Off topic but on point: Student talk in an undergraduate geometry classroom

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This paper focuses on the role that off-topic talk can play in a classroom. Although such talk has been typically ignored in the undergraduate STEM education literature, we argue that it can be highly consequential to the learning environment and thus should be taken into account. To study off-topic talk, we followed four groups throughout the semester in an upper-division Foundations of Geometry course, analyzing the talk in terms of student goals and gender. We focus on how such talk could influence the building of trust and power dynamics in small group interactions. We found that off-topic talk was prevalent (>30% of talk) and played a variety of roles in group discussions.

Introduction

What role does talk play in learning? When proficiency in a STEM discipline is viewed as the ability to participate in particular social and cultural practices, discipline-specific discourse becomes a primary mechanism for enculturating students into the norms of the discipline. Within a specific STEM discipline discourse community, talk is a driving force for generating new ideas in the discipline and building conceptual understanding. It is the mechanism through which students explicate their thinking to others and make sense of their peers' ideas. Clearly, talk is a crucial part of learning in the STEM disciplines. In this paper, we focus on the talk that takes place in a mathematics classroom, yet our results can be extended to any of the STEM disciplines.

Beyond developing conceptual understanding, what roles might talk play in the classroom? While there are ample amounts of talk that occur in the classroom space, much of it is not related to disciplinary content. It is easy to dismiss this talk simply as "off topic" and position it as a distraction to be eliminated. While such talk can, at times, distract from developing concepts, some researchers have argued that such talk plays a crucial social role (Gholson & Martin, 2014). In fact, researchers argue that "the emphasis on mathematics forms of talk has helped obscure inquiry into other forms of participation and their functions for productive collaborative mathematics activity" (Langer-Osuna, 2018, p. 1). From this perspective, we sought to better understand such off-topic talk and what roles it may play in the classroom.

The present paper focuses on an upper-division undergraduate geometry course that made extensive use of group work and classroom discussion. Because this space was built on student sense making and mathematical exploration in a collaborative environment, it was a rich environment for exploring the types of talk that arise. Moreover, by exploring talk in small groups and whole class discussions, we were able to investigate how talk might look different in these two venues.

Theoretical Framing

Talk is considered a critical aspect of learning (Bransford, Brown, & Cocking, 2000; Lampert, 1990; Sfard, 2008). When students explain and justify their ideas, it supports them as sense makers (cf. Stein, Grover, & Henningsen, 1996). In this sense, opportunities to talk about disciplinary content are opportunities to learn disciplinary content (Hufferd-Ackles, Fuson, & Emily, 2004; Michaels, O'Connor, Hall, & Resnick, 2010). What about non-content-focused talk? We adopt the sociological perspective that there is no such thing as a meaningless interaction (Goffman, 1983; Rawls, 1987). Thus, we argue that this other talk in the classroom may play a variety of roles, influencing both disciplinary learning and social interactions in the classroom.

Non-mathematical talk has been studied extensively with regard to opposition in classrooms (e.g., D'Amato, 1988; Giroux & McLaren, 1989; Ogbu & Simons, 1998). This research focuses on the behavior of students who are positioned as oppositional and the role of oppressive systemic structures (Hand, 2010). In this body of research, sociocultural perspectives of learning have been particularly productive, as they provide insight into how students engage in social practices related to broader school and societal contexts (e.g., Lave & Wenger, 1998; Nasir, Hand, & Taylor, 2008; Wertsch, 1998).

Opposition can be framed as behavior directed at resisting school activities (McFarland, 2004). This behavior may be overt, such as direct challenges to a teachers' authority, or may be more subtle actions that undermine the classroom order. Viewed as social drama, student opposition is a way to reframe dominant classroom activities into social ones (McFarland, 2001). This is a mechanism for students to reframe a given interaction into one where they have more clout or are perceived as more competent. Opposition has also been viewed as simply a misreading of the dominant discourse of a classroom, where students' goals are misaligned with what is culturally valued (Diamondstone, 2002).

Another body of research focuses on the interplay between mathematics and broader cultural spaces. Researchers have used the concept of figured worlds (Holland, Lachicotte, Skinner, & Cain, 1998) to look at both mathematical and non-mathematical figured worlds in the classroom (Esmonde & Langer-Osuna, 2013). This concept describes how social contexts are cultural spaces in which different actors hold different relationships of varying significance. The relationship between mathematical and non-mathematical cultural worlds has also been explored with respect to framing (Hand, Penuel, & Gutiérrez, 2012). This research highlights the multiple overlapping lenses that frame a classroom at any given time, with the dominant mathematics frame of the teacher as only one of many frames that guides student behavior.

