4-YEAR-OLD LANGUAGE REPERTOIRE IN A COUNTING SITUATION

David Wagner   Annica Andersson

University of New Brunswick, Canada   Stockholm University, Sweden

We consider an interaction among one of us researchers and four 4-year-old boys who were asked to count beans. By recognizing multiple discourses at play, we problematize the identification of this interaction (and other interactions) as a mathematical (or counting) situation. We identify aspects of the children's language repertoires and consider how they index various discourses and authority structures. We ask how these discourses intersect in the interaction.

CONTEXT

In this paper we account for an interaction among a researcher (David) and 4-year-old children in their classroom. The classroom is designed to model good early childhood education while giving opportunities to emerging educators and researchers to understand early childhood education better. With his office around the corner from the classroom, David had visited it earlier to talk about a stick that he likes, to talk with the teachers, and on a costume dress up day. The children often greeted him in his office when they walked by. In other words, the people in the interaction were familiar to each other.

Another aspect of the context of the interaction was the research study that motivated David in a way that he was not motivated in the earlier interactions. He brought with him a video camera and voice recorder, operated by himself, at a table to which children were invited by the teachers to choose to visit. In this interaction, David intended to record interaction. This was part of a larger study with the expressed aim of identifying language repertoires of children in mathematical situations. The goal was to understand better the way children experience mathematics across age and linguistic background spectrums. The study was supported by a successful funding proposal, which means that the researcher team (including David), international reviewers, and national adjudicators all demonstrated confidence in the achievability of the study's approaches and aims — to identify children's language repertoires in mathematical situations.

The children brought with them their own motivations and interests, which are only available to us through their language and other acts.

David had a container full of dry, uncooked kidney beans, pinto beans, and navy beans. We (Annica and David) had chosen a variety of beans to prompt the possibility of children distinguishing among the different kinds of beans. We also had broken many of the beans into pieces to provoke the children to decide what counts as a full bean. The variety of beans and presence of partial beans were intended to highlight aspects of the politics of counting; the decision of what to count is more apparent when there is variety and "abnormal" items being counted. When children came to the table, David dumped some beans into a pile and asked the children if they could count them or if they wanted to count them. We were both in the classroom, each hosting a separate table, but we focus on one table's interaction for this paper — the table where David was the host.

AN APPARENTLY MATHEMATICAL SITUATION

Though David was the primary author of the funding proposal, which is a large-scale research project that mainly focused on identifying specificities of students' language repertoires, in contexts of mathematical investigation, we now problematize the idea. We can say with confidence that the interaction described in this paper was a situation, but was it a mathematical situation? We sought to identify connections between the children's ways of talking about counting and what their expressions may mean. However, we also identified a number of other repertoires intersecting with the mathematical register. In this paper, we will use episodes from our data as examples to show how these other registers play in the mathematical conversations and thus connect with the language repertoires the children had in this apparently mathematical situation. It is important for us to be aware of what we mean by mathematics, the location of agency in mathematics, and how we think about interaction among these agents and the discourses within which they operate.

Positioning theory supports us to understand the different ways students' communication acts connect to a variety of discourses, including mathematics. In their theorization of positioning, Herbel-Eisenmann, Wagner, Johnson, Suh, and Figueras (2015) described how there are multiple storylines at work in any interaction, and they range in scale from the micro-level local interactions to large-scale stories that span human history. We will refer to these storylines as discourses because we want to highlight the recursive relationship between communication act and storyline, which is reminiscent of Foucault's (1972) description of discourses—"practices that systematically form the objects of which they speak" (p. 52). Herbel-Eisenmann et al. (2015), who also emphasize this recursive relationship, elaborate the way these discourses interact with multiple discourses at once. We claim that the non-mathematical discourses are not impediments to mathematics any more than mathematics is an impediment to those other discourses (Andersson and Wagner, in review). In short there are many discourses enacted in any classroom context. We claim that one cannot understand students' communication about mathematical processes without understanding that these acts are also part of their repertoires for the other discourses in play.

