SAME THING: MIND BLOWN. STYLIZATION OF "PLEASANTLY FRUSTRATING" ANALOGIES

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"Same thing! … Mind blown!" After two class days of periodically ignoring his groupmates' work on an algebra puzzle, exploring instead an extension that his group had posed the day before, Yadiel confirmed a significant property just after his teacher announced the end of the class, as the materials were being collected and carried away forever.

By saying *same thing,* Yadiel meant that his solution to the more complex extension was actually the same as his group's solution to the original puzzle. In the world of mathematics, this property might count as "elegant", but Yadiel's pronouncement did not seem joyful. Instead, he sounded "pleasantly frustrated", in Gee's (2005) terms, the ideal condition for learning established by some games (p. 10). Yadiel seemed to have hoped for a solution different from the one he and his group had discovered early on the previous class day. He declared the two solutions to be in an analogous relationship to each other, but he found this condition to be lacking in style.

Why study students' sense of mathematical style?

The sociolinguistic concept of style—or perhaps better, stylistic variation—is a "system of distinction" in which the manner of expression, through its contrast with functionally similar options, is particularly cogent to the participants (Irvine, 2001, p. 22). A style is a manner of speaking identified analytically as well as to speech participants through its distinctiveness compared to other styles (Irvine, 2001). Bucholtz (2010), for example, identified speech styles in a California secondary school that allowed young people to establish and negotiate group affiliations such as the intellectual "nerd" versus the athletic "jock" that also corresponded to manners of dress, differential use of school spaces, and direct statements about identity or aesthetics. A style, whether it is a regional accent, a mode of dress, a manner of walking, or a judgement about what varieties of mathematics are beautiful, cannot be identified on its own. Styles can only be known through their difference from other possible styles. Styles are important because they are central to people's processes of signaling similarities and differences in social affiliation through a stance on what is beautiful, appropriate, or appealing.

Studying students' sense of mathematical style is a potential pathway to assess a central goal of our field: that students develop a positive, personally expressive affiliation with mathematics. But how should we study students' expression of mathematical style in activity, speech or writing? Are new research methods required to understand mathematical style? David Pimm posed foundational questions about mathematical style through his long-standing study of the expressiveness of linguistic form in mathematics, especially in mathematical metaphor and analogy (1981, 2010). Later, Pimm and Sinclair (2009) together showed that style in mathematicians' writing responds to the critical expectations of their audience that, for example, a proof that explains every detail might be uninteresting (see also Sinclair, 2009).

In this article, I extend this work with a preliminary step towards the analysis of secondary students' expression of mathematical style in an algebra class. Using three descriptive vignettes, I highlight moments of more- and less-styled mathematical activity to document the nexus of their disciplinary, interpersonal, and aesthetic engagements in their classroom. Attention to style in in these students' mathematical activity invites us to notice when students experience the core values of the discipline differently than we might expect.

Modalities and methods for mathematical style and stylization

To study style in mathematics, we must consider the question, "why *this* rather than *that* form" (Pimm & Sinclair, 2009, p. 23). Fulfilling this succinct observation, though, may require adjustments in established methods and writing styles for mathematics education research. First, the form of a message or activity must become the focus of study, because this form may be more meaningful to participants than the explicit meanings, purposes or goals of the event. Importantly for mathematics, participants might elaborate these forms in a non-verbal modality as well as in speech (Machin & Van Leeuwen, 2005). Second, to demonstrate that stylistic distinctions exist, one must compare the focal event to others that are similar in purpose or adjacent in time. Contemporary linguistic ethnographies of style compile a substantial amount of evidence from across multiple communicative events (Rampton, 2006; Bucholtz, 2010). As a result, research writing needs to present contrastive evidence beyond the focal event to demonstrate that stylistic variation exists. Participants' direct evaluations of style, as in Yadiel's comment, are useful, but analysis of form is central to understanding style. A third dilemma arises from these two points, that of interpreting moments of stylistic variation. Demonstrating differences in communicative form and the evidence for their interpretation may require broader ethnographic description of styled events than is typical in research writing.