Beyond resistance to oppressive or misaligned classroom structures, other research highlights the role that social talk plays in supporting students as mathematicians (Gholson, 2015). In particular, for young black girls, Gholson argues that social talk is critical to tethering children to the classroom community and participation (p. 170). From this perspective, one's social positioning also has an important role in how they are positioned as mathematically competent in classroom work (e.g., Cohen & Lotan, 1997; Engle, Langer-Osuna, & Royston, 2014; Langer-Osuna, 2016). As Gholson notes in her study of young black girls doing mathematics (2015; p. 209),

> Many of the girls moved effortlessly between discussions about their friendships, social life, and mathematics work…this does not mean their banter during mathematics work

> was not consequential to their learning. To the contrary, it seems the girls' social talk provided social connection and engagement in the mathematics assignments.

This paints a more realistic picture of a mathematics classroom, recognizing that social interactions are a key aspect of productive working relationships. This is consistent with research on teamwork, that highlights the need to build trust and community amongst peers (Levi, 2015). In addition, research suggests that social integration may be especially important for women in STEM (Lewis, Stout, Pollock, Finkelstein, & Ito, 2016). This is due to the prevalence of problematic gender narratives that position women and girls as inferior at mathematics (Mendick, 2005; Walshaw, 2001).

The above discussion of the literature highlights two key points about off-topic talk in the classroom. First, such talk influences the social order and power structures within a classroom. In this way, social interactions can be a tool for students to either gain power for themselves, highlight the power of a peer, or diminish others (peers or the teacher) in the classroom space. Second, social interactions can play a positive role for students, building community, trust, and mutual engagement with one another. In this way, social interactions play a critical role in students' identity development (Langer-Osuna, 2018).

Carrying these two lenses with us, we add a third analytic tool to understand the role of off-topic talk: student goals. Research highlights the importance of goals in the learning process (Black & Wiliam, 2009; Nasir, 2002; Zimmerman, 2008). Goals are critical to student learning because they help learners set intentions to regulate their learning (Zimmerman, 2008). It is through goals that students orient to a particular activity, because goals help them decide how to prioritize the ways in which they will engage in order to achieve specific goals. In addition, instructors must account for student goals when providing feedback, because different students may be guided by a variety of goals that are not necessarily the same (Black & Wiliam, 2009).

Research on student goals in college classrooms highlights four main areas: personal goals, social goals, vocational goals, and intellectual goals (Stark, 1989). Without individual interviews, it is difficult to infer students' personal goals, but these categories still draw our attention to social, vocational, and intellectual goals. Social goals for students may include financial security, having time to enjoy life, or feeling connected to a community. Vocational goals focus on the types of careers students might pursue and their desire to achieve high levels of success in their respective fields. Finally, intellectual goals relate to a desire to learn, understand, and make sense of the world. In our context, these goals relate to interactions with peers, the hopes for one's career, and learning mathematics, respectively. All of these goals relate to a student's quality of life, but in different spheres of life.

Prior work on non-mathematical talk has primarily focused on K-12 schooling contexts, where features such as tracking (sorting students into different streams based on perceived ability) are highly salient (e.g., Gholson & Martin, 2014; Hand, 2010; McFarland, 2001, 2004). One may expect in these contexts to see more overt resistance from students, especially as they are navigating complex social hierarchies of adolescence. Still, the opposition research also highlights that students may oppose a teacher's goals in much more subtle ways. We argue that students may do this as a way to achieve their own goals (e.g., social goals) that may not necessarily align with their teacher. As such, our study adds to the literature by focusing on off-topic talk in undergraduate mathematics classrooms (not just K-12), and by drawing deeper attention to how students may use this talk to serve their own goals.

Given the above, in our study, we aimed to address two important questions: (1) What purpose does off-topic talk play for students in the mathematics classroom?; and (2) In what ways does a student's gender relate to their off topic talk?

Method

Participants and Context

The study took place in a Foundations of Geometry course at a large, research-extensive university with a relatively diverse student population (e.g., ~65% students of color). The course was co-taught by two mathematics educators. Of the 29 students enrolled in the course, 16 participated in the study. Of these 16 students, 10 were seeking a BA in mathematics, in preparation for earning a single-subject teaching credential. The demographics of the students who participated are given in Table 1. These were the demographics of the participants as identified by one of the course instructors. As an upper-division mathematics course, we note that the diversity of the participants do not fully represent the diversity of the university.

