

# CRITICAL AWARENESS OF VOICE IN MATHEMATICS CLASSROOM DISCOURSE: LEARNING THE STEPS IN THE 'DANCE OF AGENCY'

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*This account of my extended conversation with a high school mathematics class focuses on voice and agency. I prompted the students daily to become ever more aware of their language practices in class. The tensions in this conversation proved parallel to the tensions in mathematics between individual initiative and convention, a tension that Pickering (1995) calls the 'dance of agency'.*

## BACKGROUND

"You shouldn't use any voice, you should use the general voice. I've termed it the general voice because I'm cool and I can make my own terms." These are the words of Joey, a 17 year old boy, reflecting on his use of the 'I' voice in mathematics class ('Joey' is a pseudonym). This proclamation, together with its context, illustrates some of the possibilities opened up when mathematics students become more aware of their language practice. Joey was part of a high-school mathematics class that I engaged in a semester-long conversation with a view to raising their 'critical language awareness'. In this report, I show how a strand of this extended conversation relates to what Pickering (1995) calls the 'dance of agency'.

Morgan (1998), as a result of her extensive study of secondary school mathematics writing, identifies the need for students to become more aware of their language practice. She laments typical students' mathematical writing, because it tends to be a poor reflection of their mathematics, even their good mathematics. Her work focuses on written language practices in the mathematics classroom. I suggest that similar challenges exist for oral communication. Since Pimm (1987) introduced discourse analysis to mathematics education scholarship, there has been growing interest in the nature and form of mathematics classroom discourse (e.g. Rowland, 1997; Bills, 2002; Wagner, 2003). Discourse analysis has tremendous potential for providing insight into mathematics and its classroom practice. Like Morgan, I want both mathematics students and educators to benefit from increased language awareness.

Linguists Lilie Chouliaraki and Norman Fairclough (1999) have constructed a framework for analyzing discourse for critical purposes. With this framework, they encourage the use of discourse analysis for the identification of "the range of what people can do in given structural conditions" (p. 65). I suggest that this purpose is

well-suited to mathematics students. Though there is much potential for analyzing classroom discourses for other purposes – for example, to say what form these discourses *ought* to take – students have relatively little control over the discursive systems in their mathematics classrooms. I believe they could benefit from exploring various ways of living within the discourse space they encounter daily. They would do well to consider the range of possibilities available for them to participate in this space, to ask: which discursive forms are arbitrary and which are necessary?

## RESEARCH METHOD

Assuming that mathematics classrooms would benefit from increased critical language awareness (see Fairclough, 1992), an important question remains: how can it be brought about effectively? In Wagner (2003), I began to answer this question by analyzing transcripts of interviews in which students responded to audio-taped excerpts of themselves working on pure mathematics investigations. These interviews did not focus on language per se, but the analysis is instructive for applying critical language awareness to the mathematics classroom, especially because the audio excerpts highlighted the students taking initiative in mathematical exploration.

Subsequently, I chose to work closely with one group of mathematics students for an extended period of time. I spent a nineteen-week semester with a grade 11 pure mathematics class, co-teaching the course with the regular teacher and collecting video and audio records of classroom discourse. By directing the students' attention to their own utterances, I tried daily to engage the students in discussion about our language practices in the class. The form of my prompts varied, as I was continually responding to the participants. In addition to our classroom interaction about language, I interviewed participant students and asked them to write accounts of their experiences with language in relation to their mathematics learning.

This research was an investigation of possibility. Skovsmose and Borba's (2000) methodology for critical mathematics education research guided me: "it is by no means a simple truth that research should deal with what *is*. [...] doing *critical research* means (among other things) to research *what is not there* and *what is not actual*" (emphases theirs, p. 5). Following their model, I saw the 'original situation' of the participant class as a situation that I wanted to see transformed. I imagined a situation in which students would notice aspects of their language practice and through this noticing become more aware of the nature of mathematics and of possibilities for them to relate to the mathematics.

