
Title	Talking with your mouth full: The role of a mediating tool in shaping collective positioning
Authors	Kate T. Anderson and Melissa S. Gresalfi
Source	<i>9th International Conference of the Learning Sciences (ICLS) 2010, Chicago, IL, USA, 29 June - 2 July, 2010</i>
Published by	International Society of the Learning Sciences

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Original citation: Anderson, K., & Gresalfi, M. (2010). Talking with your mouth full: The role of a mediating tool in shaping collective positioning. In S. R. Goldman, J. Pellegrino, K. Gomez, L. Lyons & J. Radinsky (Eds.), *Proceedings of the International Conference of the Learning Sciences (ICLS) 2010* (Part 1, pp. 1079-1086). Illinois, USA: International Society of the Learning Sciences.

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Talking with your mouth full: The role of a mediating tool in shaping collective positioning

Kate T. Anderson, National Institute of Education, 1 Nanyang Walk, Singapore 637616,
katherine.anderson@nie.edu.sg

Melissa S. Gresalfi, Indiana University, 1900 E. 10th St., Eigenmann 532, Bloomington, IN 47405,
mgresalf@indiana.edu

Abstract: Research on classroom discourse has long underscored the integral role of social interaction in learning, yet designing for and supporting meaningful classroom interaction often remains a challenge. This paper examines the ways that elementary school students are positioned and position themselves during activities aimed at promoting reflexivity about small-group math discussions. We examine one student group's participation in three such activities over eight months' time and specifically highlight the role of a mediating tool that was designed to support participation-centered rather than ability-centered conceptions of learning. Our aim is to examine how one focal group's math discussions were or were not shaped by the tool in ways that were consequential for productive collaborative engagement.

Introduction

The role of small group discussion in shaping mathematics learning has received much attention in the last decade and has been promoted as an important element of effective teaching and learning (Boaler & Staples, 2008; Gresalfi, 2009; Horn, 2005; Staples, 2008). Specifically, authors have pointed to the potential of collaborative interactions in promoting deep conceptual understanding, and more specifically, in supporting the high functioning of heterogeneous groups (Ben-Ari, 1997; Cohen & Lotan, 1995). However, *how* to foster students' learning through small group discussions that require exploring multiple perspectives, negotiating tensions, and probing disagreements continues to be studied; doing so entails changing many of the traditional practices of mathematics classrooms.

This paper considers the affordances and constraints of a particular mediating tool—conversation rubric—that was used to support small group discussions about mathematics. Specifically, we examine how the conversation rubric was taken up by one student group across multiple events in a fifth grade classroom. We analyze their discussions for evidence of whether the mediating tool a) supported collaborative engagement in math activities, and b) shaped students' reflection about their understanding and their positions in discussions in ways that might not have occurred without this particular tool. By systematically examining interactions across a suite of math activities focused on student discussion, we interrogate ways that particular activity designs can afford productive tensions between students that lead to positioning in light of math and each other. The analysis we present constitutes both evidence for how artifacts can shape the texture of learning across math discussions as well as a methodological lens by which to examine math learning discursively across cases and time.

The aim of our analysis is to examine the role of an instructional scaffold as a mediator of collaborative activity. In particular, we consider whether and how students' positioning relative to one another and relative to the subject matter, elementary mathematics, is shaped by externally structured group reflection on recently completed activities. In so doing, this study has both theoretical and pragmatic implications. With respect to theory, we seek to extend positioning theory to consider how tools can serve to mediate interaction. Thus, rather than considering positioning to be an interactive accomplishment of interlocutors alone, we demonstrate how an artifact can serve as a resource and an authority for co-positioning. With respect to practice, we demonstrate how instructional scaffolds structure interaction processes among learners (Kobbe et al., 2007), although not always in intended ways.