Table 1. Participant Demographics

	Women	Men
Black	1	0
Latinx	2	1
White	6	6

The course was taught mostly using collaborative group work and involved a number of hands-on inquiry activities for students. Students used technology (e.g., dynamic geometry software) and a variety of artifacts (e.g., rulers, string, plastic panes) to physically explore concepts of projective geometry. After these inquiry activities, there was generally some sort of whole-class debrief. The course was co-taught, with the secondary instructor also playing a role of researcher, collecting data in this context. Students were in consistent groups of four throughout the first half of the course. Students were reassigned to groups (such that two members of each new group had been in a group together before, and the remaining two members came from different groups) at the halfway point and stayed in these new groups for the remainder of the course.

The course consisted of three main units, each a component of projective geometry. Physical and spatial projective geometry (unit 1) was built around the problems that gave rise to projective geometry, as well as the use of Alberti's Window. This artifact consists of a transparent pane and an adjustable eyepiece for viewing drawings or objects. This allows a user to explore projections of an image (see Ernest and Nemirovsky, 2016 for more description of the course and the Alberti's Window). Synthetic projective geometry (unit 2) focused on axioms and proofs, including major results such as Desargues' Theorem and Pappus' Theorem.

Students explored these axioms and theorems using whiteboards, rulers, and dry-erase markers, as well as with dynamic geometry software. Analytic projective geometry (unit 3) focused on the use of homogeneous coordinates. Students used Cabri 3D software, a dynamic geometry environment, to support their explorations.

Data Sources

Classroom participation was captured using five video cameras: one for the whole-class, and one each for the four groups of four students, to capture the talk of the 16 participants. A total of 27 class sessions were recorded (the first 3 were omitted from the dataset, as the semester was getting started up). Although they were not analyzed for this study, student artifacts were also collected and used as supporting materials to understand students' talk.

To study student participation in groups, a subset of the data was sampled. In particular, six tasks were chosen, with two tasks chosen at random from each of the three units in the course. For each of these tasks there were five corresponding pieces of data: the interactions of each of the four groups, and the whole-class discussion. This resulted in a total of 457 minutes of interactions that were analyzed for the study. When these data were coded, a total of 2968 lines were coded. For the analyses that follow, we only consider talk that was coded as "off topic," which represents 941 lines, or 32% of the talk. We consider only this talk because this represents times when students were engaged in some sort of talk that might not typically be classified as productive for the task at hand. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Analysis

Data were coded using the equity analytics approach associated with the EQUIP (Equity QUantified In Participation) observation tool (Reinholz & Shah, 2018). EQUIP focuses on relatively low-inference, quantifiable markers of student participation. Each time a student participates in the class, their participation is coded along a number of dimensions (i.e. each instance of student participation uninterrupted by another student constitutes the grain size of coding). After data are coded using EQUIP, they are cross-tabulated with demographic information from the class. Here, demographic constitutes any social marker such as: race, gender, age, group membership, etc. By cross-tabulating participation with different social markers, it is possible to see how participation breaks down by group.

The standard EQUIP tool has seven dimensions. In this paper, we draw on a dataset that was previously coded using a subset of the standard dimensions (length of talk, type of talk), with two additional dimensions of class mode ("small group" vs. "whole class") and on topic ("on topic" vs. "off topic"). Thus, there were five dimensions of coding (including who the participant was). For those analyses, a total of 811 lines were double coded (approximately 27% of the dataset). Across all dimensions we computed interrater agreement using Krippendorff's alpha (Hayes & Krippendorff, 2007). For all dimensions a level of alpha > 0.9 was achieved (cf. Ernest et al., forthcoming), indicated very good agreement.

We determined that any talk that did not directly relate to the instructor's goals for that lesson (i.e. the task at hand) was coded as "off topic." The subset of the data coded as "off topic" were then later coded to student goals. This resulted in three categories: intellectual, vocational, and social. Intellectual talk related to understanding the material in the course, but not as a part of the task at hand. Very often students would discuss homework problems, assignment due dates, or other things about how the class was progressing logistically. Vocational talk focused on aspects of students' majors or their career aspirations. As many students were aspiring teachers, these types of conversations focused on topics such as major coursework and student teaching. Given the prevalence of social talk, we split this category into two sub-categories, task-related and not task-related. Social talk (task-related) occurred when students used humor or made remarks about the current task that were not focused on mathematics. Social talk (not-task related) was any other type of talk: students talking about their weekends, joking around with each other, or making general remarks like "I'm hungry." Off-topic talk could be coded for multiple types of goals simultaneously.