My agenda was not the same as the students' agenda for this class. In fact, our agendas, or 'imagined situations' kept changing as we were responding to each other. Therefore, I could not expect the classroom developments to follow my plan. Indeed, I needed to expect disruption, to welcome it. Valero and Vithal (1998) illustrate the importance of disruption in research settings and argue against typical research

methodologies that assume and promote stability. Indeed, just as Valero and Vithal realized from the research they report, I am realizing that the times when I felt most resisted were frequently the most generative times, both for me and the participant students.

## CRITICAL LANGUAGE AWARENESS IN ACTION

Joey's proclamation, with which I began this paper, has its roots in one of these disruptions. I led the students in a conversation about human initiative in mathematics. We looked at voice in their utterances to discuss who has agency in the discourse, who has control over the way the mathematics is done and expressed. In particular, their initial interpretations of their personal pronoun use were very different than mine, but we all learned something through this tension. After I present some highlights from this particular conversation, I will show how the tension in our discussion about their language practice was similar to tensions inherent both in mathematics and in the language used to express mathematics.

The conversation began early in our semester together. As an exercise to develop the students' ability to locate agency in utterances, I read them a newspaper article about a popular singer. I read one sentence at a time and asked the class to identify who, if anyone, was said to be making things happen. Who had 'agency'? After this exercise, I asked them to watch for agency in our mathematics class. At the time they thought agency was not important, because when they looked at their textbook they could not find examples of humans with agency, except in the story part of word problems. Though I considered this absence significant, I did not immediately resist the students' apparent lack of interest.

In this initial conversation about agency, I did not give the students a definition of the word 'agency'. Instead, I wanted their sense of the word to develop from their use of it. However, my simple question, "who is said to be making things happen" was similar to Pickering's (1995) description of agency. He describes choice and discretion as the classic attributes of human agency, and passivity as its antithesis. Nor did I discuss with students how they discerned the agency in each sentence. In the conversations that followed, we focused our attention on the voice of sentences. For example, if the subject of a sentence is 'I', then the speaker is likely to be taking initiative in some way.

A few weeks after our initial discussion about agency, students were given the following question on a written test:

Consider the quadratic function  $f(x) = (x - 1)^2 + 3$ . Explain how you can tell which of the following is its inverse:

$$y = \sqrt{x-1} + 3$$

$$y = \sqrt{x-3} + 1$$

$$y = \pm\sqrt{x-1} + 3$$

$$y = \pm\sqrt{x-3} + 1$$

The next day, I used an overhead projector to show the students some samples of their responses to this question. Without indicating that I wanted to talk about language features in their writing, I showed and described two longer responses. Then I showed the following set of excerpts from four other student responses:

Excerpt 1: "We switch around the $x$ & $y$ (inverse) & do the work." Excerpt 2: "Switch the $y$ and the $x$ and find the value of $y$ ." Excerpt 3: "You switch the $x$ and $y$ and then solve for $y$ which will give you ..." Excerpt 4: "I can tell by switching the $y$ and the $x$ in the original equation & then ..."
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I asked, "Do you notice anything interesting about these four?" After a long silence, one student noticed that they all contain the word 'switch'. I responded by asking which words were different. After another extended silence, I simply circled the initial word in the first, third and fourth samples – the personal pronouns 'we', 'you' and 'I'. Laughter erupted. (Significantly, laughter was the beginning of a few of the most animated discussions about language in this research.)

I asked which answer was the best. A girl answered, "the second one", giving no reason. A boy said, "the one with 'I'", because that was the one he wrote on the test. Another boy said, "Well, obviously [the test question] asks you to tell how *you* can tell which of the following is its inverse. So you're not saying, 'well, my partner, the guy sitting beside me...'", This student noticed the leading nature of the question's wording: "Explain how *you* can tell ...". He was suggesting that it is natural to answer a 'you'-question with an 'I'-answer.

