AGAINST THE EPISTEMIC HORIZON TOWARD POWERFUL DISCOURSE

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In mathematics classrooms, teachers are often the authority as a knower of mathematics. To support students to develop their identity as doers of mathematics, teachers need to decenter the authority and to place students in a more powerful position as autonomous thinkers. Building on the work of Herbel-Eisenmann and colleagues (2013), this paper aims to expand the notion of powerful discourse from a conversation analytic approach. By examining the fine-grain epistemic characteristics of interactional sequences, I argue for the significance of the interactional knowledge domain, in which positioning of students as more or less knowledgeable takes place. Further, I discuss the need for examining the discursive dimension of knowledge and discursive practices that can redistribute the epistemic authority in mathematics classrooms.

Keywords: Classroom Discourse, Positioning, Conversation Analysis

The social turn in mathematics education (Lerman, 2000) widened the view on mathematics teaching. Beyond transmitting mathematical knowledge to students, teachers need to attend to the development of student identity as doers of mathematics. Through social interactions, students' identities are constructed and reconstructed over time (Hand & Gresalfi, 2015); hence, the attention to interpersonal aspects of social interactions became crucial. One way to attend to the interpersonal aspect of classroom interactions is through the lens of powerful discourse (Herbel-Eisenmann, Steele, & Cirillo, 2013), which entails purposeful positioning of students during mathematical discussions to support their identity development. The goal of this paper is to offer a concrete way to examine powerful discourse through a fine-grain analysis of social interaction. Drawing on conversation analysis (CA), I identify important aspects of interactions related to the nature of knowledge and teacher authority. I begin with a discussion on powerful discourse.

Powerful Discourse in Mathematics Classrooms

As a framework for mathematics teachers and researchers to examine discursive practices in a mathematics classroom, Herbel-Eisenmann and colleagues (2013) offered two theoretical lenses: productive discourse and powerful discourse. Productive discourse is for widening students' access to mathematical language and ideas, whereas powerful discourse attends to the social and interpersonal functions of language in discourse. Although these two lenses may overlap and interact each other, this paper mainly focuses on powerful discourse since it is closely related to the social interactions and relationships among students and teachers—a significant part of the social turn.

Drawing on positioning theory (Harré & van Langenhove, 1999), Herbel-Eisenmann and colleagues (2013) highlighted the significance of the linguistic functions that position a person or a thing (e.g., student, textbook, mathematics) to a particular position (e.g., a "smart" student). Note that "positioning" is an active doing of language, in contrast to the static meaning of "a position." For discourse to be powerful for student learning, both people (e.g., teachers and peers) and social and material environments (e.g., textbook, and policy) can position a student as a doer of mathematics, a legitimate participant in mathematical activity. Wagner and Herbel-

Eisenmann (2013) argued for purposeful positioning of students, teachers, and textbooks during instructions to reorganize the authority structure (i.e., who or what decides what is true or good) within a mathematics classroom. This deliberate form of positioning can be a tool for teachers to support identity development of students, especially those with marginalized social markers (e.g., students with disabilities, students of color, girls, emergent bilingual learners). Through this mode of positioning, teachers can promote a more equitable learning environment.

This idea of supporting a student's identity development by disrupting the visible social asymmetry within a classroom is an interest of many equity-oriented researchers in mathematics education. For instance, one of the major discussions in complex instruction is "assigning competence" (Featherstone et al., 2011, Ch. 6). In a small group setting, by deliberately drawing "public attention to a given student's intellectual contribution to a group's problem-solving efforts" (p. 90), a teacher can encourage the student and other peers to see the given student as a valuable and intelligent member of the group. Thus, assigning competence is one of the many ways a deliberate positioning by a teacher can take place in the mathematics classroom. Through the lens of powerful discourse, we can see many ways, sometimes subtle and difficult-to-notice ways, that positioning could happen in a classroom. One of the strengths of the positioning theory is its conceptual flexibility, which allows an analyst to apply the theory in a broad range of interactional contexts with a variety of analytic tools (Herbel-Eisenmann, Wagner, Johnson, Suh, & Figueras, 2015).