As described here, we created a coding scheme that consisted of four categories: intellectual, vocational, social (task-related), and social (not-task-related). This coding scheme was developed collaboratively by both authors. The first author applied this scheme to the entire dataset and 30 of the 147 episodes were double-coded to compute interrater agreement. There were a total of three disagreements for these 30 episodes, meaning that interrater agreement of 90% for this four-category scheme.

Results

Prevalence of off-topic talk

Our first area of inquiry was how off-topic talk occurred and its prevalence across small group and whole class settings. Table 2 shows the prevalence of talk in both small group and whole class settings. The differences were statistically significant, $\chi^2(1, N = 2968) = 134.65$, $p < 0.001$, Cramer's V = 0.21 (small to medium effect size). This indicates that the distribution of off-topic talk was significantly different between whole class and small group settings (unsurprisingly). We note that whole-class discussions were almost entirely on-topic, whereas the small groups featured a great deal of talk classified as off-topic (35% of the talk).

Table 2. On topic and off topic talk by class mode.

	Whole Class	Small Group
On Topic	296	1731
Off Topic	7	934

Off topic talk was far more prevalent while students were working in small groups, as might be expected. During whole class discussions, in general, it was the instructor of the course who determined which students were given the opportunity to speak publicly, highlighting the role of power held by the instructor. During small group work, on the other hand, it was the members of each group who determined which members were given the opportunity to speak. As such, students had more room to negotiate their roles and individual identities through both on- and off-topic talk. The off-topic talk that did occur during whole class discussion occurred in the small groups (captured by the table cameras), rather than as public comments.

Next, we considered how mathematical talk was distributed by gender (see Figure 1). Both women and men had approximately 70% of talk as on-topic, and 30% as off-topic. Still, there were small differences, which were statistically significant, $\chi^2(1, N = 2968) = 8.23$, $p = 0.04$, Cramer's V = 0.05 (a very small effect size).

Figure 1. On topic and off topic talk by gender.

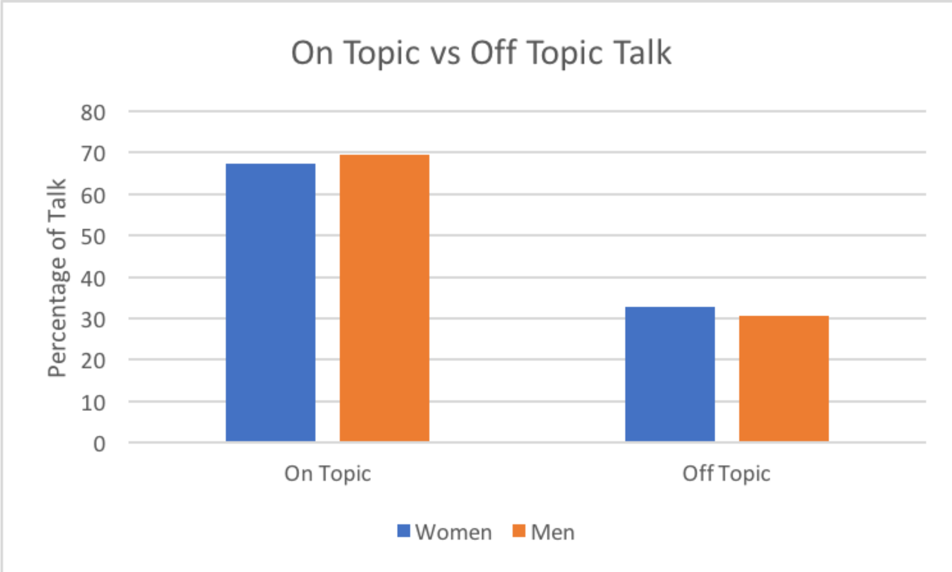
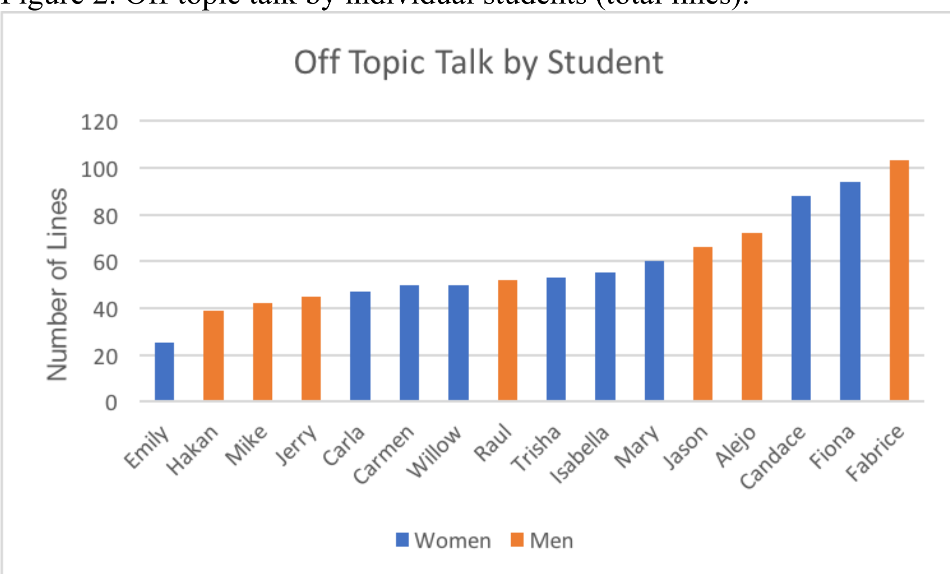