While documentation of contrast is central to the analysis of style, contemporary analysis of style moves past generic lists of its characteristics towards tracing its capacity to make and contest social meanings (Bauman & Briggs, 1990). According to Jaspers and Van Hoof (2020):

> Speakers can also "stylise", *i.e.* suddenly, momentarily, and in an exaggerated manner produce particular styles that lie beyond their regular linguistic repertoires, or beyond what is conventional in the situation at hand. (p. 110)

Usually this stylization involves deployment of some semiotic combination that is "regular" whether in terms of register, dialect, or some other recognizable expression. For Rampton (2006), stylized performances are means of managing social boundaries, for example, interactions with more powerful people, or at the beginning and endings of institutionalized exchanges, in what he calls an interaction ritual. In this article, I focus on these unexpected, improvisational stylizations. Because mathematical style is an expression of students' sense of aesthetics, and stylization may be a way of expressing social affiliation or navigating power-laden boundaries, we should follow Sinclair (2009) in considering how expressions of style represent the emotional, embodied or intersubjective impact of classroom mathematics.

In a mathematics class, the multisemiotic nature of styles suggests attention to distinctive uses of writing, diagramming, graphing, manipulation of materials and their interrelation with speech. We should attend to the form of these multimodal "texts", in addition to students' direct evaluation of them. The regularity, recognizability, and distinction conditions of styles raise questions of timescale; that is, different and recognizable for whom and compared to what other activities over what span of time? Overall, to answer why a style occurs, we must find a way to analyze how distinctive styles communicate: amongst people; about ideologies and value systems; across boundaries; and abreast of any activity or modality (Coupland, 2007; Irvine, 2001).

Analogy as a gateway to style

That communicative form is meaningful, in ways that upon close consideration may be astonishingly different from our routine imaginings, is a characteristic theme of much of David Pimm's work, including some of his earliest work on analogies (1981). His linguistic analyses show that analogies and metaphors in mathematics are not superfluous figures of speech but instead powerful ways of making mathematical meanings. While the analogy A:B::C:D, a "resemblance of relations", seems like a proportion, we may know more about the relationships among A:B than C:D, so that an analogy may possess some element of mystery (p. 48). Through this consideration of written and spoken figures of speech in mathematics, David Pimm opened the "metaphoric way" for many of us researchers:

> There is so much more that could be said. I am interested in pursuing a metaphoric way that is both productive and hypothetical; more interested in the parallels between mathematics and poetry rather than emphasizing their dissimilarities [...] interested in the power of names and naming in framing our experience of the world in all its forms. (2010, p. 22)

As a way of honoring David Pimm's work, I listened to recordings of Yadiel's class for moments when students explored, in some committed way, relationships of similarity or of analogy while solving an algebra puzzle. Analogies are not uniquely associated with mathematical style, but stylized speech may sometimes serve to explore the mysterious terrain of a comparison before it is fully mapped.

I describe three cases in which student groups explored an analogy during the algebra activity. Two analogies were clearly mathematical and one was less so; one of the analogies was less styled and the other two more so. To analyze them, I first documented ways in which these moments stood out as having a distinctive form compared to similar events in the classroom. I included modes of solution that the student had developed recently and was trying to extend or that the teacher knew and wanted the student to experience. Second, I constructed temporary interpretations for how participants seemed to experience the styled events, such as "Yadiel was trying to contribute to his group's work all along", or for another student group, "Khadra was tired of Becky's overbearing manner". Multiple reviews of all the video and audio records, however, allowed me to adjust these interpretations with descriptions that account for the form of the styled event and that are compatible with the other expressions of the participants: "Yadiel was obsessed with finding a 'different' solution"; "Khadra and Becky were exploring a possible friendship". This process of intentional description to account for all the available data fulfilled the principle of style research to compare form and function of expressions across multiple events. I convert these moments into theorizable descriptions that demonstrate students' intersubjective valuations of mathematics. Because these stylized expressions are always highly socialized and metapragmatic—they communicate to and with others about the on-going activity (Silverstein, 1979)—analysis of style provides productive entry into students' critical naming and framing of their intellectual and social experiences in a mathematics classroom.

