

Gaining power and shaping space through helping in introductory physics classes

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In physics classrooms, like in society writ large, power is embedded in *space*—both material space and actors’ conceptions of space. In this paper, we explore space and power through the lens of “helping.” Using our analysis of a classroom video clip and excerpts from stimulated recall interviews, we offer a case where “helping” mediates spatiality, reifying a hierarchy where some students are positioned as “knowing more” or “doing better” and others are thought of as “knowing less” or “not ‘doing it’ right.” We connect this dynamic to age-old narratives of “helping” that are embedded in white supremacy to critically examine ways “helping” can be oppressive. Analyses like this open up possibilities for re-imagining physics classroom spaces, toward more just and equitable physics teaching and learning.

I. INTRODUCTION

A major goal of physics education research is to increase diversity, equity, and inclusion in physics classrooms [1–3]. Our project approaches this goal by using classroom video and student interview data to understand how *power shapes space* in introductory physics classrooms. By space, we mean material space—e.g., the arrangement of tables and chairs—and conceptions of space—e.g., how participants think about and take up (or don't) space, as well as how these choices are shaped by power. As an example, school policymakers determine neighborhood boundaries that delineate who attends a particular school. Over time, “attendance zones” reproduce neighborhood segregation by race and class, shaping the opportunities specific groups of students are afforded (or not) [4]. In other words, power becomes embedded in space through decisions about who should go where. These decisions reinforce and reproduce white supremacy and other power-laden ideologies in the *here* (space) and *now* (time).

We extend this understanding of the relationship between space and power to the physics classroom. Frequently in our data—both in classroom video and in stimulated recall interviews [5]—students act and narrate themselves as “helpers.” We observe these students moderating group dynamics by setting pace, monitoring their peers’ learning, explaining content, and controlling the use of supplies (e.g., lab materials). The “helper” typically assumes this role without being asked or invited. Importantly, this act of “helping” sets up a non-negotiated power dynamic between students, which we argue is always spatially situated. That is, some people are thought to “know more” or “be better” and others are thought to “know less” or “not be ‘doing it’ right”—and are “placed” in the classroom accordingly.

We argue that this particular form of “helping” is one way in which white supremacy *mediates* space, by shaping (i) how dominant actors take up space, therefore (ii) shaping the space itself. As we will show, students who narrate themselves as “helpers” enter and leave the discussion space with ease, and students who are narrated as “being helped” appear to move into and out of the space *around* the contributions of the “helpers.”

We acknowledge that unpacking this relationship requires a lengthier engagement beyond the limits of this paper; we offer this start as an introduction into the theoretical landscape of spatial justice and its relationship to physics classroom dynamics.

II. LITERATURE & THEORY

Core to our claim is a theory of space and spatiality where space is more than concrete, mappable “locales”—the

background in which our lives occur. In this theory, our everyday actions produce a consequential geography, which shape a range of possibilities for everyday life. To understand injustice, then, requires an unpacking of historical socio-spatial processes that constitute geographies of the present [6], especially in the classroom where spatial dynamics allow and disallow for particular actions. Seawright defines spatiality as a “pre-existing relation to place that guides [actors’] extension into social space based on their prior experiences in place” [7]. It is also a responsiveness to “the *orientation* of the social space...and the normative behavioral expectations of said place” [7]. For example, imagine the simplified scenario of a student in their first quarter of an introductory physics sequence. Throughout this class, this student has been repeatedly affirmed for asking questions, particularly when their instructor has perceived them to be seeking clarification of a concept. Their instructor chooses them before or in place of others when their hand is raised and invites them to ask follow-up questions. We might say that this treatment has constructed a (now) pre-existing relation to the physics classroom that would guide how this student extends themselves into that space (e.g., asking clarifying questions when things feel unclear), and this extension is then a part of the *spatiality* of the physics classroom for this student. Another student—one who has not been chosen to ask questions even when their hand has been raised, or whose questions have not been affirmed as relevant—may instead be guided by the space to *suppress* their extension into it.

What whiteness scholars add to this simplified example is an analysis of power, what Seawright calls a “racialized temporality” [7]. If “spatiality speaks to one’s capacity to extend the self into social space,” racialized temporalities guide social choreography “through the inequitable possibility for action” [7]. This “social choreography”—an interactional dance—both (i) *creates the here* (space) and the *now* (time of interactions), and (ii) is *drawn out* of actors in response to a sense of what is expected of them in that space. These expectations are informed by an embodied history: “how a body has repeatedly and sequentially been (mis)treated and (un)acknowledged in particular situations,” which is itself shaped by white supremacy [7].