Positioning Theory

Our analysis draws on positioning theory as a means of tracking changes in student collaboration. We consider positioning as moment-by-moment interaction, which involves the kinds of opportunities that interlocutors create for one another to participate in particular ways (Davies & Harré, 1999). This can be seen most easily in talk as participants speak to and about each other (van Langenhove & Harré, 1999). Positioning concerns the fluid arrangements that people make available for themselves and others through their talk and refers to participants' fluctuating status relative to one another. For example, students are positioned relative to each other as smart vs. slow, or cooperative vs. competitive. Positioning can include students' relative academic status but can also reference students' positions outside of the classroom

(Cohen & Lotan, 1995). Interpersonal positioning can also be accomplished though implicit and explicit comparisons between students. Students' ideas might be positioned as equally valuable (even if they are not both accurate, c.f. Lampert, 1990), or one idea might be positioned as less important than another—for example, in a classroom that is more competitive. In some classrooms, distinctions between who is “smart” and who is not may become a particularly dominant form of positioning, while in others such distinctions are rarely made. The effects of positioning can begin to endure as students become associated with specific ways of participating in classroom settings (e.g., Anderson, 2009; Holland, Skinner, Lachicotte, & Cain, 1998; O'Connor & Michaels, 1996; Wortham, 2004).

The Importance of Math Talk

Significant attention has been given to the challenge of promoting robust mathematical conversation in classrooms. In particular, the goal of such initiatives has been to shift mathematics away from a procedural, didactic activity to an active process that involves strategic thinking, problem solving, decision-making, and talking about math. The challenges of organizing mathematics classrooms in this way have been well documented and include teachers' own histories and experiences with mathematics, their vision of the nature of mathematical thinking and learning, and students' previous histories with mathematics and their resulting expectations for activity in the classroom.

It is clear that classrooms cannot promote problem solving, discussion, and justification without supporting students to learn how to talk with and work with each other. Productive collaboration has been notoriously difficult to facilitate, particularly in classrooms that are organized heterogeneously. However, examples of successful collaboration in such classrooms paint a picture of the possible and a vision of what to strive for (Boaler & Staples, 2008; Staples, 2008). This research has led to recommendations for practice that are likely to support collaboration, including assigning students roles (Ben-Ari, 1997; Cohen & Lotan, 1995), structuring students' interaction (Kobbe et al., 2007), posing complex problems (Staples, 2008), and being consistent about expectations and accountability (Gresalfi, Martin, Hand, & Greeno, 2009). What is clear is that successfully supporting collaboration is no mean feat and requires facility with content and with orchestrating student practice. In this paper, we consider the role of a small intervention that targeted only student group work (as opposed to teacher practice) as a resource for organizing collaborative activity.

Our perspective on the role of discourse in mathematics classrooms aims to make visible the ways that what we say, how we say it, and how we implicate others' engagement in such interactions all shape participation in ways that affect students' opportunities to learn. Supporting productive modes of interaction and awareness of the crucial role of discursive exploration of math topics is central to views of language and learning as inherently social processes (Barwell, 2005). Implications of such sociocultural views on positioning within mathematical learning point to a need to foster and examine discourse that supports learning how to navigate both ways of being (social selves) in relation to ways of knowing (math learners) that are viewed as relevant, expected, or valued in certain classrooms.

In this paper we build on our understanding of student positioning with the goal of investigating how an external artifact mediated student interaction. Considering one group's interactions over the course of the academic year, we track students' patterns of participation over time and examine micro-interactional details of their conversations across three days spanning the ten activity days we conducted throughout the school year. We view such small-group math discourse and the meta-discourse through which students evaluate their participation as evidence of their positioning relative to each other and the math at hand. We thus consider how the tool afforded or constrained interpersonal and perhaps disciplinary positioning.

Context of the Study

The data we consider draws from the second of a three-year, U.S. National Science Foundation-funded research project that examined the role of discourse in supporting mathematics learning in fifth grade classrooms (Hickey, Lewison, & Mewborn, 2005). The overarching project aimed to examine the impact of regularly occurring, collaborative math activities aligned to specific state and national mathematics standards on the development of student learning. The project's goals were to support teachers' facilitation of mathematics activities and to refine activities and related assessment materials to promote conversation and collaboration, which was not normative for the schools with whom we partnered. In this study, we conduct a fine-grained interactional analysis of the how certain aspects of the designed activity structure afforded participation in math discussions in ways that differ from traditional math classrooms, which are often modeled after learning-as-acquisition models (Sfard, 2001).

We partnered with four classrooms in two midwestern primary schools for the second year of this project. Teachers of these classrooms taught all subjects, including mathematics. We worked with these four classroom teachers for the duration of the school year, throughout which we participated in monthly interventions during math class time as well as monthly meetings with all four teachers in which we reviewed data, activities, and discussed and planned upcoming activities.