In the context we describe in this paper there was some counting going on, and thus there was mathematical interaction. We will also consider other discourses at play, including ones relating to gender, ability/inability/disability, food, fantasy, canonical children's story, techno-gadgetry, friendship, humour/clowning, and teacher/student relationships. These are the discourses we have identified in the interaction, but there are others we may notice later, and again others the children may have engaged that are unknown or unavailable to us. Thus when we consider any *communication act* (the term chosen by Herbel-Eisenmann et al. (2015)), it is problematic to claim that it represents the speaker's mathematical language repertoire. It may well do so, but it may also represent the other discourses important to the speaker. The word *representation* is also problematic because, as noted by Herbel-Eisenmann et al. (2015), communication acts do not only represent various discourses at play, they also initiate, maintain and shape those discourses.

ANALYTIC APPROACH

For our analysis we draw on an authority structure framework as described by Wagner and Herbel-Eisenmann (2014), which draws from their large-scale quantitative analysis of communications in mathematics classrooms (Herbel-Eisenmann and Wagner, 2010). This framework distinguishes

among expressions of *personal latitude, personal authority, discourse as authority,* and *discursive inevitability.*

With expressions of *personal latitude* it is recognized that people are making choices. We look for "evidence that people are aware they or others are making choices" (Wagner and Herbel-Eisenmann, 2014, p. 875). The linguistic indicators for personal latitude include open questions, inclusive imperatives, and indicators of someone changing their mind—for example, *I was going to, could have*. Expressions of *personal authority* are those utterances in which there are no apparent reasons for people's actions except that they follow the wishes of one of the people in the interaction. In transcripts we look for "evidence that someone is following the wishes of another for no explicitly given reason" (p. 875). Linguistic clues for personal authority include the presence of *I* and *you* in the same sentence, exclusive imperatives, closed questions, and choral responses. We find expressions of *discourse as authority* where there is explicit recognition of a force outside the interaction compelling certain actions in the interaction. We look for "evidence that certain actions must be done where no person/people are identified as demanding this" (p. 875). The strongest linguistic clue is the presence of modal verbs that suggest necessity—e.g., *have to, need to, must*. Lastly, we search for expressions of *discursive inevitability* in which there is a sense of only one possible direction for action but no explicit recognition of what compels this action. We find "evidence that people speak as though they know what will happen without giving reasons why they know" (p. 875). The modal verb *going to* is a strong indicator of this structure.

Awareness of the positioning among the participants in an interaction and the many storylines they draw on to negotiate that interaction brings to centre stage the wishes of the people involved. Thus we attend to the location of personal agency in the interactions described here. The first two of the structures described above locate agency within the interaction and thus we think of them as micro-political. The other two structures locate agency outside the interaction and thus following the politics of one of the many larger discourses at play in the interaction, and thus we think of them as macro-political. This distinction aligns with positioning theory's distinction between immanent and transcendent forces. Positioning theory recognizes only the immanent as a force (Davies and Harré, 1999) but people in the moment of interaction can mediate and thus bring transcendent forces into the moment. We will use the term *index* to describe this recursive connection between a communication act and a discourse, though we recognize that any possible verb, including *index*, would seem to favour either representation or production. In our account of the children's display of their language repertoires, we chose instances within the conversation, rather than presenting the situation in a singular narrative as is so often done in our field. Presenting a narrative often favours one narrative, chosen by the researcher(s) and thus cleansed from other repertoires that probably are present in the transcripts but played out in the "wrong" discourses. As an invitation to others to consider alternative discourses at play, we identify some of the discourses we saw at play as evidenced in the children's' communication acts. Sometimes the timing is important (which then requires a little narrative). We connect these instances of conversation to the four authority structures identified above.

LANGUAGE REPERTOIRES IN THE SITUATION

Four boys came to David's table over the course of his time hosting the table, though most of the girls in the class chose to have interactions with David at various other times in the year. On this

day, with Annica hosting one of the tables, generally the boys came to David and the girls to Annica. The children's choice of who to talk with may be a communication act that indexes gender narratives. Undoubtedly these discourses were present throughout the interaction though no other communication acts specifically invoked for us a connection to gender (except gender-exclusive pronouns). We reference gender discourses first because this makes it easier to write about the other discourses in English with its gender exclusive pronouns, not because we think gender was any more important than the other narratives in the context.