Building on the work of Herbel-Eisenmann and colleagues (2013), this paper expands the notion of powerful discourse from a conversation analytic approach. Positioning can happen at multiple levels within the range of "scales" (Herbel-Eisenmann et al., 2015, p. 193). The conversation analysis presented in this paper allows for the finest-grain analysis (i.e., "utterance" level with a typical duration of 10^0–10^1 seconds). This paper highlights that this type of fine-grain analysis is necessary to understand powerful discourse in the context of moment-by-moment interaction in which a teacher and students are engaged in sequences of acting and reacting. Furthermore, Herbel-Eisenmann and colleagues (2015) stated that mathematics education researchers often make claims about positioning without much attention to communication acts. This paper illustrates how the application of CA can address the common pitfall by grounding the discussion of positioning on the temporal progression of the sequence of actions. The following section discusses CA and its key constructs related to powerful discourse in more depth.

Epistemic Dimensions in Conversation Analysis

The primary focus of CA is to understand normative practices of conducting social interactions, in particular, talk-in-interaction. As the term "talk-in-interaction" refers, CA attends to forms of talk (e.g., lexical, syntactic, speech features) and other visible social cues (e.g., gaze) in interactional contexts. The context includes not only when, where, and by whom the utterance was made but more importantly the temporal sequence of talk-in-interaction. As Heritage (1984b) articulated, "any speaker's communicative action is doubly contextual in being both *context-shaped* and *context-renewing*" (p. 242, emphasis original). In other words, an utterance is examined based on the context shaped by the prior interactions—notably, the immediately preceding action. The same utterance also reshapes the context for the following action. Both before- and after-utterances are, therefore, considered to infer action-performing aspects of a given utterance.

Influenced by ethnomethodology (see, for more information, Ingram, 2018), CA lays its epistemological grounding on what *participants* orient to (i.e., treat something as relevant to the conversation at hand) and on how both speaker and recipient treat the target utterance, which offers a window into participants' view on conducting moment-by-moment interaction. CA scholars argue that mainstream social science researchers too often impose a presupposed social model to explain a system of social interaction (Schegloff, 1997; Speer, 2004). On the contrary, the focus of *ethno*-methodology is on revealing participants' (i.e., ethno-) methods to design an utterance as a social action (e.g., advising, offering) and to recognize the utterance as such by the recipient. The social norms, from the view of CA, are not seen as theoretical rules that govern interactions among participants. Normative practices of social conduct are rather accomplished by the participants through routinized, seen—but unnoticed—procedures, which is the main interest of CA.

Epistemic Dimensions in Conversation and Epistemic Engine

This paper focuses on a particular topic in CA called *epistemic dimensions*—the "dimensions of knowledge that interactants treat as salient in and for conversation, particularly with respect to asymmetries" (Stivers, Mondada, & Steensig, 2011, p. 9). Epistemic dimensions include but not limited to: epistemic status (relative status as more or less knowledgeable based on social relationships); epistemic stance (moment-by-moment expression of being more or less knowledgeable); epistemic access (relative access to knowledge); and epistemic authority (relative authority of knowledge). Initiated by Goodwin (1979) and Heritage (1984a), CA scholars have been discussing the significance of participants' relative statuses as more or less knowledgeable in a particular knowledge domain. For instance, Heritage (2012b) coined the term, "epistemic engine," which is a normative social force for participants to engage in a sequence of interaction when information imbalance between participants is acknowledged. The sequence closes when the participants acknowledge that the imbalance is equalized for a practical purpose. Notably, CA does not concern what participants actually know in their minds. The focus is on how participants display themselves and treat the other participants as relatively more or less knowledgeable and on how such visible actions function as an epistemic engine, which shapes the normative patterns in interaction.