Figure 2 shows a more detailed look at how off topic talk was distributed across students. Figure 2 shows that at the extremes Fabrice had five times as much off-topic talk as Emily. At the next most extreme, Fiona had two and a half times as much off-topic talk as Hakan. Thus, we concluded that talk being on- or off-topic was not strongly related to gender, but rather the participation patterns of individual students.

Figure 2. Off topic talk by individual students (total lines).



Student goals

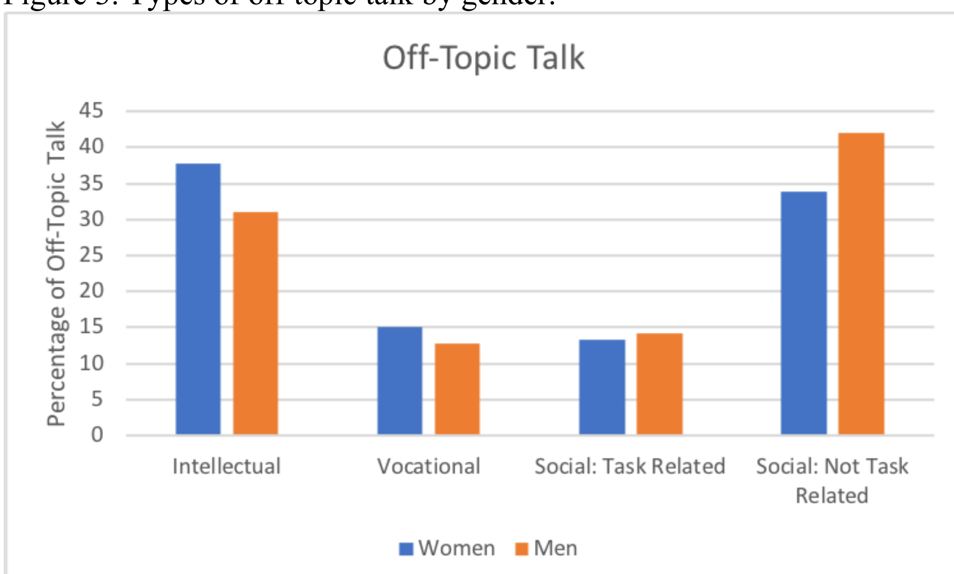
Table 3 shows the distribution of off-topic talk as it relates to student goals. In this table, an *episode* refers to an uninterrupted exchange of off-topic talk between participants, regardless of the length of the exchange. A *line* refers to the uninterrupted talk of a single participant during an exchange. An episode can consist of any number of lines. Here we see that the greatest quantity of talk was social, not focused on the task. Still, there was a considerable amount of talk related to students' vocational and intellectual goals, indicating that students used this talk for a variety of different purposes relevant to them. As mentioned previously, we do not have interviews that could indicate the personal goals of students, so we cannot make claims about this type of talk. Off-topic talk could be coded for multiple categories, so the total number of lines in Table 3 (1670) exceeds the 941 lines of off-topic talk coded.