Next we consider counting words and strategies, because that focus motivated the interaction from our perspective. (We remind ourselves at this point that the children were likely otherwise motivated.) However, this focus on counting immediately draws our attention to ability discourses. Three of the four boys counted beans. This does not mean that Patrick (the other boy) was unable to count (names of participants are pseudonyms). Perhaps he was not interested in counting. He certainly expressed interest in the technical gadgetry at the table, and knowledge of human interaction involving such gadgetry, which he demonstrated by picking up the voice recorder and modelling ways of holding it to mimic photography and telephone conversations. As Patrick indexed this techno-gadgetry discourse, he also became increasingly aware of his friends' pleasure at his humour, and thus seemed to increasingly play up his mimicry, and apparently index a clowning discourse.

We highlight Patrick's ability and interest in various human discourses here because they confound stereotypical interpretations of children with Down's Syndrome (like Patrick), but also because ability discourses connect to an indicator of personal latitude, particularly in relation to inclination. David's and the other boys' expectations for counting from Patrick may have been relatively low because of disability discourses. David has seen Patrick count before but he did not show any interest in counting on this day. He had not answered David when invited to count before the interaction above. The other boys displayed mixed messages about an interest in counting. When they came to the table (Colm first, followed by Gavin, followed by Reece, with Patrick coming and going), David asked each of them if they wanted to count. Our first transcript excerpt represents Colm's response to the invitation to count.

1	David:	We're going to count them. Do you want to get someone else to count with you? Or do you want to count by yourself?
2	Colm:	I want to count by myself.
3	David:	Okay.
4	Colm:	Well, I can count higher than ten.
5	David:	Can you, can you show me?
6	Colm:	One, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty-one.
7	David:	[*Laughs*] That's twenty-one, right?
8	Colm:	Yeah, thirty, thirty-one, thirty-two, thirty-nine, thirty

[...]

| 14 | David: | Now I'm going to put some [*beans*] out here. |

15	Colm:	Oooh! What are you going to do with them?
16	David:	Ah, what do you think I'm going to do?
17	Colm:	A pile.
18	David:	A pile. How many?
19	Colm:	Well, I can't even tell because there's too many!
20	David:	Is there too many?
21	Colm:	Yeah!
22	David:	What if you really wanted to know how many there are, how would you do it?
23	Colm:	Count.
24	David:	Okay, let's see. Start with these, Start with those.
25	Colm:	One, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty-one, twenty-two, twenty-three, thirty, thirty-one, thirty-two, thirty-three, thirty!

Colm answered David's question about whether he wanted to count by himself or with someone else, saying, "I want to count by myself" (turn 2). This is not necessarily the same as saying he wanted to count. Indeed, when David dumped a pile on the table and said, "How many?" (turn 18), Colm said, "I can't even tell because there are too many!" (turn 19). The modal verb *can* appeared often in the interaction. For example, Colm said "I can count higher than ten" (turn 4) shortly before exclaiming that there are too many to count. We might then wonder whether he really *can* count higher than ten. After saying he can, he recited the numbers going from one to nineteen, jumping back to twelve and continuing to twenty-one (turn 6). But that was reciting numbers without reference to objects. The modal verb *can* has drawn significant attention in this research project as it is common to language repertoires of children across the age spectrum and because the verb carries multiple possible meanings, some of which have mathematical significance (Wagner, Dicks, and Kristmanson, 2015). Some of these meanings will be considered in the analysis below.

When Colm counted actual beans later (turn 25), pointing to the beans he was counting, he did not make such mistakes, at least not as soon — he got as far as twenty-three before losing count. Later, he proudly demonstrated his ability to count the beans while sitting on his hands. Colm's pride indexes an assessment discourse, as he seemed to want to impress David. The counting while sitting on the hands indexed a body discourse. Within this conversation, it seemed to be assumed that restricting the involvement of one's hands makes counting more difficult. Looking at the beans and counting them (turn 25), and later pointing with eyes while sitting on hands was different than simply reciting numbers, a list of arbitrary signifiers (turn 6). The connection between the numbers and the beans indicates the presence of a non-personal discourse that is unlike discourse as authority and unlike discursive inevitability because this non-personal discourse was immanent. This connection reminds us of Pickering's (1995) identification of agency in material in addition to humans and discourses.

