Social Positioning Newcomer Roles on a High School Robotics Team: A Chronotopic Micro-Analysis

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Abstract: This paper uses a chronotopic analysis to map newcomer positioning and its effect on roles for an urban high school robotics team. Comparing three distinct episodes shows that with imminent competition, the case's newcomer positioning changes, deprivileging her learning through a rejection of any chronotopic contributions. In practice, the newcomer's role is crafted by posing choices she can make in the imagined future of competition through chronotopic co-construction.

Purpose

Robotics teams are typically viewed as places where youth engage in science and engineering practices in authentic ways (Puvirajah, et al., 2012). As Basu, Barton, Clairmont, and Locke (2009) argue social positioning is an important way to view STEM learning opportunities. A robotics team is one such opportunity where students opt to participate much like the informal contexts studied by others (Nasir & Cooks, 2008; Ma & Munter, 2014). The purpose of this paper is to explore the produced social spaces within one robotics team in an urban high school to better understand how one newcomer is positioned in three situations over two competition seasons. The question for this study is: In the semi-formal learning environment of this robotics team, how is one newcomer afforded participation in learning opportunities as she takes on an important role on the team over her first two competition seasons?

Theoretical framework: A chronotopic approach

Chronotopes are a dialogic unit, which theoretically acknowledges the "inseparability of time and space," according to Bakhtin (1981). This, framed in a sociocultural view of human development (Vygotsky, 1980), means that participants in the social world bring to interactions interpretations of past-space, present-space, and imagined future-space, to contribute. This study uses the chronotope as a unit of analysis to build an understanding of how social actors collaboratively position each other in interactions as part of a community like Engineering Robotics. Such an analysis provides a view on how power structures are produced

Positioning is an "interactional, social practice" (Leander, 2004, p. 210) that builds a converging community understanding of power by crafting different roles and the members of the community that belong in them. A learner's position, or place in relation to power and possible action within a social space, effects what and how they learn. Exploring the chronotopes participants bring to an interaction is an underused way to analyze learner positioning. Leander (2002; 2004) argues that social interactions can be viewed as the co-creation of chronotopes, building on Bakhtin's concept; participants in an interaction bring together different chronotopes to collectively construct social life. Chronotopes, in this view, are interpretations of space-time shared and constructed together in an unfolding interaction. Foucault (1995) argues that power is enacted in a distributed way, through interactional discourse by participants who collectively discipline each other. Therefore, chronotopic analysis allows us to analyze power roles crafted in a learning community and make sense of how power is enacted in a distributed way in social practice.

Modes of inquiry

Engineering Robotics is housed at Engineering High School, a Title 1 school that serves a majority black and Latinx students from a midsized Northeastern city. All team members and mentors featured in this research are black, Latinx or southeast Asian. The participating coach is a white man, as am I. All participants are referred to by pseudonyms in Table 1 and throughout this paper. Episodes for this study span two competition years.

Table 1: EHS Robotics Club participant list

Name:	Major Position/Duties	Grades During the study	Year #s on Team
Denisse	Robot Driver	9th and 10th	1st and 2nd
Ave	Coding and Robot wiring	12th (mentor next year)	1st
Jav	Robot Designer, Builder and Machine Shop	10th and 11th	2nd and 3rd

Eliza	Captain, Fundraising leader, robot operator	11th and 12th	2nd and 3rd
JF	Coach and Engineering teacher	Teacher	3rd and 4th year as Coach
John	Mentor/ Driving coach	Alumnus/ Undergraduate 4	2nd year as mentor;

Influenced by Interaction Analysis (Jordon & Henderson, 1995) I focused on taping the Engineering Robotics team in action, while they designed the robot, practiced driving the robot, and participated in competition. My goal was to capture a viewpoint of the participants' experience together. I chose what to record in an emergent way deciding where learning was happening in the moment, influenced by Goldman-Segall's (1998) digital video ethnography.