According to Heritage (1984a), the epistemic dimensions are an important concern for participants *in situ* because participants' epistemic positioning, called "epistemic status" (Heritage, 2012a), is a crucial part of the interactional context for participants as they design and interpret each other's actions in everyday conversations. Heritage (2012a) illustrated the differing action-performing nature of particular morphosyntax and intonation depending on the epistemic status of participants. For instance, the declarative syntax with falling intonation is often aligned with a speaker in a knowing position (K+) *conveying* new information to a recipient in an unknowing position (K–). A speaker in a K– position, however, can use the same morphosyntax and intonation to *request* information from a recipient. In an interview setting, for instance, when an interviewer (K–) says, "You have a child," despite the declarative syntax and falling intonation, the interviewee (K+) would respond as a request for information (e.g., "Yes, I have a son.") rather than an assertion from the interviewer. In other words, participants rely on their relative epistemic statuses to determine what the utterance performs and to project ways they can respond.

Heritage's (1984a; 2012a) argument above brings up an important issue when teachers and researchers examine the action-performing nature of discourses in a mathematics classroom. Solely focusing on textual and speech features of talk-in-interaction may overlook the epistemic dimensions of the conversational exchange, an important source for participants to interpret and respond to social actions *in situ*. To attend to the epistemic dimensions, analysts need to consider the knowledge domain in which the sequence of interaction is situated. The epistemic status is not static—the same participants may occupy different epistemic statuses depending on the knowledge domain in which participants are engaged. In a classroom setting, for instance, the teacher is often a sole K+ individual during a mathematical discussion (Ball 1993, Lampert 1990). However, when students share out what they did over the last weekend, students can be positioned as K+ in such a knowledge domain. This "epistemic asymmetry" (Heritage & Sefi, 1992) between the teacher and students is shaped by the institutional context of the mathematics classroom, in which a teacher with required educational credentials teaches and students learn school mathematics. This normative institutional setup thus creates an inherent epistemic asymmetry with K+ teachers and K– students.

Epistemic Dimensions in Mathematics Classroom Interactions

To illustrate the significance of knowledge domains and epistemic stance during moment-by-moment interactions, I first compare two cases from the study by Ingram (2012) in a secondary classroom setting in the U.K. I place a particular focus on teacher-initiated question-response sequences to discuss the contrasting epistemic characteristics of the sequences. Second, I turn my attention to two extracts from an article by Ball (1993), which is widely read and known for "Sean's number" in mathematics education. I apply the epistemic lens to offer an insight into the important discursive characteristics embedded in the discussions in Ball's (1993) study.

Epistemic Dimensions in Question-Response Sequences

The following two extracts share a common characteristic—they both consist of teacher-initiated question-response sequences, what Mehan (1979) called Initiation-Response-Evaluation sequence (IRE). In Extract 1 below, Simon is the teacher, and other speakers are students.

Extract 1 (Ingram, 2012, p. 110)

```
Simon:   … what was the highest number of days absence.
A:       eight
Simon:   it was eight. And what was the lowest number of
         days absent.
B:       zero or one I don't know
Simon:   you don't know. ok someone else then, what's the
         lowest number of days pe- someone was absent.
         George.
         2.5)
Alex:    zero?
         (0.9)
George:  zero.
Simon:   that was Alex talking I want to hear it from you.
         look at the table, what was the lowest number of
         days that someone had absent.
George:  zero.
Simon:   it is zero, because ↑twenty people had no days off.
```

Figure 1: Extract 1

The epistemic stances, which Simon and the students display, align with the epistemic statuses of K+ teacher and K– students. For instance, in the third turn position (i.e., the turn after the question and response turns) of the question-response sequence (line 330), Simon repeats the

Otten, S., Candela, A. G., de Araujo, Z., Haines, C., & Munter, C. (2019). *Proceedings of the forty-first annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. St Louis, MO: University of Missouri.

answer and confirms that the answer is correct. The action performed by the third turn is twofold. First, it closes the question-response sequence as a “sequence closing third” (Schegloff, 2007), which indicates that Simon has received a preferred response from a student. Second, Simon reasserts his K+ position. In this IRE sequence, the teacher holds a K+ position with K– students, and the third turn publicly displays that Simon already knew the answer to the question he posed, reaffirming his K+ position.