Activities

The interactions that we had with the four classrooms entailed: (1) monthly, small-group math activities in which small groups of students completed and discussed pencil-and-paper problem sets that the research team designed (three to four questions each); (2) whole class discussions led by the teacher in which representatives of each group presented problem solutions on transparencies projected overhead; (3) *conversation rubric discussions* in which groups reflected on the quality of their group discussions (the focus of our analysis, discussed below); and (4) bi-yearly pre-post formative assessments that covered similar topics to the monthly problem sets and were completed individually, were not graded, and were discussed in similar fashion to the activities already described. In addition, we also administered bi-yearly pre-post tests that served as a proxy for state and nationally administered achievement tests. The design of both the monthly activities and formative assessments included small-group feedback conversations that were meant to foster discussion of math reasoning and reflection on math discourse. We focus here on an interactional analysis of one group's participation in three of the ten monthly, small-group activities.

The problem sets in the monthly activities dealt with recently covered concepts from students' regular math curriculum, such as determining the area of polygons, prime factorization, interpreting graphic representations of data, multiplication and division of fractions, and order of operations. The sets often prioritized open-ended problems with multiple solution paths and were intended to foster extended discourse within groups. These activities were not graded, but students did receive "hints" sheets (named "Dori's Hints" after a fictional cartoon sixth grader) partway through their discussions. These "hints" were intended to scaffold possible procedures to solve the problems and to move group conversation forward.

Conversation Rubric

In addition to the problem sets themselves and "Dori's Hints," the main focus of our analysis is the role of the *Conversation Rubric* (CR) as a mediating tool that shaped students' participation in math discussions. The CR was designed to foster groups' reflection on their math discussions about the problem sets and their positions as engaged learners within those activities (see Figure 1 below for the CR). The CR (and teacher and research team's scaffolding of groups' use of it) focused students' attention on what are considered important elements of "productive" math discourse—listening, explaining, challenging, and reflecting on understanding.

Groups worked on the CR collaboratively after discussing their reasoning and completing whole-class discussion of the problem sets. Additionally, prior to completing the problem sets on each activity day, teachers organized a whole-class discussion around the prior month's CR to encourage groups' reflection on points for improvement from last time, which usually took five to ten minutes. Our interest in highlighting the CR for examining small group discourse lies in its potential for provoking reflection on students' participation in groups. In these reflections, students were no longer talking just about math, but also talking *about* their talk about math (and sometimes taking a personal stake therein). This talk effectively created a context for students to contest the accuracy and quality of their groups' math discussions, when students actually engaged the CR, which was not always the case. We argue that this affordance of the CR evoked different ways that students could orient to their own and each other's positions with regard to the math activity, their participation in it, and what social elements were relevant to distinguish "productive" and "unproductive" engagement in math talk (Gresalfi, 2009). We argue that the traditional classroom space of received mathematical learning (Boaler & Greeno, 2000) and classroom mathematical practice was mediated by this affordance of the CR in that it prompted students to think about the ways they talk about math together—not only the mathematical procedures used, reasoning employed, or their own individual understanding, but also how productively they engaged discourse and understanding as a group.

The CR was thus a pivotal artifact (Jurow, 2005) in that it provided a shifting frame that was outside that of received mathematical knowledge, which characterizes the traditional, individualistic math instruction these students were accustomed to engaging in, because it focuses on group work and discussion. The CR was also outside the frame of the group math activities themselves, because it fostered reflection on those activities. Despite both the activity's and CR's distance from "traditional" math instruction, it is not entirely separate, as it shares some features such as pencil-and-paper format and is easily adoptable by teachers without an actual change in classroom practice. The ways that interactions afford meaning making in classrooms vary widely but are never neutral. Theoretical views on classroom talk range from characterizing it as dissemination of information to a tool for problematizing understanding, creating meaning, and positioning identity. We view interaction around the CR as a reflective meta-tool for learning on two levels—understanding how to position one's self as a type of person, and understanding ways to reason about math with others.