Denisse, a female Black and Latina 9th grader (during the first year of the study) and newcomer to EHS' robotics team is the focus of this paper. She becomes the driver of the robot at competitions in her first year on the team. For this paper, I analyzed three episodes of team interactions to analyze the social patterns that result in her positioning in the role of the driver. These particular episodes occurred during instances of practice and competition over two seasons. Influenced by Sewell's (2004) definition of culture as continually contested, I selected the episodes for this study in relation to a cursory understanding of interactional patterns. I choose two episodes that somewhat match the typical patterns and one that is a contradiction. Video data was analyzed in the tradition of Interaction Analysis (Jordan and Henderson, 1995; Hall & Stevens, 2015).

In the first video clip selected, Denisse wears the GoPro on her head as she drives a practice robot around the workshop. She eventually practices picking up and shooting a large ball at the practice goal. After Ave troubleshoots a connection issue with the robot, he gives her the controller and comments on her driving. In the second video clip, the drive team is standing with their robot discussing the competition just behind the field minutes before their first match of the season. Ave, Jav, and John are all standing near the robot, trying to re-teach Denisse the controls; Ave changed them that morning with the consent of the coach but without telling or consulting Denisse. In the third clip, Denisse and Eliza practice driving the robot in the shop during the second year of the study. In a different driving configuration than the year before, Denisse controls the motion of the robot with a large joystick and Eliza controls the mechanical motion of the robot. This video clip focuses on their interaction with John, and me (the researcher) as they practice and discuss strategy for moving around the game map. The clip takes place before the team's second competition and exemplifies different positioning practices.

Analysis

A focus on chronotopic contributions to an interaction shines the analytic light on how participants bring different interpretations of past space-time and perspectives on the future space-time to collaboratively create present interaction. According to Leander (2004) a "lamination" occurs when these contributions become part of the interaction and are collaboratively positioned. In the case of this study, chronotope laminations locally construct the development of Denisse's role as the driver on the team and the power that comes with it.

Episode 1: Becoming the driver

In the shop during practice, Ave and JF, the coach, laminate non-present chronotopes to collectively define Denisse's role and construct their view of the choices she could make as a driver. Once Denisse gets to use the controller, she beings by shooting the ball the robot holds at a high goal. Ave then challenges a choice she makes:

1. **The Robot**: ((shooter motor starts))
2. **Ave:** You didn't do the sequence
3. **Denisse:** I don't care.
4. **Ave:** Its' too late now.

In line 2, Ave refers directly to the current choice that Denisse makes, not to use the programed shooting sequence with the push of a button but to manually turn on the shooting motor and drop the ball into the shooter. Denisse counters with "I don't care" (line 3), laminating the chronotope with Ave's contribution that positions her as the driver with decision making power in the future. Later in the practice session JF, the coach, asks her to justify why she was shooting from a certain distance, "why so far back," a reference to a past-chronotope. After some discussion, he uses her input to adjust the shooter. Both of these interactions show the influence of past and future chronotope laminations. They position Denisse with power as a decision-maker in the role of the driver; they incubate her development of agency in that role.

Episode 2: A controlled driver

Minutes before their first match at their first competition of the year, Ave reviews the new driving controls for Denisse on the Xbox controller while Jav and John look on. Two important moments in this interaction chain highlight the way Jav, Ave, Denisse, and John position Denisse's role as the driver. After showing Denisse the new controls, Ave places the controller in the middle of their interaction formation towards Jav and her. Jav grabs the controller as both he and Denisse reach for it (see Figure 1) and says, "Alright so run it through me" handing it to her. Paired with Jav's words the grabbing gesture physically embodies the denial of Denisse's chronotopic contribution to the interaction and her positioning as driver. It shifts the interaction to one between Denisse and Jav. Just after, Denisse challenges the button change she is just hearing about. John, the driving mentor, joins the interaction:

Figure 1. Controller Grab.

1. **Denisse:** I thought it was Y ((looks at Ave))
2. **Jav:** No we changed ((looks to John))
3. **John:** You gotta learn it again. Forget what you know.