Simon’s epistemic authority is also evident based on how the students treat the question-response sequence. Students orient to his epistemic authority with their downgrading epistemic stance. Note, for instance, that Alex offered his answer “zero?” (line 337) with rising intonation (noted by “?”) thus downgrading the certainty of his answer. Moreover, students offer only short answers (e.g., “eight,” “zero”) without offering any account for their answers. This lack of accountability (i.e., the social norm that requires the speaker to offer an account for their response) can be explained by the epistemic statuses among the K+ teacher and K– students. The epistemic engine, the normative social force, works so that information flows from K+ position to K– position. When students are positioned in a K– position, students offering additional account works against such normative social force. To further argue for this point, I illustrate a contrasting case in the following extract, in which Richard is the teacher.

Extract 2 (Ingram, 2012, p. 115)

```
Richard: what do you understand by the idea of (.) proof.
         mathematical proof. p r double o f.
         (0.9)
         what do you understand by that (.) concept, that
         idea. Maybe say one thing about it (.) then let
         somebody else say something else. Um:: hands going
         up. Alex.
Alex:    you can’t prove anything apart from maths because
         it’s all point of view.
Richard: oh I see
         (0.7)
         um: can you give an example or something
Alex:    um (there’s different kinds of things) everybody’s
         eyes might be slightly different, you can’t tell
         (.) because it’s like, (.) you see different
         shades ((inaudible)) the eye could be different.
Richard: oh so when you look at your red thing there,
         somebody might (.) see it differently.
Alex:    yeah
Richard: I see, whereas mathematically? What are you saying
         about maths that’s different?
Alex:    it’s because the maths deals with absolute
         (substances) like numbers, you can’t be
         ((inaudible)) can you.
Richard: ah: ok that’s very interesting. very good. …
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Figure 2: Extract 2

Similar to the case of Simon, we see Richard also practices his process-authority (Oyler, 1996). He selects who speaks next (e.g., line 567), and he controls the topic of the discussion by initiating a series of question-response sequences. The epistemic statuses are, however, shaped differently compared to the earlier case of Simon.

In the first question-response sequence, after Richard selects Alex as a next speaker (line 567), Alex offers his response with an account—note the use of "because" in line 568. Richard responds to Alex with "oh," a "change-of-state token" (Heritage, 1984a), which indicates that Richard's epistemic position changed from K– to K+. In other words, Richard displays that he now knows Alex's understanding of proof, which he did not know before the conversational exchange. The following "I see" also reaffirms that his question is a "genuine question," not what Searle (1969) called a "test question." This third turn closes the sequence, and Richard initiates another sequence (line 572) by requesting an example. This second question can be categorized as "probing a student's thinking" (Herbel-Eisenmann et al., 2013), but also there are important yet subtle epistemic stances that Richard and Alex display. Alex offers his response with an account—note "because" (line 575) once again and then Richards responds with his "oh" (line 577) with a subsequent statement. Despite its declarative syntax, we see Alex orients to Richard's statement as not an *assertion* but a *request for confirmation*, to which Alex responds with his approval of "yeah" (line 579).

The teacher and student, in this case, are positioned in contrasting epistemic statuses compared to the case of Simon. Richard is in K– position, wanting to know how his students understand the concept of proof, and Alex is in K+ position with his exclusive epistemic access to his own understanding of proof. In this epistemic terrain, the epistemic engine naturally works for the flow of information from K+ student to K– teacher. In other words, as a knower of his own understanding of proof, Alex is under the normative social force for explaining his knowledge to Richard and other students, which is evidenced by Alex's use of "because" and additional accounts that he provides after his responses. Thus, the question-response sequences above position Alex in a more powerful position with his epistemic authority.

Richard's case also shows how teachers' epistemic authority is tied to the notion of mathematics. In line 580, Richard focuses his question on the *mathematical* meaning of the proof by invoking "mathematically" and "maths." Alex shifts his epistemic stance by downgrading his certainty about his answer with a tag question, "… can you." (line 584). Alex's downgraded epistemic stance shows that, for his idea to be "mathematical," it requires approval from an external authority like a teacher. This particular sequence serves as an example of a teacher' identity as a legitimate bearer of "official knowledge" (Apple, 1993).

Examining the epistemic dimensions in the above extracts shows that epistemic statuses are shaped differently *relative to the knowledge domain* that teacher and students dwell during the question-response sequence. On one hand, when the question is targeted at the mathematical understanding that students hold in their mind, the students are positioned in K+ position. On the other hand, when the question is targeted at the mathematics defined by the institution, the teacher occupies K+ position.

Epistemic Dimensions in Reform-based Teaching

I now turn to two extracts from Ball's (1993) study to situate the current discussion on knowledge domains and positioning in the broader discussion of reform-based teaching. CA can reveal the routinized, seen—but unnoticed—procedures. In the case of Ball's study, by applying the lens of epistemic dimensions to her data, it may explain what Ball (1993) described as an abstract goal of reform-based teaching as more tangible discursive practices. In her paper, Ball (1993) discussed her dilemma as a teacher between hearing what students know now and supporting them as they transcend their present understanding. Her paper in part illustrates how she *hears* students' understanding, and I examine her actions through the lens of epistemic dimensions and positioning. In Extract 3 below, Mei offers her understanding of Sean's number, which can be both even and odd.

Extract 3 (Ball, 1993, p. 386)