Traffic jam in an urban school

The students portrayed in this article attended a high poverty, multiethnic urban secondary school in the Twin Cities metropolitan area of Minnesota, USA, and were completing an inquiry-oriented algebra class that covers linear, quadratic, exponential and logarithmic functions and basic topics in probability and counting. Although they were secondary school students, their class was a university course and their work earned them free university credit through an increasingly commonplace postsecondary access system in North America known as concurrent enrollment (Staats & Laster, 2018). I am the coordinator for the concurrent enrollment university algebra class. I was video- and audiorecording that day because the teacher and I wanted to explore better ways of teaching one of the class activities, to encourage students to explore some of the number theory principles that arise from it. Preliminary class discussions emphasized that students should ask as many questions as they could generate about the puzzle, and try to answer them mathematically.

The puzzle that students were solving is commonly known as Traffic Jam, Hop to It, or Frogs. Problem statements for the task often promote it as a way to engage students and teachers on the value of non-standard written representations. Students use tokens—plastic animals in our case—on a playing board as shown in Figure 1, with the game rules that the animals on positions 1, 2 and 3 must trade places with the animals on positions 4, 5 and 6. Animals in the 1, 2, and 3 positions can only move right, and 4, 5, and 6 can only move left. Animals can hop over one other animal, or slide one unit to an empty space in their designated direction. For example, the solution developed by Nhia, Keej and Mee's group is shown below in Figure 2. There, R and P stand for Red animals (starting on 1, 2, 3) and Purple animals (starting on 4, 5, 6); S stands for a slide and J stands for a jump over another animal.

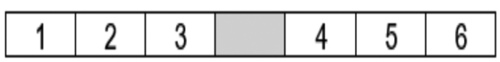

Figure 1. Traffic jam playing board.

After students solve the three by three case, they usually extend it to two, four, five or N animals on a side. Besides discovering a pattern of moves to solve the puzzle, students can find an equation for *M*, the minimum number of moves to solve the game, $M = N^2 + 2N$, either by noticing that their table of values yields constant second differences, or by noticing from their written notation system that there are N^2 jumps and 2N slides.

Analogy 1: Nhia, Keej and Mee's Gaussian exploration, a non-stylized analogy

The first analogy that I will consider arose when I suggested that Nhia, Keej and Mee could investigate number patterns such as 1 2 3 3 3 2 1 that arose from their solution diagram (Figure 2). Their work constitutes an analogy because, like Yadiel, they eventually found two solutions that they characterized as "the same thing": that the sum is equal to both $N^2 + 2N$ and $N(N + 2)$. The embodied work towards summing this number pattern also involves analogy by using symmetry to collect pairs of numbers into a focal number such as three. Nhia, Keej and Mee solved this clearly mathematical analogy without much verbal stylization.

I visited their group three times on day two of the activity and, each time, gave them a more directive nudge towards a Gaussian approach to analysis of their patterns. They accepted the suggestion, but after I left their table, Mee sighed tiredly, "More questions. More answers". Mee later reviewed the young men's work on the patterns, and discovered the property of N^2 jumps and $2N$ slides, but her participation was intermittent for the rest of the class. Nhia and Keej worked consistently but quietly and mostly independently on the question. During my last visit, I was quite directive [1].

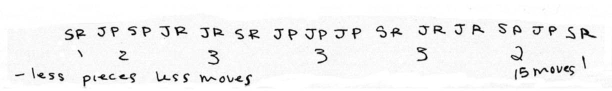

Figure 2. Keej, Nhia and Mee's traffic jam solution.

Sue There was a math guy, his name was Gauss, and he used a method for these strings, and he was trying to add them up [...] His way was, "Oh, I've got some threes, but this one is not a three. Is there any way to make it into a three?"