Because white supremacy “fills” space and time, the possibilities for action for white bodies exceed those for Bodies of Color¹. Ahmed argues that whiteness is an *orientation* with an “ongoing and unfinished history;” everything feels “in [the right] place” when the space opens up the possibilities for white bodies to act, and when the space blocks the actions of People of Color [9]. This produces inequities in the ease and/or comfort that different bodies feel in particular spaces. Comfort, then, for white

¹We choose not to capitalize white and do choose to capitalize Black, Latinx, Indigenous, and Students or People of Color. This choice is informed by critical scholarship and activism, such as that by Dumas [8].

bodies, comes from their repeated extension into spaces “that have already taken their shape;” there is no resistance to that movement [9].

The opening up and/or foreclosing on possibilities for action unfolds as actors “intelligently respond to the subtle cues embedded in social space”—responses that “take little to no reflective thought” [7]. Just as our bodies know to duck when a ball is flying toward us, bodies also carry “pre-predicative racial knowledge of how...*to be* in particular spaces” [7]. This knowledge is informed by a history of interactions that establish our “ability to navigate social worlds” with some sense of anticipation of what might happen [7]. In this way, spaces *put our bodies to work*, even as we co-create the unfolding *here* and *now* of those spaces.

In this paper, we specifically argue that *helping* mediates and is mediated by the spatiality of introductory physics classrooms, putting dominant students’ bodies *to work* as helpers and minoritized students’ bodies *to work* as in need of help. “Helping” of this type is part of an age-old narrative. For example, residential schools were used to extinguish Indigenous cultures in the US and Canada. These “education programs” were justified as “conferring benefits of incalculable value on the Indian peoples” [10]. Because “Europeans possessed the Truth” [11] they were in a position to “help;” in fact, the logic was that they were *compelled* to help. Thus, all actions to this end were justified insofar as they were doing their part, as Pratt put it, to “kill the Indian and save the man” [12]. At the time, residential schools were advertised as charitable places that “sav[ed] the lives of children who would otherwise perish” if left in their communities marked by disease and poverty” [10]. Similar sentiments were also used to justify the enslavement of Africans. Early colonizers and pioneers of the Atlantic slave trade justified enslavement as “helpful” because African Americans “lacked the intelligence to participate in society and were more prone to disease, physical impairments and immoral behavior” [13]. Thus, they needed to be protected [13]. Contemporarily, the same logic is used in global charity work, mission trips, and what some refer to as the “white-savior complex” [14–16].

In the remainder of this paper, we argue that two introductory students, Zander and Natalie, are “made white” [7] by *becoming* helpers, shaping the space in ways that reify this narrative and thus reproduce white supremacy. We show that Zander and Natalie’s actions are supported by broader narratives that point to a history of being “repeatedly and sequentially” [7] acknowledged (and affirmed) as helpers in similar situations, and that therefore this physics classroom space, which calls for a certain kind of learning and progress, *draws helping out* of them. Likewise, though less central to our analysis, Sam and Mia (two other students in the group), are, in this case, made marginal by *being helped*.

III. METHODS

Data was collected by video recording two weeks of instruction in introductory physics classes at three colleges/universities and through stimulated recall interviews [5] with students who appeared in the videos. The episode presented here is from a community college that serves students from multiple racial, gender, and income groups, in addition to Running Start students [17], who choose to take college-level classes prior to graduating high school. The focal course integrated lab and lecture, and most days students alternated between (i) small group work using *Tutorials in Introductory Physics* [18] and (ii) lecture/class discussion. The groups were chosen by the instructor and switched often. All the students in the episode we analyze consented to be recorded.

After recording, our team watched the classroom video and selected multiple short (2-5 minute) episodes in which students appeared to be actively negotiating the classroom space, in some cases in ways that made apparent differences in power. We expected these episodes may serve as *cases* [19,20] that could support our broader aim of understanding how power is shaping space in physics classrooms. All the students who appeared in at least one selected episode were invited to participate in stimulated recall interviews.

Interviews were conducted virtually and lasted approximately one hour. The interview protocol was semi-structured and included general questions about students’ experience in their physics course in addition to stimulated recall questions about the episode(s) they were shown. For example, students were shown an episode and asked questions like: What is happening in this episode, from your perspective? Is this interaction typical or atypical? Is there anything about the participants’ personalities or identities that you think mattered for what happened here? Two of the four students who appear in the episode presented here chose to participate in interviews. This particular episode was selected based on shared analysis among research team members, where Seawright’s framework [7] guided sense-making about the “helping” behaviors exhibited by students.