```
Mei:  I think I know what he is saying ... is that it's, see.
      I think what he's saying is that you have three groups
      of two. And three is an odd number and an even number.
T:    Is that what you are saying, Sean?
Sean: Yeah.
```

Figure 3: Extract 3

After Mei explains her understanding of what Sean is trying to convey, the teacher asks Sean to confirm if that is what he is saying (line 304). Sean also orients to the teacher's question as seeking confirmation, and he gives his approval of "Yeah." Asking Sean to confirm is a discursive move that positions him as a K+ individual, but there is more to show in this scene. In this sequence of seeking and offering confirmation, the participants are engaged within the knowledge domain of *Sean's* understanding. That is, the goal of the exchange is not to know how school mathematics defines even and odd numbers, but rather, the participants' concern in the interaction is how Sean understands even and odd numbers. In this knowledge domain, Sean holds the primary right and authority as a knower of his own thinking, which positions Sean as K+ individual. This epistemic terrain aligns with Mei's downgrading epistemic stance indicated by her use of "I think …" (lines 301-302) and the teacher's confirmation-seeking. I discuss another example in the following extract of how epistemic status can be reshaped in interactions.

Extract 4 (Ball, 1993, p. 390)

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Mei:  So when we put two in each group in order to make
      one because it's below zero.
T:    I don't understand this part— put two in each group
      in order to make 1.
Mei:  If we take six and add six to it, we get twelve above
      zero, but it's below zero, so— and three plus three is
      six, so we add three more to the six above zero.
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Figure 4: Extract 4

Starting from line 401, Mei explains her way of understanding 6 + (–6), and then the teacher indicated that she does not understand a part of her explanation. As a response, Mei expands her explanation. Here, we see the visible working of the epistemic engine. The teacher did not ask a question, but she only indicated her K– position of unknowing what Mei explained earlier. The publicly displayed epistemic status was enough for Mei to expand her explanation. This move is similar to what Herbel-Eisenmann (2000) observed from one teacher, named Karla, who often voiced her own confusion (e.g., "You lost me ….”). Through the epistemic lens, Karla publicly displayed her K– position and pushed her student to offer further explanation. As Drew (2005) suggested, we can see the state of confusion as an interactional resource generated *for* an interaction. Thus, teachers downgrading their epistemic status in a particular knowledge domain, to which students have primary access, is a powerful pedagogical move. This way, teachers can unleash the power of the epistemic engine and allow information flow from a K+ student.

Discussions and Implications

Through the lens of epistemic dimensions, I have discussed how positioning can happen in a sequence of interaction based on the knowledge domain in which participants engage and epistemic stances that participants display. In this section, I make connections between the epistemic dimensions in conversations and important discussions on knowledge and authority in the mathematics classroom.

The examination of discursive practices related to epistemic dimensions expands the notion of knowledge in the mathematics classroom. Often in mathematics education, the discussion of knowledge is limited to what individuals have in their mind. As Barwell (2013) critiqued, this individualistic approach overlooks the discursive dimension of mathematics knowledge embedded in social interactions. Barwell (2013), for instance, noticed that displays of teacher knowledge are "often inter-related with constructions of students as *not* knowing" (p. 605, emphasis original). His observation aligns with the relative nature of epistemic status that I discussed above, and I argued that powerful teaching is sometimes teachers displaying themselves as not knowing (i.e., downgrading epistemic status). That is to say, expanding the discussion from what knowledge a teacher *has* to how a teacher *performs* knowledge can further our understanding of the nature of knowledge situated in the interpersonal context.