Keej You could combine these two [*pointing to the first 1 and 2 in the string*].

Sue Yeah, you could combine those two [*drawing an arc connecting the first 1 and the first 2*]. And in this one, the special number is four. Is there any way—

Keej OH! OK, I SEE, I SEE, I SEE, OK!

After I left, Keej and Nhia drew the arcs to sort all the numbers in their pattern string into the focal number, and after about ten minutes of work, they arrived at the formula $M = N(N + 2)$.

Nhia So, hey, if you know what this is, you got, you should add first and then multiply—

Keej Wait, what am I doing? Wait, isn't it the same thing as the OTHER ONE? OOOmigod! Omigod. So then it works, right? [*laughing*].

Nhia Yes. (*slight, ironic laugh*) [...]

Nhia See (*writing formulas*) same thing on each side (throws down pencil, claps hands) [...]

Keej Same equation [*laughing*]. That's about it [...] So basically, we just did more work and got the same answer.

Nhia Just different forms.

Keej Yeah, that was haaard.

In this selection, Keej, Nhia and Mee re-discovered Gauss's famous analogy without notable stylization. There were moments of energetic expression—"OH, I SEE, I SEE, I SEE!" and "same as the OTHER ONE?" that had the feeling of a mind being tickled through insight about "the likeness of unlike things" (Pimm, 2010). Nhia took a conciliatory position towards my suggestion that they work more on their pattern: "Just different forms". But these moments must be balanced against Mee's tiredness while answering the central questions of the puzzle and Nhia's summing up: "So, basically, we just did more work and got the same answer". Following Rampton, who noticed young people stylizing to carve out identity space in an institutionalized and power-laden setting, the lack of stylization and the goal of contributing work towards getting an answer speak to a mathematical experience strongly conditioned by compliance.

Analogy 2: Becky and Khadra's ordinality chants, highly stylized analogies

The most verbally stylized series of analogies arose in Khadra and Becky's group after repeatedly investigating numerical relationships in the puzzle. The pair had discovered the formula $M = N^2 + 2N$, used second differences to verify that the equation is quadratic, and Becky had visited Yadiel's table twice to "help" them. As they waited to be released for lunch, Khadra (who was hungry and complained of hunger pangs) impelled Becky to chant numbers in Oromo. Then they chanted numbers in Spanish together up to *veintitrés*, followed by the Spanish alphabet.

Khadra and Betsy's sequential, collective chanting put three ordinal systems into analogical relationship to each other. It was strongly stylized because the multilingual, coordinated, rhythmic sound stands out from the speech that was typical in this classroom and that was necessary to complete the classwork. The chanting had a tone of both affection for each other and competition that seemed at least briefly meaningful to the pair. But in what sense, if any, does this stylized chanting matter to mathematics education researchers?

Khadra	Tokko, lama. Say tokko. Say tokko.
Becky	What?
Khadra	Tokko, lama.
Becky	I don't know what you're saying [*gruffly*].
Khadra	Just say tokko, lama, sadii, afuri.
Becky	I don't know what you just said.
Khadra	Repeat. Tokko.
Becky	Tokko.
Khadra	Lama.
Becky	Lama.
Khadra	Sadii.
Becky	Sadii.
Khadra	Afuri.
Becky	What?
Khadra	Afur.
Becky	Afur.
Khadra	Shan.
Becky	Shan.
Khadra	Jaa'a.
Becky	Jaa'a.
Khadra	Torba.
Becky	Torba.
Khadra	Sadeet.
Becky	Sadeet. What am I saying?
Khadra	Just one, two, three, four, five, six.
Becky	So you're counting [*voice warms slightly*]. Do you know Spanish?
Khadra	Yeah.
Becky	What?
Khadra	Uno, dos, tres, cuatro, cinco, seis.
Becky	Cuatro. You said cato.
Khadra	Girl. I'm not–
Becky	That sounds like cat.
Khadra	Cuatro, cuatro, cinco. Siete. No.
Becky	Uno=
Both	=dos, tres, cuatro, cinco, seis, siete, ocho, nueve, diez, once, doce, trece, catorce, quince.
Becky	You're like skipping all these numbers.
Khadra	Dieciséis, diecisiete, dieciocho, diecinueve.
Becky	Can you say the alphabet?
Khadra	Veinte. Veintiuno, veinti=
Becky	=idos, veintitrés. Can you say the alphabet?
Khadra	A. B.
Becky	A, B, C, D, E, F, G, H, I, J, K, L, M, N, Ñ O, P, Q, R, S, T, U, V, W, X, Y, Z [*Spanish pronunciation*].
Khadra	Uh, I'm dying. It hurts.