IV. EPISODE CONTEXT & SUMMARY

A. Context

The episode presented here features four students (pseudonymed): Natalie, Zander, Sam, and Mia. Natalie (she/her) and Zander (he/him) are both white students, and Sam (he/him) and Mia (she/her) are both Students of Color. In the focal episode for this paper, they sit around a table (Figure 1) as they work through “A model for circuits Part 1” in the *Tutorials in Introductory Physics* workbook [18].

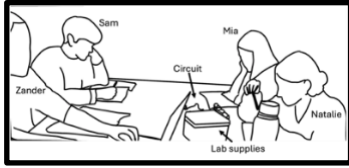


FIG. 1. Line drawing of the start of the video clip. A box of lab supplies sits in front of Natalie, and a circuit sits near the center of the table, slightly closer to Natalie than the other students.

During the class period leading up to the focal episode, Natalie is the primary person building the circuits for the group. At the start of the episode, the group is focused on the question: When you add more bulbs in series, does the total resistance of the circuit increase, decrease, or stay the same?

B. Summary

At the start of the episode, Natalie looks up from her work to check with the group: “Ummm, it [adding bulbs in series] would increase the total resistance, right?” No one responds for several seconds, until Sam asks, “It would stay the same, wouldn’t it?” Natalie and Sam talk to one another, sharing ideas. During this exchange, Natalie shifts her gaze toward Zander, and we speculate that she is seeking his attention. Zander then enters the exchange, interrupting Sam to apologize for not engaging because he has a headache; he says that things are “not computing.” Sam then continues his explanation, leaning across the table and pointing at the bulbs with his pencil as he explains his answer.

Natalie acknowledges Sam explanation—“Ohh, that’s what you were thinking”—and proceeds to reiterate her own explanation while pointing to the bulbs: “I was thinking more like this...” Throughout the exchange between Sam and Natalie, Mia has been quiet, pencil in hand, staring at the circuit. A few sentences into Natalie’s reiteration, Sam says “Ohh” in agreement. A beat later, Zander speaks up and everyone’s gaze turns towards him. He uses his hands to gesture as though he is laying an argument out on the table, saying: “We’re talking about the total resistance, right?” He doesn’t wait for a response, but continues, “Individually all the resistances are the same, obviously, but we’re adding more things with a resistance to the system, so the total goes up, right?” As Zander continues to talk, Sam shifts his gaze back to the circuit, Natalie focuses on Zander, and Mia glances between the circuit and Zander. Natalie then agrees with Zander: “That’s what I said, yeah.” Zander and Natalie continue to co-construct an explanation and Sam says: “I get it. I get it.”

Zander—leaning back and now off screen—asks if they are “all on the same page.” Sam doesn’t reply but starts writing in his *Tutorial* book. Natalie says, “I think so,” and turns to Mia who is looking at the circuit and her *Tutorial* book, but not writing anything down. Natalie asks Mia: “Do you get it?” Mia continues to look her book, not responding. After a few seconds, Natalie asks: “What are you confused about?” Mia continues to look down and very quietly starts to speak: “Soo...” but trails off. Natalie then begins an

explanation—“Here, okay...”—as she gathers the materials to demonstrate. At this point, Sam is focussed on his own *Tutorial* book, writing, and Zander leans in and watches Natalie and Mia. Mia stays focused on her *Tutorial* book and doesn’t make eye contact with Natalie. Natalie uses the lab materials as she narrates—“If you add a light bulb...” Something isn’t working quite right with the light bulbs and she mutters more to herself, “Nope, they’re not all hooked up...” checking the connections before realizing, “Oh, they are...They are just really dim...” She continues her explanation to Mia, stopping occasionally to look at her, and keeps talking until she has reached her conclusion: “Which means it’s increasing the resistance because you need more power to light it up at the same brightness.” Mia says “okay” and nods, returning to her book. Natalie nods back and then starts to deconstruct the circuit she built.

V. ANALYSIS: SPATIALITY AND HELPING

In analyzing the data, we go beyond illustrating how these students shape the space, to illustrate how the way they each take up space is *drawn out* in response to a sense of what is expected of them in that space. In particular, we argue that the classroom space is oriented to open up possibilities for action for Zander and Natalie through positioning them as “helpers.”