Table 3. Distribution of off topic talk by type.

	Intellectual	Vocational	Social (Task-Related)	Social (Not Task-Related)
# of Episodes	32	9	47	59
# of Lines	586	231	238	615

Figure 3 illustrates the extent to which men and women participated in episodes of off topic talk that pertained to the four goals, highlighting the differences between genders in their participation. This figure shows that 42% of men's off-topic talk took place during episodes that consisted of social talk not related to the task at hand. The corresponding value for women was nearly 34%. On the flipside, 37.7% of women's off-topic talk occurred during episodes containing intellectual off-topic talk, versus only 31.1% for men. This suggests that there may be some gender differences in student goals for participating in off topic talk.

Figure 3. Types of off topic talk by gender.



As we mention above, students used off-topic talk for a variety of purposes relevant to them. Here we provide examples of what these types of off-topic talk looked like and extrapolate to how it may have served various goals that the students had.

Intellectual Goals. We identified numerous instances in which students were discussing mathematics in the course, but mathematics that was not related to the task at hand. This indicates that students were indeed interested in learning the mathematical content, but for various reasons, they may not have chosen to engage with the task at hand. This aligns with students pursuing their own intellectual goals. For instance, the following episode took place during a class session in which groups were instructed to discuss the projection of a parabola. Rather than focusing on determining how a parabola would project, one particular group of students were discussing a problem from the previous class session. In the previous class session, groups were guided through creating a sketch in Geometer's Sketchpad that was a two-dimensional representation of a three-dimensional tool the students used in class (the Alberti's Window). During the previous class session, this particular group was unable to create an accurate sketch, and class ended before they were able to correct their construction mistakes. In the subsequent class session, during which the following episode took place, the group was determined to identify why their previous sketch did not behave as it should have, and to successfully create the sketch they were unable to complete the previous class session. The group began by troubleshooting their original sketch, where pairs of lines needed to intersect in particular locations.

1. Jason: You could extend those lines to see where they meet.
2. Fiona: Why are they meeting downward and not upward?
3. Jason: Delete them and do them again. Do it on the- this time do it on the-
4. Willow: Did you do the wrong transformation?
5. Fiona: I don't know.

This conversation continued for a total of 75 lines, which took up nearly all the time for group work on the assigned task. As a result, the group made no progress on the assigned task, and subsequently did not participate in the whole class debrief. Yet, this extended discussion of the task from the previous day illustrates the group's intellectual goal of understanding the mathematics associated with the previous task.

At other times, students used the opportunity of being with fellow students to discuss the homework assignments and projects associated with the course. Across the corpus of data, this is one of the more common ways that students engaged with intellectual goals. We consider this to be off-topic talk with an intellectual goal, since the discussion of the homework was not typically directly related to the task at hand, yet the students were discussing mathematical content. Consider the following episode where a group was discussing the homework that they just turned in,

1. Alejo: I turned in these amazing drawings for homework and, I thought they were amazing.
2. Jerry: You thought your amazing drawings were amazing?
3. Emily: I couldn't remember what parabola to draw.
4. Carla: My imagination is ugh. I don't have good imagination. My drawings were not very good.
5. Alejo: I'll show you guys. I'll show you guys. I'll show you guys what I did. I need a ruler.
6. Emily: I couldn't remember what [the projections] looked like. I remember the hyperbola but not the parabola.
7. Jerry: Well nothing will map on the horizon because there's nothing behind the eye base.
8. Alejo: Watch, okay. Okay, watch this.

9. Jerry: Isn't it just going to look like a horseshoe?

In this case, the students were frustrated with the homework, but they still used the space to discuss their attempts. In addition, we believe that this talk might also serve a social goal, of helping the students bond and build rapport. Nevertheless, we still coded this talk as intellectual, given that the conversation was centered on the discussion of another task in the class.

Vocational Goals. As mentioned previously, many of the students in the course were prospective secondary teachers. This provided numerous opportunities for students to discuss their program of study and future careers with one another. Given the student population, this was the primary type of vocational goal discussed. The following episode highlights a discussion where students focused on their major requirements for observation hours in school settings,

1. Raul: And that's what I was trying to articulate. And then- (to a student at another table) Did you get observation hours? You've already done forty-five? You're the man.
2. Isabella: Shut up. Have you guys done forty-five already?
3. Carla: Forty-five what?
4. Fabrice: Forty-five what?
5. Isabella: Observation hours. For being teachers.
6. Fabrice: Oh, no.
7. Carla: I didn't do that.
8. Fabrice: Should we have done forty-five hours?
9. Carla: I'm doing my masters. I'm doing it with my masters.