We can build a plausible interpretation of this Oromo mathematical imagery by reviewing Becky and Khadra's number work across all their recorded interactions. Notably, Becky and Khadra used counting prominently in multiple, dramatically large versions of the puzzle, such as a 7 × 7 game, with Becky counting aloud to 63 as they moved the pieces, and similar cases of move counting to 15, 24, 35, and 48. Becky tended to handle the pieces and manage the counting, and thereby seemed more in control of the activity. However, because Khadra recorded the results into tables of values, she had better access to mathematical patterns.

Khadra recommended using *N* rather than 2*N* as the base variable for their equation $y = N^2 + 2N$, and claimed authorship of it, though Becky disputed this. Khadra also noticed a pattern in the first and second differences in the number of moves 15, 24, 35, 48. This led Becky to confer with a young woman at another table, to establish that a system with constant second differences could be termed "quadratic". Armed with this knowledge, Becky visited Yadiel's table twice, to suggest that they should find a quadratic formula for the number of moves in the original puzzle.

Becky and Khadra's mutual interactions involved personal questions, friendly attacks and counter-defenses— several such moments occur during the stylizations of the selection—leaving me with the impression of two young women getting to know each other better, whose mathematics work overlaid an assessment of each other's potential for friendship. Throughout the activity, Becky used mathematics for affable domination of others in the class—especially Khadra, Yadiel and Alejo, through counting and knowledge of quadratics. By initiating Oromo number chanting, Khadra turned the tables on Becky, reversing the flow of mathematical power for a few moments. In this way, this most-stylized moment could be considered as an interaction ritual (Rampton, 2006), less about institutional power and more about restoring equality among peers. By re-performing the counting activity of several Traffic Jam solutions, Khadra and Becky's stylized counting repurposed successful mathematical work in order to advance a moment of becoming friends.

Analogy 3: Yadiel's perpendicular game, a stylized multimodal analogy

The most extended activity across all the recorded groups was Yadiel's involvement with what I will call the "Perpendicular Game" based on a new playing board that his group devised early on the first day of the activity (Figure 3). The Perpendicular Game was analogous to the original game through similarity of moves and playing board, and because Yadiel's group explicitly designated the solutions for the two games as the "same thing", several times. The group apparently considered this activity as separate from, perhaps even a violation of the mandated classwork. They never counted it as one of the "mathematical questions" that they were charged with posing, and in fact, Alejo was a bit desperate at times to get contributions to their collaborative written work: "Come on, Yadiel, be a hero". Even after Yadiel and Alejo noted that their current solution was the same as their original solution, Yadiel played the Perpendicular Game repeatedly, until the last moment of class. This suggests that the elaborated, extended, unnecessary, slightly transgressive multimodal activity of sliding and hopping pieces across the board was a search for a more appealing-because-different solution, a stylization that led them into the mystery of the Perpendicular Game.

