

Co-Construction of Course-Taking Narratives in Undergraduate Mathematics Advising

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This study explores a mathematics department's advising process for incoming, first-year undergraduate students. Through the analysis of video-recorded advising sessions, the interactional dynamics of an undergraduate mathematics advising program are explored. In particular, we describe how student-advisor interactions co-construct students' course-taking narratives in ways that shape their mathematical opportunities.

Keywords: Advising, Discourse Analysis, Gender

Introduction

Mathematics coursework plays a crucial role for undergraduate students as a prerequisite for many programs of study, particularly in STEM fields. The continued underrepresentation of women in mathematically demanding STEM fields (Watt et al., 2017) has been attributed to attrition of women at various points between participation in early education and persistence in STEM careers (Blickenstaff, 2005). While research has linked women's attrition from the STEM pipeline to a variety of causes such as discrimination, societal gender inequality, gendered differences in academic interests, and differential high school academic preparation (Watt et al., 2017, p. 255), it has rarely demonstrated how these factors operate to impact academic and career choices for individual women at the timescale of moments (i.e., seconds to minutes). In this paper, we explore mathematics advising for incoming undergraduates as an undertheorized site of attrition along the STEM pipeline and illustrate how interactions at a small timescale can shape students' mathematical trajectories. Although we do not extend our analysis to examine the influence of gendered discourses or gender performances, we see this work as a necessary first step to learning more about the experience of women moving through the STEM pipeline. Our preliminary analysis of the impact of gender performance can be found in the poster sessions for this conference.

The Context of Mathematics Advising

Academic advising serves a critical purpose in the process of welcoming new undergraduates to the complex system of course offerings and institutional requirements at any university. While academic advising programs serve similar purposes across universities, they are uniquely structured to fit the needs of a particular institutional context. We use the term *mathematics advising* to describe academic advising programs for incoming undergraduates and offered by mathematics departments for the sole purpose of guiding students toward a decision about which mathematics course(s) to register for.

The mathematics advising sessions we examine take place over a very short timescale (five to ten minutes) and occur between an advisor and student who have no knowledge of each other. In this brief interaction, the advisor needs to learn something about the student and provide relevant information about available courses. At the same time, the student must share something about themselves and gather the information they deem relevant to the decision-making process. Course registration typically occurs within days of the advising session, so students have limited opportunities to seek out additional information or support before making a decision.

Mathematics Advising as Genre

We take a discursive approach in which written representations of advising sessions (transcripts) are thought of as *texts* that fit within a particular *genre*. The genre of a text is defined as “a staged, goal-oriented social process” (Martin & Rose, 2003, p. 7), meaning that instantiations of a particular genre generally follow the same steps to accomplish a specific goal and are enacted in social contexts. The genre of a text, and the stages that comprise that genre, constrain the range of discursive acts that are possible (or likely) to occur at various points within the text. Genre analysis provides a way of justifying the reader’s context-specific interpretations of discursive acts within a text. For example, the question *What do you think?* can be interpreted as referring to what the student is considering for an academic major or for a math course depending on when in the advising session it is spoken.

The genre of *mathematics advising* follows a particular logic in the pursuit of a clear goal. Namely, the purpose of an advising session in this study’s context is for the student to decide which course they will register for. To accomplish this goal, the advisor and student engage in a conversation that consists of three stages: Opening, Deliberation, and Closing. In the Opening, the advisor solicits information from the student about their prior mathematics experiences as well as academic and career goals. During the Deliberation, the advisor and student evaluate available course offerings in relation to the information shared during the Opening. Finally, the student and advisor arrive at a consensus during the Closing. The outcome of a mathematics advising session is an informal agreement between the advisor and student about which math course(s) the student will register for.

Mathematics Advising by Co-Constructing Narratives

We conceptualize mathematics advising sessions as sites in which the student and advisor co-construct a narrative about the set of courses that are appropriate for the student to take. The goal of a mathematics advising session is for the student to decide which math course to take, given the set of options made available by this co-constructed narrative. The act of registering for courses can then function as a collapse of students’ potential mathematical futures, particularly when they elect not to take a math course or to take a course that will not support their entry into a mathematically demanding field of study.