After hearing these various opinions, I offered an interpretation that I hoped would provoke resistance, but I gave no time for response. I said that the subjects of these sentences were interchangeable. In mathematics it does not matter who does something, because the result should be the same no matter what. I summed up by saying, "In mathematics, people don't matter".

My plans to pursue this conversation about voice and to relate it to issues of agency were foiled by various disruptions. A four-day long weekend and an extra-curricular class engagement intervened. Also, on the first day after our discussion about the various voices, I had planned to prompt a discussion about agency by interrupting the flow of a mathematics conversation when students used pronouns interestingly. I failed to do this because of the difficulty of noticing language use in action and because I did not want to interrupt important mathematics.

Upon reflection, I realized that I myself was experiencing difficulties doing the very thing I wanted the students to do – pay attention to their language practice while using language for mathematics. Because I was concentrating on communication *about* mathematics, language itself was for me at this time a transparent, non-problematic medium. Adler (2001) calls this tension the 'dilemma of transparency', in her account of the dilemmas facing teachers in multilingual mathematics classes.

While it is normal to use language as though it is transparent, at times it is valuable to become aware of language as a mediating resource.

To avoid a repetition of this problem, I began the next day by continuing the conversation. The students immediately engaged in the conversation even though it had been a week since our brief discussion of voice in their writing. I put the same group of four student responses (see above) on the overhead projector, with the initial pronouns still circled. Here is an excerpt from the student response ('DW' refers to my utterances):

DW: I said in mathematics, it shouldn't matter who is doing the work. The subject of any sentence is interchangeable. [...] Is what I said true? And, if not, when is the subject interchangeable and when is it not?

Joey: I think you should, well personally, I think you shouldn't use 'I', 'you', or 'we' or 'me' or whatever because if you say "you switch", that means that somebody else has to do something different. You know what I'm talking about?

DW: To, telling someone what to do.

Joey: No, because if you, like, "you switch" something and if somebody else decides to not switch you're making that one person switch it. It's all wrong. Shambles.

Joey and others articulated a literal interpretation of these personal pronouns. They did not seem to see the possibility of 'you' being used in a general sense. Rowland (2000) has remarked on this form of generalization and Bills (2002) gives evidence that more successful students use 'you' in this way. By contrast, it was clear that the students in my research group did not see this usage as a possibility. I saw an opportunity to help these students become aware of a practice to which they had already been exposed. Indeed, they themselves regularly used 'you' in a general sense without realizing it.

In the next class period, I challenged Joey by quoting the excerpt given above and then quoting from his participation in mathematics discussion later that day. I said:

Joey said, "I think you shouldn't use 'I' or 'you' or 'me' or 'we' or whatever because if you say 'you switch' that means somebody else has to do something different." Then, ten minutes later, he said, "say you are on a test, what would you round this one to?" And he did the exact opposite of what he said.

At the time, we had a rule that no student could participate two consecutive days in discussion about language (to promote wider participation). After the laughter died down and after Joey resigned himself to not speaking, a classmate defended Joey's word choice by describing how he was addressing a particular person: "Joey's just asking you what *you* think with his question." I responded by quoting another more obvious instance of Joey using 'you' in what I considered to be a general sense: "you

know you have degree two ...”. Another classmate described Joey’s language choice this way: “it’s putting pretty much what you did from their perspective”. Other classmates said the same thing, that this ‘you’-voice represented an individual trying to relate his own experiences in such a way as to help others understand his experiences from their own perspectives. I resisted their interpretation and gave invented examples of people using the general ‘you’-voice in everyday life, but I did not call it a ‘general’ voice. And the students likewise resisted my interpretations, giving plausible literal interpretations of the pronoun ‘you’ for every one of my examples.

On reflection, I can see how their interpretations actually described the general sense of the pronoun ‘you’. These students were describing mathematical communication as an attempt to combat diversity of perspectives. They were describing a discourse that promotes a sense of everyone seeing the same things in the same way. This explains the general ‘you’-voice and even the mathematics class ‘we’-voice that Rowland (2000) and Pimm (1987) remark on and discuss. My interpretation of the students’ emerging understanding was supported a week later in an interview with Joey when he made the proclamation I quoted at the beginning of this paper: “You shouldn’t use any voice, ...”.