Stylized activities are discernable through contrast with similar events, so that the evidence for, and interpretation of Yadiel's mathematical stylization—like Khadra and Becky's stylization—did not reside in a single, transcribable moment. Instead, it emerged over many detailed non-verbal actions and several conversations during two days of class-

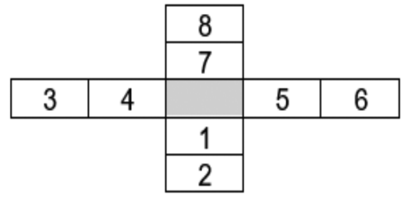

Figure 3. The perpendicular gameboard.

work. The following vignettes trace how the sameness of their solution came to be designated as "no fun", so that we can infer that Yadiel's continued commitment to the puzzle was a search for a mathematically different style.

Yadiel's group first noticed the analogy between the one- and two-dimensional versions of the puzzle after the fifth Perpendicular Game of day two. After some negotiation of how to set up the board and what their goals were, Yadiel's whole group started a game with three animals in each wing and same-colored animals facing each other, as shown in Figure 4. They did a combination of clockwise and counterclockwise rotational hops, with some horizontal or vertical slides and hops. After about a minute, they decided that the game had failed, and Yadiel and Alejo first noticed a similarity with their original solution.

Yadiel	Wait, you want.
Bian	Wait, so this one has to be yellow and this one here, or what? Wait— [*her flat, vertical hand cuts across the facing horizontal wings of the board*].
Yadiel	Yellow! [*similar gesture*] Wait. What? [*laughing*].
Bian	We set them up yellow and green.
Yadiel	I forgot what was the—
Alejo	Ah, we started that wrong.
Bian	Because, so this one's gonna be green— (*same gesture across the horizontal wings of the board*).
Yadiel	Because if you do that, it's going to be pretty much the same thing as what we did with the others.
Alejo	Now watch.
Yadiel	What're you trying to do?
Alejo	Ooooh, you're right, it's the same thing as the original, right?

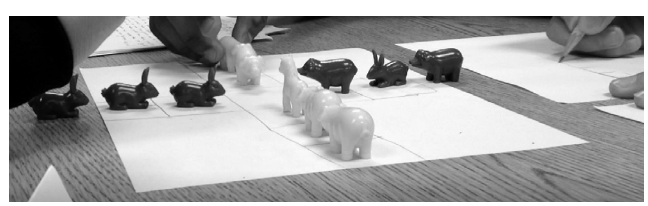

Figure 4. An N = 3 Perpendicular Game.

As Yadiel's group discovered, it is possible to solve the Perpendicular Game using the original game's method, either in a "forward direction", which uses the original game to exchange the two vertical wings and then the two horizontal wings, or in a "corner direction", which uses the original game to exchange 1, 2 for 5, 6 and then 3, 4 for 7, 8 (Figure 3). Just after the selection, Alejo began to play a few steps of a corner version of the game, but he made a mistake, groaned, and returned to writing up comments on the original game that his group needed to submit to the teacher. Yadiel and Bian helped Alejo at first, but quickly abandoned him to commence and solve two simultaneous $N = 2$ Perpendicular Games. Bian began to recreate her solution when Alejo broke in, "Hey, I got it, here's how you do it" and demonstrated, with Bian's help, the forward solution. Alejo offered some critical comments about the style of this solution:

Yadiel There's a lotta ways to do this [*unintelligible*].

Alejo [*laughing*] Easy, right? It's the same method as that, as this [*touching their written work*]. There's no fun in doing this, like that, if you just use the same method. You hear me? So, it takes like, uh, I don't know how many moves this is.

Yadiel I'm pretty sure it'd be thirty.

Alejo Yeah, thirty.

The $N = 3$ Perpendicular Game could be solved using the original method twice in thirty moves. At this moment, the group identified a solution for the Perpendicular Game, and had stated a mathematical inference that could easily have led to a generalized equation, if they had valued this solution more highly. But Alejo critiqued the method as "no fun", due to its sameness with the original game. Yadiel's commitment to the Perpendicular Game before this moment and during his subsequent 45 minutes of intermittent play suggest that this was not an adequate resolution for him.