Stories told about the self by oneself are likely to have the most immediate impact on an individual’s actions (Sfard & Prusak, 2005). The stories that students tell about themselves during the math advising sessions that we observed are particularly likely to have an impact on their actions because students registered for classes within a day or two of their math advising sessions. Given that the explicit goal of advising sessions is to influence students’ action with respect to course registration, the stories that students tell about themselves in this context are very likely to influence their mathematical trajectories. Although students are narrating stories about themselves, they are doing so through interaction with an advisor. Advisors may ask questions that surface aspects of a student’s narrative that wouldn’t have otherwise entered the discursive space. Even seemingly innocuous utterances have the potential to shift the way a student’s narrative unfolds. In this study, we are trying to learn how the advisor-student interactions shape the narratives about students’ mathematical potentialities by influencing their actions with respect to course registration.

Theoretical Framework

Following Sfard and Prusak (2005), we take a narrative theory of identity that equates “identities with stories about persons” (p. 14), told by the self or others, each of which can exist

simultaneously and change dynamically in response to contextual factors. In this view, the discursive construction of narratives comprise the identity of an individual rather than functioning as a window into some “true” sense of self that is represented by the narratives. Not all narratives about an individual count as identities, however. Sfard and Prusak (2005) define identities as collections of stories about a person that are *reifying* (they describe properties of the individual), *endorsable* (the narrator believes the story to be a faithful reflection of how things are in the world), and *significant* (changing some aspect of the story is likely to impact the narrator’s feelings about the identified person). Identity-narratives are important in the context of mathematics advising because the goal of each session is to determine which course, out of a large number of options, is most appropriate for the students given who they are. In our conceptualization, *who the student is* is the collection of stories about the student that have been co-constructed within the advising session. In this study, we focus on the mechanisms through which students and advisors co-construct reifying narratives about the student during mathematics advising sessions.

Narratives have reifying qualities when utterances are about *being* or *having* (e.g., *I am a mathematician* or *I have a math brain*) rather than *doing* (e.g., *I do math*). Sfard and Prusak (2005) identify use of the *is*-sentence (e.g., *she is an able student*) as a particularly effective mechanism for reifying identity because it turns “properties of actions into properties of actors” (p. 16). In addition, they note that identity narratives can be analyzed for reifying qualities by looking for “verbs such as *be*, *have*, or *can* rather than *do*, and with the adverbs *always*, *never*, *usually*, and so forth, that stress repetitiveness of action” (p. 16). Additionally, given that the context of the interaction is an advising meeting where the information provided by the student is used to set an academic trajectory, sentences utilizing sensing processes like *love*, *hate*, and *want* also result in the reification of identities. For example, the statement *I hate math* functions like *I am not a person who likes math* which is a *being* process.

Given the potential impact of the reifying narratives co-constructed in mathematics advising sessions, this study seeks to address the following questions:

1. How are reifying narratives co-constructed through student-advisor interactions in mathematics advising sessions?
2. How do reifying narratives shape students’ mathematical opportunities?

Method

Context & Participants

This study is part of a larger project exploring the mathematics advising program situated across three sites at Midwestern University (a pseudonym): the general student body in the liberal arts college, the honors program in the liberal arts college, and the engineering school. The participants included mathematics advisors consisting of faculty, lecturers, postdoctoral fellows, and doctoral students in the mathematics department, as well as incoming undergraduates. The data was collected over several weeks at these sites during the summer of 2019. In this study, we narrow our focus to examine 32 advising sessions from the honors program conducted by one man and one woman advisor.

Data Sources

The data corpus for the larger project consists of several sources: video-recordings of 100 advising sessions across six advisors at three sites, 100 web-based surveys from undergraduate students after their advising session, 1 video-recording and fieldnotes of the training session, and

4 audio-recordings of interviews with mathematics advisors after the advising sessions. For this study, we draw on video-recordings of the advising sessions as well as transcriptions constructed by our research team (Hammersley, 2010).

Analysis of the Co-Construction of Reifying Narratives

After applying stage and timeline codes to each transcript, we looked at the student's turns of talk and marked instances where reifying narratives were being constructed. In particular, we looked for markers of reification such as the first person equivalents of *is*-sentences, *I am* and *I was*; use of verbs such as *be*, *have*, or *can*; adverbs that stress repetitiveness of action such as *always*, *never*, and *usually*; and sentences utilizing sensing processes like *love*, *hate*, and *want*. After marking the reifying narratives constructed through the student's talk, we looked at the advisor's talk preceding each instance of reification to determine what the narrative was in response to. Looking ahead from each instance of reification, we created memos about how the advisor's talk took up (or did not take up) aspects of the student's narratives. For each session, we generated a diagram depicting the co-construction of narratives and indicated whether each utterance was a bid to move the student toward or away from mathematics coursework. Lastly, each session was placed in a two-dimensional matrix based on whether the student and advisor co-construction was cooperative (both moving toward or both moving away from math) or competing (moving in opposite directions), and whether the student was ultimately moved toward or away from mathematics.