Conversation Rubric	
Active Listening Definition: <ul style="list-style-type: none"> • Hear what everyone has to say • Try to understand everyone's explanation • Ask questions when you don't understand • Make sure everyone has a chance to express his or her position (not necessarily in order) 	How did your group do on listening? What will your group work on to improve this?
Explaining Definition: <ul style="list-style-type: none"> • Describe your way of thinking about the problems • Take a stance • Try out new ideas by explaining to others • Use math reasoning to support your answer 	How did your group do on explaining? What will your group work on to improve this?
Challenging each other Definition: <ul style="list-style-type: none"> • Be sure to voice different reasoning and solutions • Draw out others' explanations with questions • Agree to disagree, if necessary • Everyone has something important to add • Different solutions are a good thing 	How did your group do on challenging? What will your group work on to improve this?
Group Reflection How did your group's understanding evolve? How did your group use Dori? In what ways did she help?	

Figure 1: Conversation Rubric

Methods

The small groups in which students completed and discussed the problem sets were comprised of three to five students each, which we organized with the teacher at the beginning of the school year based on mixed student math ability and parity across male and female students. In each of the four classes with whom we partnered we video-recorded two focal groups (limited due to equipment and personnel constraints), which we selected based on teachers' recommendations about likely talkativeness (a positive thing when examining discourse), consent to be video-recorded, and diversity of socioeconomic status, race, and math ability across the eight groups.

The data for this study include three, hour-long video-recorded activities of a four-student focal group comprised of two boys (Trey and Adam) and two girls (Christy and Mandy; all names are pseudonyms). We chose this group because they remained intact for all but the first activity day of the year, and they often talked at length about the CR. We chose these three activity days—day 2, day 4, and day 10—out of the total ten because they included complete video records of the CR discussion that also represents a range across the entire group trajectory throughout the year. Our analysis examines the types of positioning and learning that the CR fostered, both in the discussions around the problem sets and in the CR discussions themselves. Since the CR was discussed at the start of each activity in a whole-class discussion led by the teacher, we found that it shaped elements of discussion throughout each activity day. We use discourse analysis informed by sociocultural and sociolinguistic commitments (e.g., Anderson, 2009; Bucholtz & Hall, 2005; Mercer, 2004), including the immediate details of talk (pauses, pronoun usage, indexicals, content) as they relate to social positioning as well as categorizations of the group's trajectory of participation across the ten months of the intervention.

Findings

We present the overall findings in terms of the elements of the CR for each episode. Our analysis includes both verbatim snippets from the group's CR discussion and our commentary on how that aligned with what we saw actually happening in the video recordings of their math discussions preceding the CR discussions. We first present an account of how the students used the conversation rubric and the alignment between their reflections on their participation and our observations of their participation. We then consider the episodes in terms of positioning.

Day 2

The group's reflections on their activity from the second day in the CR discussion was generally positive; for the most part, the group stated that they had collaborated quite productively as a group, at least with respect to the items to which they responded. Specifically, they claimed that: "we tried to listen to [the explanations]"; "[we] heard what everyone had to say," and "'sort of'" asked questions when we didn't understand each other." Likewise, the group claimed that they had offered productive explanations, stating that they had "half and half tried to describe our way of thinking about the problems." "We said 'I don't think that's right' if we didn't understand each other," and "did not just sit there and nod our head." "We used math reasoning." In contrast however, they noted that they did not robustly challenge one another when working on the problems, stating: "We didn't really voice different reasoning and solutions except at the very end (after Dori)." Although one student claimed that their performance at challenging one another was only mediocre, others argued they did well because "we actually tried and did our best."

These reflections were generally not aligned with our observations of students' actual math discussions on Day 2: although students did at times listen to each other to the extent that they shared answers or procedures, they did not work collaboratively beyond "reporting out." As an example, after the students had finished the first problem on their worksheet, they were asked to share their answers with their group. The following exchange ensued:¹

Christy: Um, I did drawings like 12.5 plus 5, you just add. You just, like, add. So I just added 5 to that one. And then if you do, um, 12.5 times 5, you'd be doubling, the number over and over again. So, like that's why I thought it would be greater. Because with this you only add 5 and you'd be doubled.

Trey: I didn't get anything.

Christy: Well, how far did you get?

Trey: I didn't get any [inaudible] [has covered his face with his paper]

Christy: I thought you had something wrote down.

Trey: But then I erased it.

Christy: [looks at Adam who is concentrating on his paper] Well, what did you think? [looks back at Trey]

Trey: [closes the paper closer over his mouth] My mind is blank.