Analysis of style depends on analysis of form, not fundamentally on participant exegesis. Yadiel's unnarrated moves allow a glimpse of his possible sense of a better mathematical style. Many of his solution attempts seemed to work towards a different, rotational aesthetic, for example:

Animal in position 1 moves to center

Animal in position 4 moves to position 1

Animal in position 7 moves to position 4

Animal in position 5 moves to position 7

This sequence of rotational hops is not compatible with either the forward or the corner solution, but it is compatible with a rotational symmetry solution that is similar to solving a Rubik's cube. While Yadiel gave no evidence of his goal or strategy during his first several games, he seems to have valued rotational hops, mixing up the animals a lot, and making use of the new potential of the perpendicular board compared to the original board. This difference in style only becomes apparent after reviewing numerous cases of Yadiel's playing preferences.

Figure 5. Yadiel demonstrates that the corner solution is "the same thing" as the original solution.

Based on Becky's visit to their group, Yadiel, Bian and Alejo worked for a while on an analysis of the original game that they thought was important to submit to the teacher. Eventually, a dissatisfied Yadiel played the $N = 2$ version three more times, counting his moves. He grumbled, "That's stupid, it's the same thing. Wowww. I'm so dumb. It's the SAME THING". He covered half of the gameboard with his hand, and demonstrated the corner solution with his other hand (Figure 5).

He miscounted at 18 moves, and commented that he should have 16 moves (twice the eight moves needed for a 2 x 2 original game). The teacher called for the end of class and submission of group answers. The next selection shows Yadiel's final engagement with his Perpendicular Game.

Yadiel There's no point in doing this. It's the same pattern, pretty much. [*Yadiel solved the puzzle by playing two corner games*]. See, the SAME THING. Omigod, omigod, omigod.

Alejo What happened? [*sounding concerned*] What's the "same thing?"

[*Yadiel set up and solved an N = 3 Perpendicular game*].

Yadiel Same Thing! Omigod. Mind blown!

Conclusion

There is a mystery in watching students explore the mystery of analogies. In the vignettes shared here, students' immersion in analogies were sometimes dedicated, intense or playful, sometimes nonchalant, despite their historical significance. The discourse research that David Pimm inspired avoids artificial reconstructions of student thinking, preferring instead the deep insights we can gain by attending to the manifest form of spoken and written mathematical language.

Analysis of spoken and enacted mathematical style does not require substantial theoretical amendments to current work on style in sociolinguistics and linguistic anthropology. However, it does require focused attention to ways in which rhetorical or multimodal form expresses knowledge, values and emotions beyond the immediate referential translations of students' words (Staats, 2017, 2018). The form exhibited by game moves, the sound of chanted multilingual numbers, these are mysteries that arise while doing mathematics and that, I suggest, need to be accounted for. In Mee, Nhia and Keej's group, low stylization might indicate less excitement in their work than I desired. Yadiel's absorption in the Perpendicular Game hinted at his vision for a solution aesthetically appropriate to his group's new playing board. Khadra and Becky's percussive ordinal chanting restyled their mathematical successes into a new type of mathematical application: friendship.

Clearly, analysis of mathematical style in student work places the research gaze and ear at the boundaries of what is currently acceptable in the field. One of the singularities at this margin joins issues of methods and presentation. Here, I have offered glimpses of the many more observations that helped me arrive at interpretations of students' stylization while exploring analogies—Mee's tiredness; Khadra and Becky's bickering and their allocation of mathematical responsibilities; Yadiel's first four or five moves over multiple games; Alejo's worriment over Yadiel's inattention to their assignment. Evidence of style is best conveyed through this "thick description" which imposes "the need for theory to stay rather closer to the ground" (Geertz, 1973, p. 24). Theorizing that is richly descriptive preserves a hint of students personalities and their social involvements, mediated through their co-participant teachers, human presences that confound the positivist tendencies of a great deal of educational research.