This type of talk gave students an opportunity to gauge their progress on program objectives with other students in their course of study to see how they were doing. This gave students a way to calibrate their progress with their peers. Like many other episodes, this particular interaction arose when a number of students were stuck on the task at hand.

It was clear that discussions of vocational goals could also do real social work for the students. Here, Tricia and Mary were discussing a teacher education course they were both taking,

1. Tricia: You're going to miss the human knot?
2. Mary: Yeah. Shucks.
3. Tricia: Yeah, Simon told me, he said yeah so your last thing is the human knot and I was like-
4. Mary: How'd he know?
5. Tricia: He took that class.
6. Mary: Which one's Simon? Oh, Simon-
7. Tricia: The guy I sit next to.
8. Mary: Okay, gotcha.
9. Tricia: We sit together in almost every single class except for TE2.
10. Mary: Oh wow, okay.
11. Tricia: And this class, because he took this class last semester.
12. Mary: Okay. Oh the human knot, that will be fun.

13. Tricia: Yeah. He's like, “It's so annoying”.
14. Mary: One of the other girls, when we were doing it, was getting so mad. It was funny. She was like yelling at me but I was like, “I can't move”.
15. Tricia: I was dying I was laughing so hard.
16. Mary: It was funny.
17. Tricia: It was quite irritating.

Here the students shared an experience that they found quite amusing and irritating. It was a good way for them to bond and connect with one another, building a space of trust for group interactions.

Social Goals. The category of task-related social talk consisted of numerous small exchanges related to the task at hand and interspersed with talk focused on carrying out the given task. Students were generally playful in their groups, with exchanges that helped students bond and lightened the mood during tasks that students may have found frustrating. Students often made puns, jokes about materials, or small jabs at how their peers were engaging with the tasks. Consider the following exchange in which a woman in the class playfully ribbed another student regarding the method he used for finding a solution to a task,

1. Raul: [A]re we allowed to use geometry and trig to find where [the intersection] should be? Because that's what I did. No, I'll still use the cross product, but I used geometry and found it.
2. Isabella: He's too good for the cross product.
3. Carla: I still don’t get what we’re trying to prove.

At this stage of working on the assigned task, the students seemed to know they needed to use the cross product to find the solution but had not determined exactly how to find the solution. In fact, Carla suggests she is not sure of what they are trying to find. In this case, Isabella’s single off-topic comment that Raul is “too good for the cross product” may have been an attempt to lighten the mood during a frustrating task or may have been an attempt to deflect attention from her own understanding of the problem.

Another example of task-related social talk is given in the following example, in which the two men in the group have a brief joking exchange about what one female student suggested (correctly) that the group needed to do to arrive at a solution to the given task,

1. Tricia: You wanna imagine this is going down. So the string would continue to go down and it would hit at a point underneath [the table], like by your feet.
2. Candace: Then how do you draw that?
3. Tricia: You have to imagine like, what it would look like.

Other group members chimed in with social talk, as follows,

4. Fabrice: But, I don't have an imagination.
5. Mike: We're taking a trip to imagination land. Imagination land (sing songy)

In this exchange, while Tricia and Candace are focused on carrying out the task at hand, Fabrice interrupts with joking social talk. While Fabrice’s statement may initially seem focused on the task, the intonation of Fabrice’s comment suggested he was avoiding engaging in Tricia’s suggested action. This is further evidenced by Mike’s follow-up comment, indicating Mike interpreted Fabrice’s comment as playfulness, rather than a statement focused on doing mathematical work.

There was also social talk not related to tasks. This talk took any variety of idiosyncratic forms, talking about food, weekend plans, work, other courses, or other students. At times, such exchanges may have helped build camaraderie in the groups, but on the other hand, there were certain students who were most likely to engage in such exchanges, such as Fabrice. Thus, one might also view his participation here as a way to engage in a social exchange rather than focusing on the mathematics at hand.

Fabrice frequently engaged in these types of interactions, particularly with his group member Candace. Based on one of the instructor’s interactions with these groups over the semester, it appeared that Fabrice was often attempting to flirt with Candace, perhaps expressing a romantic interest in her. Such episodes often came up in subtle ways, particularly in social talk that was not related to the task at hand. Here is an example from the same group, later on working on the same task.