Joey’s proclamation is significant when it is considered in its context. With this introduction of his own terminology, he demonstrated his individual human agency, his capacity to explore varying ways of participating in mathematics discourse. Furthermore, in his thinking about language, he touched upon important characteristics of mathematical thinking – generalization and abstraction. His move from envisaging particular perspectives in mathematics to envisaging a general, conventional perspective exemplifies a tension that is at the heart of mathematics.

## **THE EXPRESSIVE FORM OF THE DANCE OF AGENCY**

Pickering (1995) identifies this tension in his account of historical scientific and mathematical advances. He identifies different types of agency – human, material and disciplinary – but he does not consider material agency significant in mathematics. Human agency can be resisted by physical reality (material agency) or by conceptual systems (disciplinary agency). When scientists and mathematicians follow the established patterns of their disciplines they surrender to disciplinary agency. It is when they take initiative with open-ended modelling and cross-discipline conversation that they extend present cultural and conceptual practices and, in so doing, demonstrate their human agency. He calls the tension between human and disciplinary agency in such instances a ‘dance of agency’.

Boaler (2003) draws on Pickering’s metaphor to describe good mathematics class discourse. While Pickering is interested in global cultural extension, Boaler is more interested in more local extensions of discourse, particularly in mathematics

classrooms. In her depiction of traditional classrooms, students simply follow the paths set before them. They surrender to the disciplinary agency. By contrast, she promotes classroom discourse that prompts students to take initiative, to demonstrate human agency. Unlike Pickering's interest in scientific, disciplinary advancement, it seems that Boaler is more interested in each individual mathematics student's human advancement. I suggest that the strong presence of the student 'I'-voice in Boaler's exemplar (pp. 9-10) demonstrates the human agency within the classroom disciplinary setting.

The class with which I discussed their language practice would likely be characterized by Boaler as a traditional class. The students mostly followed and practiced mathematical procedures that were given to them. Because of their traditional, passive frame of reference, it was a challenge for me to draw out their 'I'-voices in conversation about language (and about mathematics). However, Joey and some of his classmates were able to overcome the typical patterns of discourse in this class. They expressed their human agency. When they expressed their own voices and resisted the dominant voice of their teacher, they began their 'dance of agency'. I was trying to get them to agree that there is an appropriate use of the 'you'-voice in mathematics, when it is used in a general form, but they resisted my interpretation. This became a generative tension.

With his proclamation about the general voice, Joey displayed his awareness that he can make decisions about how to say things in mathematics class. He showed this awareness by inventing terminology, by saying that he was rejecting the 'I'-voice and the 'you'-voice (even in its general sense) and by adopting a passive voice to reflect mathematical necessity – that utterances should be generally true, independent of the perspectives of particular people.

Ironically, with this display of human agency, Joey seemed to be rejecting human agency in mathematics. He said that he (and others) should not use the 'I'-voice (nor the 'you'-voice and the 'we'-voice). Had he followed his own directive, he would have cut himself off from participating in the dance of agency between his own understanding and the conventional demands of mathematical discourse. However, he did not follow his own directives. Joey, more than any other student in his class, regularly exercised his 'I'-voice. It is conceivable that Joey's growing ability to articulate his linguistic agency strengthened his inclination to engage in the mathematical dance of agency. It is because of this possibility that I think critical language awareness belongs in mathematics classrooms.

## CONCLUSION

Dance is about relationship. However, the relationship itself cannot be observed directly. We only see the dance steps. We can see and feel the moves, which tell us something about the relationship. In mathematics, there is a dance of agency between

humans and either conventionality or common necessity. This relationship expresses itself in the language that flows between people doing mathematics. If language is the dance step, then awareness of language allows us to understand the relationships between the actors in our mathematics. Though it is important to participate in the dance when learning it, at times there is value in attending to the steps.

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