Mandy: Wait, what?

Trey: [turns head to Mandy] My mind's blank.

Christy: OK. Adam, what did you get?

This exchange represents an "explanation relevant" moment; one of the members of the group expressed confusion about the problem but did not receive an explanation or assistance from the rest of the group. In this way, Trey was positioned as both off task and unworthy of assistance, as his confusion did not merit discussion or explanation from any of the other group members.

Day 4

The group began this day prepared to listen actively to each other, because they decided that "we weren't listening to each other's problems last time; We're gonna try to listen to each other more," in their discussion about what to improve upon this day (based on last months' CR). Importantly, the group left their goal at this relatively unspecified level; they did not detail what listening actively looked like, or what specific steps they would take to ensure that they were realizing their goal. In reflecting on their discussion of the problem set (completed in two pairs this time) using the conversation rubric, the students did not evaluate their listening very positively; Christy said that she and Trey "did really good listening to each other and asked questions and communicating," but Mandy reported that she and Adam were only "sort of" listening to each other at the end a little bit. Interestingly, the students did not refer back to their stated goal for the day. With respect to explaining, Adam said (of he and Mandy), that "we did good because at least we explained. It may have been wrong but at least we challenged with respect and stuff." However, as a whole the group concluded that they could have done more to challenge each other because they didn't talk or listen all the way through.

Again, our observations of the group's work did not conform closely with the students' own characterization of their work. The group broke into pairs (as instructed by the teacher). Christy and Trey worked mostly independently next to each other; they listened to each other's answers and reviewed their procedures, but mostly they did not engage each other beyond stating their answers and reasoning. They did not actually work on the problem together. Mandy and Adam, however, did not even discuss what they

¹ Transcription conventions: [text] = description of non-verbal action; TEXT = stressed speech.

had written with each other and required extensive intervention from one researcher to even comparing their answers.

Day 10

Adam was absent this day, and although the teacher and research team encouraged the rest to work as a threesome on the problems, Trey resisted (and Mandy immediately said that was fine with her and Christy). This final day of our analysis illustrates the extent to which the group's interaction came to a head; whereas in the previous two episodes, reflection about their work was generally not contentious and only tangentially related to the group's work, in this final episode the CR became an explicit tool for positioning each other in relation to the group's work. Specifically, although Christy and Mandy claimed that they had worked well together, Trey argued vociferously that they had neither listened nor explained *to him*. In our observations of the video data, although Christy and Mandy worked together without conflict, their collaboration was rather one-sided with Christy leading the work and Mandy writing answers and neither asking for, nor receiving, explanations. Trey worked independently, initially by his own desire, and later when the three were meant to discuss what they had written because he could not get the attention of the rest of the group.

In their discussion of their collaborative work, the CR became a mediating tool that Trey leveraged to successfully note his dissatisfaction with the group's discussion (or lack thereof). Although he had previously attempted to get the attention of the two girls, it wasn't until the CR became a topic of discussion that he was able to engage his group mates productively.

Christy: Listening? We listened to each other.

Mandy: What, where?

Christy: We listened to each other [points to CR].

Trey: No we're not done yet. We're not done yet [meaning not ready to discuss the CR].

Christy: Too bad.

Trey: You can't do it [CR], we all have to do this together [discuss their work].

Christy: [to Trey] Do you think we listened good?

Trey: [pauses] No.

Mandy: Yes.

Trey: NO, we haven't listened at all to each other.

Christy: That's because you didn't want to work with us, so too bad. We listened to each other!

Trey: But you cut- we all have to agree!

Mandy: But you said you didn't want to work with us.

Christy: No, you just don't want to work with us, so it's [inaudible]

Trey: No but we all have to agree. She said when you're done after we discuss this [lifts up activity sheet. Christy keeps writing on CR with Mandy looking on. 16 sec pass. Trey picks up their written work and examines it].

As the excerpts and descriptions above illustrate, the group did not really engage the CR in deep and meaningful ways, which was the case across the 10 activity days throughout the school year. For this reason, we argue that although they clearly used the CR for interpersonal positioning, especially on day ten, they did not engage in disciplinary positioning around the CR discussion (one of our hopes in designing it).