1. Fabrice: You're too funny (to Candace).
2. Candace: What?
3. Fabrice: I don't know.
4. Candace: I am?
5. Fabrice: You crack people up. This square's messed up. I ruined it. Are you breaking class rules now? [referring to Candace using her phone]
6. Candace: That wasn't in the syllabus. I'm just saying.

Here the conversation continues for another 35 lines, talking about the approved use of cell phones in another course. Much of this conversation happened in parallel to a conversation between the two other students in the group that was focused on completing the task at hand. Taken over the course of the semester, it was clear that Fabrice’s social goals, dominated any meaningful mathematical contributions that he may have made.

Discussion

This paper extends research on off-topic talk in a number of ways. First, it focuses on an upper-division undergraduate mathematics course and shows that off-topic talk is still ubiquitous at this level. When it came to whole-class discussions, evidently students were well aware of what the expectations were, because the talk was almost all on topic. Yet, 35% of their time in small groups was spent focused on goals other than related to the instructor’s ideas for the task at hand. Whole class and small group are different social situations that require different interactions. When students do interact in whole class, it is generally from a more distanced, impersonal perspective. In contrast, for students to work together with their peers in small groups, it is more important for them to build positive social relationships (e.g., Gholson, 2015). Short of explicit team-building activities (which were not present in this course), “off topic” talk provides such a venue for building those relationships. Although our focal classroom was in mathematics, the results should speak to STEM disciplines more broadly. After all, social belonging is critical for students in science as well as mathematics (Lewis et al., 2016).

Second, we draw attention to the ways that students used off-topic talk to pursue a variety of intellectual, vocational, and social goals during this time. Indeed, it is noteworthy that students often used this time to better understand the content, even if it was not the content that the instructor wanted them to focus on at the time. Still, this contradicts positioning of all of this talk as not related to learning. We follow the lead of others (e.g., Gholson 2015; Hand, 2010) to argue that this talk indeed does play an important role for the students in the classroom. Building these relationships can support the students both as STEM students working together and as they aspire to their future careers, as teachers, for instance. In our own data, we found evidence that such talk could help form social bonds (supporting groupwork), or it could be used to negatively position students, which would marginalize their participation (cf. Cohen & Lotan, 1997). One might ask what the relevant importance of on-topic and off-topic is for student learning and relationship building, which is an interesting question for future research.

Regardless of an instructor's intention, this paper highlights that students will pursue a variety of goals in the classroom space. We believe that many of these can be quite productive, such as better understanding the content or supporting career aspirations. Still, these discussions may conflict with a productive classroom, as students may not engage with the task at hand, instead working on a problem from a prior class. There are also more pernicious uses of this talk, as students may negatively position one another in problematic ways. We noted some potential differences in off-topic talk for men and women but given our small sample we cannot draw strong conclusions. This is an area worthy of follow-up in future research.

What are the implications for instruction? A clear takeaway is that instruction benefits from a variety of modes: partner work, small groups, and whole class discussions. The type of talk that occurs in these venues, so providing productive opportunities for students to engage in different ways is likely to support better engagement. Moreover, tools like a gallery walk, think-pair-share, or other scripted discourse moves can help students engage in a particular way, rather than only in free-flowing discourse.

Given the need for students to build strong social relationships, instructors might also think more explicitly how to do this. Students will likely engage in social talk regardless of what the instructor does, but they may also do so to fill a gap in what the standard instructional space is creating for them. By explicitly setting aside time for developing norms and team building, an instructor may indicate to students that this is valued, and it may shift the interactions that take place during mathematical "work time." The impact of such moves on classroom discourse is a useful area for future study.

A final implication is the types of tasks used. In particular, when students were bored or found the tasks too difficult, one avenue was to engage in other types of talk, so that they could have a productive activity. Even if they were not able to make progress on the mathematical task, they were able to make progress in their social relationships with their peers. In this way, how students engage in social talk can be seen as a marker of what they perceive as a meaningful way to engage with the classroom space.

In sum, we argue that the goal should not be for an instructor to eliminate all social talk. Indeed, a classroom focused only on "business" seems like a sterile an uninviting environment, one that would likely push students away from STEM. Given that students have certain social needs, and social talk can be meaningful in different ways, rather, we argue that instructors should be particularly intentional about how they build community within their classrooms in ways that support their students to engage in productive and fulfilling ways.

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