Analysis of students' exploration of mathematical style could shift what we attend to, what we think is important, and in so doing, become a place where students speak more powerfully to teachers and mathematicians (Sinclair, 2009). Generalization may not be experienced as a victory, as Yadiel and Alejo commented, "There's no fun in doing this...if you just use the same method". Nor in weaving the connections among the representations of movement, diagram and algebraic procedures, as Keej commented, "So basically, we just did more work and got the same answer". Analysis of style in these scenes calls into question the mathematical morals of the stories our assignments tell. As soon as one reaches generality or sameness, the activity stops being fun because there is no longer anything different to do. On the other hand, style poses mysteries to be answered in brief, emotional engagements such as Khadra and Betsy's musicalized ordinality or Alejo's genuine concern for Yadiel's mathematical frustration, "What happened? What's the 'same thing'?". Many of us mathematics teachers have heard students ask, "What will I ever use this for?". Attention to style in mathematical talk will productively invert this question: "What are students using our mathematics classes for?"

Note

[1] In transcripts, capitalized words indicate speech that was louder than the surrounding speech. The latching symbol = indicates that a word rapidly follows another word with no pause between them.

References

Bauman, R. & Briggs, C.L. (1990) Poetics and performances as critical perspectives on language and social life. *Annual Review of Anthropology* **19**(1), 59–88.

Bucholtz, M. (2010) *White Kids: Language, Race, and Styles of Youth Identity.* Cambridge University Press.

Coupland, N. (2007) *Style: Language Variation and Identity.* Cambridge University Press.

Gee, J.P. (2005) Learning by design: good video games as learning machines. *E-learning and Digital Media* **2**(1), 5–16.

Geertz, C. (1973) *The Interpretation of Cultures.* Basic Books.

Irvine, J. (2001) "Style" as distinctiveness: the culture and ideology of linguistic differentiation. In Eckert, P. & Rickford, J. (Eds.) *Style and Sociolinguistic Variation,* 21–43. Cambridge University Press.

Jaspers, J. & Van Hoof, S. (2020) Style and stylisation. In Tusting, K. (Ed.) *The Routledge Handbook of Linguistic Ethnography,* 109–124. Routledge.

Machin, D. & Van Leeuwen, T. (2005) Language style and lifestyle: the case of a global magazine. *Media, Culture & Society* **27**(4), 577–600.

Pimm, D. (1981) Metaphor and analogy in mathematics. *For the Learning of Mathematics* **1**(3), 47–50.

Pimm, D. (2010) "The likeness of unlike things": insight, enlightenment and the metaphoric way. *For the Learning of Mathematics* **30**(1), 20–23.

Pimm, D. & Sinclair, N. (2009) Audience, style and criticism. *For the Learning of Mathematics* **29**(2), 23–27.

Rampton, B. (2006) *Language in Late Modernity: Interaction in an Urban School.* Cambridge University Press.

Silverstein, M. (1979) Language structure and linguistic ideology. In Clyne, P.R., Hanks, W.F. & Hofbauer, C.L. (Eds.) *The Elements: A Parasession on Linguistic Units and Levels,* 193–247. Chicago Linguistic Society.

Sinclair, N. (2009) Aesthetics as a liberating force in mathematics education? *ZDM* **41**(1–2), 45.

Staats, S. (2017) The poetics of argumentation: the relevance of conversational repetition for two theories of emergent mathematical reasoning. *Research in Mathematics Education* **19**(3), 276–292.

Staats, S. (2018) Coloring conjectures with sound, silence, syntax and gesture: a multimodal poetic analysis. *For the Learning of Mathematics* **38**(2), 2–8.

Staats, S. & Laster, L.A. (2018) Extending universal design for learning through concurrent enrollment: algebra teachers' perspectives. *Education Sciences* **8**(4).

Mathematics exemplifies a wish for permanence, an expression of a longing. What are two of mathematicians' prime concerns? Invariance and infinity. One of the current ritual utterances of mathematics education is asking "What changes and what stays the same?". That which does not change, does not die.

David Pimm, from p. 36 of 'The Silence of the Body' in *FLM* **13**(1).