Gavin and Reece said similar things about their ability to count using *can*, but added further language repertoire to index ability, including Reece responding to the invitation to count with "I definitely can." Also, Colm possibly gave agency to the beans by saying, "it *can* detach" (again a

possible *material agency*, in Pickering's (1995) words). Colm was manipulating two partial beans, trying to fit them together to make one bean. He seemed to be thinking about whether or not to count the pair of broken bean pieces as one or two. This suggests the significance of the beans in the assemblage. As we note above, these broken beans may also be seen as our communication act because we carefully constructed the bean pile to raise the question about what counts as a bean.

In addition to indexing ability, the verb *can* may be interpreted to index inclination (Martin and Rose, 2005). When it comes to Colm's inclinations, the many narratives that are at play in this context are factors that warrant attention. For example, after Colm took a break from counting activities to take pleasure in Patrick's clowning he could have said "I can count beans again." Perhaps gender discourses were influential in him being at this particular table instead of, for example, Annica's. Nevertheless, while gender and other discourses may have influenced the children's inclinations, we could identify desire as a discourse — children follow their inclinations.

Other important modal verbs that commonly appear in mathematics classrooms and which are tell tale markers of *discourse as authority* are "have to", and "need to" (and "must" which is less common). There are no instances of these modal verbs in the interaction (except David saying that to eat these beans "we have to soak them in water for a long time and then cook them"). The absence of these verbs highlights the question that motivated the research project: What strategies do the children use instead to index the compulsion of an exterior discourse? The answer to this question is rather complicated. It is especially complicated by the ambiguity that goes with these strategies in terms of which external discourses they are indexing. In the following transcript we will point to some of the possible external discourses that are present in David's conversation with Colm and Reece, who just came to table and joined the conversation. With this and the next transcript we consider how the children index the exterior discourses, given that they do not use the common modal verbs "have to" and "need to."

156 David: Do you want to count, the beans?

157 Colm: I'll count the beans.

158 David: [*Facing Colm*] Do you want to ask, what's, [*turning to Reece*] what's your name?

159 Reece: Reece.

160 David: Sorry?

171 Reece   Reece.

172 David   [*Turning back to Colm*] Colm, do you want to ask Reece to count some beans, Colm?

173 Colm: Well, I'm cleaning this up so it doesn't go…

174 David: Well maybe you can clean it up, and ask, and then ask Reece to count, just like I asked you. Do you want to do that? Now that's enough in here and then… There. [*Dumps beans on table*]

First, if we focus on the initial part of the conversation between David and Colm, we might interpret Colm's willingness to engage in the tasks David gave him as part of a teacher/student discourse. We see the familiar lines of David, the adult, initiating tasks and the boys, being children, enacting the tasks. David not only asked Colm to count, but he also invited him to ask his friend to count. Colm changed the storyline and said that he would be cleaning up. With this choice he could neither invite Reece nor continue counting himself, though perhaps he was thinking that Reece should start

fresh with the beans in the cup like they were when he started talking with David himself. Still within in the expectations of a discourse of teacher/student interactions, Colm changed the discourse/storyline, and thus displayed personal latitude. David, on the other hand, confirmed Colm's wish through "Well maybe you can clean it up". However, in the second part of the utterance, David brought Colm back to the discourse of teacher/student interaction and asked again if Colm could ask Reece to count: "and then ask Reece to count, just like I asked you. Do you want to do that?" David avoided using his personal authority in this conversation, he instead indexed a more subtle teacher/student discourse where the teacher invites the students back to the exercise at the times were they step out from the prescribed discourse. This more subtle discourse gives a semblance of personal latitude and hence a sense of agency but still maintains personal authority.

In the next excerpt, continuing the conversation above, David saw an opportunity to open discussion about what counts as a bean as we had hoped to do. Reece counted twenty-five beans from a pile and put them one-by-one into the cup. When Reece finished, David pointed to a piece of a bean left over on the table and asked him about that one.