Researcher Positionality

This analysis was carried out by a multi-ethnic, multi-racial (Black, White, and Latinx) research team, who identify as women. Each team member has an academic background in mathematics and is now focused on mathematics education. We use Black feminist perspectives to acknowledge the relationships between gender, race, and class within this analysis and draw on our own experiences as women working in and through mathematics spaces to inform our questions and interpretations of the data. Therefore, gender and gendered dynamics are taken as ubiquitous within social interactions and, thus, ground our analytical focus for the present study.

Preliminary Analysis & Discussion

Given constraints on space, we present an excerpt from one transcript and the accompanying diagram in Table 1. In the diagram, circles represent reifying narratives spoken by the student and squares represent responses to, and elicitation of, reifying narratives by the advisor. Arrows pointing left indicate narratives that move the student away from math, and arrows to the right represent narratives that move the student toward math. Shading is used to track particular narratives; white indicates *I plan to be a psychology major*, light gray indicates *I plan to take a math course*, and dark gray indicates *I plan to take a statistics course*.

In this session, the student repeatedly states that she enjoys math and would like to take calculus. The advisor, taking up the narrative of the student as a psychology major, repeatedly points out that math is not required and points the student toward statistics courses as more relevant. The student ultimately concedes that she may not take a calculus course, so we characterized this session as Away From Math. The co-construction in this session was classified as Competing to reflect the push and pull between the student's narrative of mathematical interest and the advisor's narrative of mathematics not being necessary.

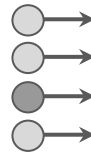
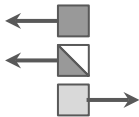
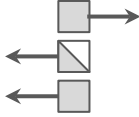
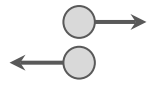
<u>Text</u>	<u>Narrative</u>	<u>Diagram</u>
Advisor: Well you don't need any math for psychology. Did you want to take a math class or do you want to avoid math?	Psych majors don't need math Do you want to avoid math?	
Student: I did. I– I do enjoy math even though it's not really a part of psychology, but I still really enjoy math . Like I am thinking of taking statistics , but I wanted to. I'm thinking also of including calculus if I have enough room for it.	I enjoy math. I really enjoy math. I'm thinking of taking statistics. I'm thinking about taking calc.	
Advisor: So stats and math are two different departments here and I agree that if you're going into psych you're probably gonna have to take some stats and that's probably more relevant. But if you want to take math that certainly. (I encourage you to do that).	Stats isn't math. Stats is more relevant for psych. If you want to take math, I encourage that.	
Student: Yeah, I really enjoy it . [...]	I really enjoy math.	
Advisor: [your AP score] means that you don't have to take calc one. So if you're going to take calculus, it would make sense to start with calc two. But you don't need that for psych. So, th- the only reason you should take calculus is if you really want to take more calculus.	You placed into Calc 2 You don't need Calc 2 for psych The only reason to take Calc 2 is if you really want to take more calc.	
Student: Okay. Yeah. I- I'm pretty interested in taking it , but I think I'm actually going to talk to my advisor first	I'm pretty interested in taking calc I may not take calc	
Advisor: I think that makes sense.	Not taking calc might make sense	

Figure 1. A transcript excerpt from a math advising session, reifying narratives, and diagram of co-constructed narratives.

This preliminary analysis included eight (of 32) randomly selected sessions from the honors college. Of those sessions, three were characterized as Cooperative/Toward Math and one was characterized as a Competing/Toward Math. All four of those sessions were with students who identify as men. Of the four sessions characterized as Away From Math, one was Cooperative (with a Woman student) and the other three were Competing (two women and one man). Although we expect to find variability as we analyze more sessions, it is notable that all three randomly selected sessions that have women students featured co-constructed narratives that moved these women away from further mathematics study. While there are many reasons for women to not pursue the study of advanced mathematics, that decision has long-term implications for the range of academic majors and careers that remain viable options. The results of this study illustrate how interactions at the timescale of seconds and minutes can impact the mathematical trajectories of students and act as a site of attrition for women in STEM.

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