Conclusions and Implications

To revisit our earlier stated aims, in this paper we considered one small student group's discourse across three monthly, collaborative math activities as evidence of the extent to which the *Conversation Rubric* was a mediating tool that supported collaborative engagement in math activities and shaped students' reflection about their understanding and their positions in discussions in ways that might not have occurred without the CR. With respect to these two points, we conclude from our interactional analysis of the three activity days that the CR supported competitive rather than collaborative engagement for this group, and that it failed to shape actual reflection on math understandings. We base this claim on observance that the group tended to focus on procedural display, task completion, and compliance with teacher formulations of the CR discussion as well as arbitrary group-dictated rules rather than considering how they might learn from each other or reflect on changes in understanding about the math from beginning to end of each activity day (or between activity days—another goal of the CR that was not realized for this group).

Clearly the CR had affordances for shaping group discussion, but how these affordances were realized as compared to how they were envisioned by the research team, at least with respect to the evidence supported in this case study, begs the question of whether the CR in fact does not afford reflexivity, or whether its use in this classroom with this particular group simply thwarted these

affordances. In terms of design, we feel that if the group had taken up the CR as an actual platform for considering their math discussion, it could have worked. However, this group became fixated on either getting it done quickly and complying as if it were a set of boxes to tick, or using it to enforce compliance with dominant group members' whims (as seemed to be the case on day 10 with Christy and Mandy). As we stated above, activity designs can afford productive tensions between students that lead to positioning of each other. In this case, we observed tensions, but they unfortunately were not productive in terms of pushing understanding and learning from difference. Instances of different mathematical representations for this group were either glossed over as the same representations (so they could move more quickly through the activity) or became arguments about who was "right." As a result, the group never moved beyond initial understandings of the math activities, and they never reflected on these differences in the CR discussions. To further explore the design implications of the CR, we will be analyzing all eight groups' discourse and positioning in a future paper, of which this analysis will serve as a model for the analytic methods. In addition, we will also compare the second year iteration with that of the first year's groups' work on the CR, which was slightly different in form and enactment (see Anderson, 2009 for an in-depth analysis of one group's positioning relative to the CR in the first year).

Our methodological contribution from this analysis includes considering how a mediating tool shaped the texture of learning across small-group discussions, which we examined across time. In this student group's case, the CR-as-artifact shaped math discussions but not in ways we had intended or hoped. The CR-as-methodological lens, however, provides us with useful implications for considering the role of math discourse in supporting opportunities to learn, as we can learn considerably from negative cases. We examined the CR discussions as discrete points along the group's trajectory where values became explicitly associated with participation explicitly in light of intervening math discussions. In this way, the CR foregrounds how participation in small group discussion highlights tensions surrounding accountability—*especially* when such practice is not the norm for a classroom.

This analytic lens on the surfacing and navigation of tensions surrounding group participation is useful for understanding how interpersonal positioning can afford or thwart deep math discussions. For this group, their trajectory across the ten activity days spanning ten months illuminated a practice that did not change—their explicit attention was always focused on listening, but they never really changed how they listened to each other much beyond the second day. In terms of learning, it is unclear whether the math discussions or the CR aided this group's collective or individual understanding. We argue that these lacks stem from a failure on the group's part to get beyond the notion of their math work as their own, in other words something to which they alone were individually accountable. The group treated the math activities as their own work for which they would eventually be evaluated and the CR as a rote activity in which to give the appearance that they were doing things as a group. However, because the CR was not pushed or taken up in this classroom in a meaningful way, it thus failed to be meaningful. From these conclusions we summarize that interpersonal positioning must be navigated so that it does not get in the way of engaging the math, as it did for this group because vulnerability and righteousness clouded their ability to see the math for the spats. Instead, interpersonal positioning must lead into an appreciation for the variety of different ways there are to approach the representation and solving of math problems. In this way, the group we considered here "talked with their mouths full" of the CR, in that they interpreted their participation through its lens. However, that mediating tool only shaped participation after mathematical activity was completed, and thus the CR served more as a snack than a meal.

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Acknowledgments

We would like to thank the PIs on the grant that supported this work, Dan Hickey, Mitzi Lewison, and Denise Mewborn as well as the National Science Foundation without which this data could not have been collected. We are also grateful to other members of the research team—Dionne Cross, Asli Ersoz, Peiwei Li, Ingrid Graves, Lenny Sanchez, and Erik Winarski.