182 Reece:	… twenty-two, twenty-three, twenty-four, twenty-five [*putting a bean in the cup for each number*].
183 David:	Ok, what about this one? [*pointing to a small piece of bean*]
184 Reece:	Twenty-eight.
185 David:	What about this? [*pointing at a small piece of bean shell*]
186 Colm:	These are just paper.
187 David:	No, this isn't paper, this is part of a bean.
188 Colm:	No, this is. This is [*pointing at the same small piece of bean shell*]
189 David:	Is that, that's not paper.
190 Colm:	That's the paper from one of the beans.
191 David:	Oh, that's the part that goes around the bean. It's not really paper but I don't know what it's called.
192 Colm:	I don't
193 David:	So you don't think that should count?
194 Colm:	No. It doesn't count.
195 David:	Why not?
196 Colm:	It just doesn't.

This play between subtle teacher/student discourses, conceptualizations, and terminology has us wondering what conclusions we could make about students' language repertoires in relation to their conceptual knowledge of mathematics. It is not clear this conversation is considered to be a mathematics (or counting) situation for Colm and Reece. They may have seen it as a conversation about beans (this sounds very obvious yet strange in a mathematics pedagogy context). Nevertheless, Colm's assertions that the small shell/paper did not count demonstrates a language strategy—a bald assertion. Perhaps he did not know how to justify his claim or perhaps he felt the claim was so obvious that no justification was necessary; the piece in question was very small.

Similarly, the tell tale marker of discursive inevitability—"going to" —was not present in this interaction. Again, we consider the boys' other ways of more subtly referencing an exterior discourse. The strongest indicator of discursive inevitability seems to be the boys' bald assertions (as with discourse as authority) and also their counting without any suggestion that another way of counting was possible. Counting through the articulation of numbers is a unique grammatical situation because there are no verbs, and no nouns; there is only a string of adjectives—the numbers that refer to the objects being counted. This grammatical structure seems to leave no room for personal authority or personal latitude—no room for human agency. Yet the children in this episode demonstrate that personal latitude is possible in counting. They exercised their agency by determining what objects warranted inclusion in the count, and what objects did not count.

DISCUSSION

We close with consideration about the potential contribution such analysis makes. For teachers, it is potentially valuable to think about the different discourses that may be in play in any classroom situation. It is likewise helpful to think about what indicators help us identify which discourses are at play. This awareness may help a teacher be attentive to how students are experiencing a classroom situation (e.g., a mathematical problem solving context). It is also instructive for teachers to realize that students' expressions of ability and inclination are not so easy to separate. Assessment may seem quite straightforward when we are sure what discourse a student is envisioning. But with a different discourse in mind, the kinds of activity that could be valued may well vary. Finally, the focus of our analysis points attention to the language repertoires of children. It is important for teachers to be aware that these repertoires intersect multiple discourses. Thus there is value in encouraging such intersection of discourses, because students can develop mathematical language repertoire by drawing from their language repertoires in other discourses.

References

Andersson, A., and Wagner, D. (in review). Language repertoires for mathematical and other discourses.

Davies, B. and Harré, R. (1999). Positioning and personhood. In R. Harré and L. van Langenhove (Eds.), *Positioning theory: Moral contexts of intentional action* (pp. 32-51). Blackwell: Oxford.

Foucault, M. (1982). The subject and power. *Critical inquiry*, 777-795.

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

Martin, J. and Rose, D. (2005). *Working with discourse: Meaning beyond the clause*. London: Continuum.

Pickering, A. (1995). *The mangle of practice: Time, agency, and science*. Chicago: University of Chicago Press.

Wagner, D., Dicks, J., and Kristmanson, P. (2015). Students' Language Repertoires for Prediction. *The Mathematics Enthusiast*, 12 (1), 246-261.

Wagner, D., and Herbel-Eisenmann, B. (2014). Identifying authority structures in mathematics classroom discourse: a case of a teacher's early experience in a new context. *ZDM: The International Journal of Mathematics Education*, 46, 871-882.