Denisse brings a chronotope contribution citing the past-space of the robot and her practice (line 1) where the control was Y. Her attempted lamination is disregarded with "we changed." Further, John's utterance rejects any past or future space-time contribution, bringing to bear a narrative where only the present matters.

Episode 3: Learning role of being a driver

In this clip, John is visiting the shop about a year after the clip from episode 1 and 2 took place. He discusses strategy with me (the researcher), Denisse and Eliza, as the two of them practice driving and operating that year's robot. Particularly, he tries to share with Denisse that she should drive backways when bringing a gear back from the other side of the competition field to complete one of the objectives of the game for points.

1. **Researcher:** Most people want to do it that way. Right? [Drive forward all the time]
2. **John:** Yeah that's a normal condition thing. Most people wanna do it that way anyway
3. **John:** You shouldn't have to.
4. **Researcher:** [to Denisse] He's saying try backing up. So trying grabbing it ((the gear)) and then just backing up and dropping the gear.
5. **Denisse:** Oh I can do that.
6. **John:** Exactly. But you don't do that.
7. **Denisse:** I don't?
8. **John:** You haven't been.

John refers to two distinct space-times to position Denisse as a driver with decision making power, while still trying to persuade her that driving backwards can help her accomplish the task faster with the robot. First, he refers to an imagined future-space of the competition with "you shouldn't have to [drive forward]' (line 3). This laminates a chronotope that positions Denisse with a decision of how to drive in competition. Then, he juxtaposes the future chronotope with an interpretation of past space-times, "you don't" (line 6) and "you haven't been" (line 8). Therefore, in trying to get her to practice a specific technique, he argues for its possibility in an imagined future, and then argues that she has not used it at all in his interpretation of past space-time of the earlier competition. Both become laminations which collaboratively position Denisse as a decision-making driver showing a choice she makes in the role of the driver.

Discussion

In episode 1 and episode 3 which are a year apart, different members of the interaction bring past and future chronotopes to bear on the interaction which are them laminated, co-constructing the role of Denisse as a decision-making driver. Both collaboratives episodes shine the light on decisions she has the agency to make as the driver: using the sequence (episode 1) and driving backwards (episode 3). These moments show the dialogic nature of the robotics club where members "live in the chronotope" (Bakhtin, 1981) actively participating in the construction of Denisse's driver role together embracing different viewpoints. Denisse's development in this role is privileged. In the competition episode, all chronotopic contributions are rejected by the participants except Denisse. This constructs a social narrative consistent with what Bakhtin (1981) calls "adventure time" whereby time and space are separated, and all historical and possible futures are disregarded for a focus on the emerging present. Leander (2002) argues that this typically occurs in institutional spaces such as classrooms, or "classroom

adventure time." Here, the social interactions framed in adventure time privileges the imminent competition and deprivileges Denisse's learning, positioning her as a controlled driver who operates the robot as she is told where to go and what to do. Denisse's disciplining deprivileges her expertise and disrupts her ability to develop a deeper sense of how the robot drives. This severely limits her ability to develop as a driver during competition.

This comparison, taken in a lens of Foucault's micropower (1995), portrays a view of the social mechanics of how Denisse's role is collectively disciplined. The differing access to power may be driven by perceptions of her race, as an identifying Black and Latina youth, and/or her gender, as a young woman in a male gendered space. Further analysis is necessary from a feminist and anti-racist lens to consider the reasoning. Yet, the difference between the two types of episodes, practicing episodes (1 & 3) and a competition episode (2), over two seasons of the Engineering Robotics' paints a picture of how imminent competition may influence newcomers positioning and how roles are disciplined as acts of power. It also begs the question, does competition typically influence learning communities like this to reject the dialogic nature of chronotope co-construction and craft a narrative in adventure time?

Significance

This work points to a specific instance where a STEM learning opportunity with competition as a leading activity limited a newcomer's development, disciplining her out of an active role in competition time. From a sociocultural perspective of participation's relationship to learning (Rogoff, et al. 2003), we must embrace learning possibilities that focus on competitions dialogically positioning learning as a leading goal and focusing on the roles it creates.

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