The epistemic dimensions in conversation offer a framework to understand the interactions between the discursive dimension of knowledge and teacher authority in a more nuanced way. For instance, in her discussion on teacher authority, Herbel-Eisenmann (2000) illustrated how the tag questions (e.g., … isn't it?) used by one teacher made his corrective course of actions appear more polite and less authoritative. Through the epistemic lens, Herbel-Eisenmann's (2000) insight shows the graded nature of epistemic asymmetry. The teacher's use of tag questions downgraded his epistemic stance; yet, staying in the same knowledge domain, the teacher continued to maintain a K+ position. This case shows that teachers' deliberate effort to downgrade their epistemic status—without moving the discussion to another knowledge domain—has limited effect on reshaping epistemic status.

The significance of the knowledge domain to reshape the epistemic asymmetry between a teacher and students points to the need for moving across multiple knowledge domains during a mathematical discussion. Such as the case of Sean's number, focusing the discussion on how students understand a mathematical idea is one way to distribute epistemic authority to students based on their exclusive epistemic access to their minds. As Greeno (1991) stated, valuing students' thinking and reasoning encourages "positive epistemological beliefs and attitudes that are favorable to participation" (p. 211). The epistemic dimensions of interaction offer a lens to see what "valuing" students' thinking and reasoning looks and sounds like *in practice* and its fine-grain interactional characteristics. Based on the significance of the knowledge domain, the "valuing" requires moving the target of the conversational inquiry from official mathematics to the mathematics in students' mind. Furthermore, there are other knowledge domains to which students have relative epistemic access. For instance, students' cultural knowledge (Ladson-Billings, 1995) and community knowledge (Civil, 2006) can serve the same purpose, especially when the teacher's cultural and communal backgrounds do not overlap with those of students. These knowledge domains are great interactional resources to position students in a K+ position with epistemic authority.

Lastly, the distinction that I presented between teachers' content-authority and process-authority (Oyler, 1996) requires further discussions. This paper does not argue for an anti-authority stance. Rather, it argues for a more nuanced, multi-dimensional understanding of teacher authority and better use of authority during discussions for student learning. For instance, to reshape the epistemic terrain during the discussion, teachers need to be in authority to control the topic of discussion so that the teacher can intentionally steer the discussion toward different knowledge domains. Moreover, to accomplish more equitable participation among students, teachers may need to intentionally distribute the speakership among students with a particular social marker (e.g., race, gender) or prior history of participation. Without teachers' enactment of process-authority, the participation patterns in classroom discussions would likely continue to marginalize a particular group of students and remain dominated by a small number of students. Epistemic authority, a content dimension of authority, however, needs to be displaced from the teacher to allow students to engage in a mathematical activity as legitimate doers of mathematics rather than mere receivers of knowledge. The powerful discourse that I addressed in this paper concerns this epistemic authority.

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