education. *ZDM* **46**(6), 883–893.

Staats, S. (2019) Re-mythologizing mathematics? Lessons from a sacred text. In Subramanian, J. (Ed.) *Proceedings of the 10th International Mathematics Education and Society Conference,* 794–803. MES10.

Skovsmose, O. (2000) Aporism and critical mathematics education. *For the Learning of Mathematics* **20**(1), 2–8.

Thom, R. (1973) Modern mathematics: does it exist? In Howson, A. (Ed.) *Developments in Mathematical Education: Proceedings of the 2nd International Congress on Mathematical Education,* 194–209. Cambridge University Press.

Wagner, D. & Culligan, K. (2020) Documenting mathematical language: distinction-making and register-fitting. Sacristán, A.I., Cortés-Zavala, J.C. & Ruiz-Arias, P.M. (Eds.) *Mathematics Education Across Cultures: Proceedings of the 42nd Annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education,* 2138–2142. Cinvestav/AMIUTEM/PME-NA.

Wagner, D., & Herbel-Eisenmann, B. (2015) Positioning positioning theory in its application to mathematics education research. Paper presented at the first Positioning Theory Symposium, Bruges, Belgium, 6–8 July.

Wagner, D. (2022) Subject to mathematics. *For the Learning of Mathematics,* **42**(1), 35–39.