For example, Zander uses gestures that sweep through space as he talks, simultaneously taking up material and discursive space and Natalie is the only student who manages the equipment throughout the interaction. Zander does not speak during the first part of the conversation but interjects without hesitation (e.g., interrupting Sam) and is given the floor without overt negotiation (e.g., the group physically re-orient around him when he speaks). Zander then remains in the space, leaning in and observing, while Natalie explains her answer to Mia. Natalie participates consistently throughout the clip; however, her role shifts as she interacts with different actors. She gives Zander her attention even when engaged with other students and cedes the conversation to him when he speaks up, whereas she dialogues with Sam, orienting him towards her ideas (“I was thinking this...”). With Mia, she does not dialogue or cede the conversation but explains her thinking. Sam speaks when invited by Natalie, but stops speaking when Zander enters the conversation, and stays quiet as the two of them discuss. In this way, Sam’s extension into the space appears to be limited and shaped by Natalie and Zander. For example, when they turn their focus toward “helping” Mia, Sam works independently in his workbook. Mia does not take up shared material or discursive space: she appears to be engaged (e.g., reading her *Tutorial* book with her pencil in hand, observing the lab materials as students point, and shifting her gaze between speakers), but she does not speak or interact directly with lab materials.

Seawright would argue that this “social choreography” is informed by a pre-existing relation to place that guides

actors' extension into social space, based on how their bodies have "repeatedly and sequentially been (mis)treated and (un)acknowledged in particular situations" [7]. That is, Natalie and Zander's extension into space is not only a product of the moment-to-moment unfolding of *this* interaction, but the *orientation* of the social space and their lifetime of embodied experiences within it. Drawing on Ahmed, whiteness is an *orientation* that informs our capacity to navigate the social world, putting our *bodies to work* to construct a space that opens up possibilities for white bodies to act and blocks the actions of People of Color [9]. In this episode, *helping* mediates spatiality by putting Natalie and Zander *to work* as helpers.

In fact, both Natalie and Zander narrated this interaction in terms of "helping." For example, Zander explained that he interjected because he could tell the "guy to his left" (Sam) and "the girl" (Mia) weren't "really up to speed" with where he and Natalie were. Similarly, he remained in the space, leaning in and watching Natalie explain her answer to Mia because he wanted to be helpful: he "was observing, just waiting to see where [he] could jump in if [he] noticed what [Mia] kind of got snagged on." Natalie narrated the interaction as part of a broader effort to be helpful. She described her early engagement as "trying to help explain the stuff" to Sam, and she said that she specifically "asked [Mia] if she understood" because she "could see [Mia] struggling and [Mia] was not the type of person to speak up and ask for help and [she] knew she didn't understand it." Here, Natalie and Zander make sense of the ways in which they inhabited this interaction—interjecting, watching, and explaining—through the lens of "helping."

Importantly, both Zander and Natalie narrated this extension into space as "typical" and appropriate, with Zander saying that he often "switches [his] brain from student, and like trying to figure out things, to teacher." He further described this helping role as "pretty natural for [him]," remarking that he usually "tend[s] to gravitate towards leader roles whether [he] want[s] to or not." Just as Zander described his taking on the role of helper as magnetic—something he is destined for or drawn to, whether he wants to or not—Natalie attributed the roles students take to "the kind of people" they are. She said that some people are the "type of people to like always ask questions during [Tutorial]" while others, like Mia, are "not the type of [people] to like speak up and ask for help."

Not only did Zander and Natalie naturalize certain people taking certain roles—with some as helpers and some being helped—they also made sense of these roles in terms of *what the physics classroom space requires*. Zander noted the importance of doing *Tutorials* efficiently, saying that he "want[s] everyone to be at a certain pace because otherwise [he doesn't] feel like they're gonna be learning as well." Natalie also described striking a balance in pace where they make "sure that [they] finish the *Tutorial* and everyone knows what they need to know." In these quotes, Zander and Natalie point to the ways in which space *puts their bodies to*

work, opening up possibilities for *certain* kinds of action by *certain* kinds of people. Zander and Natalie act reflexively in response to these openings, in service of recreating the space of a physics classroom and reifying the role of *helping*.

VI. IMPLICATIONS AND DISCUSSION

The relationship between "helping" and white supremacy has a long history in education, as noted earlier in the example of residential boarding schools. This history continues to shape schooling today, despite numerous interventions to deepen the "critical consciousness" of students and instructors about matters of inclusion and belonging, especially in STEM [7]. Using critical theories of space and spatiality [7,9] to illuminate *how* a helping relationship mediates classroom dynamics, we demonstrate through a case from our project that white supremacy is reproduced not only in the *minds* of classroom actors, but *through their bodies*. Repeated embodied (inter)actions give shape to a social choreography of power that puts dominant students' bodies *to work* as helpers and minoritized students' bodies *to work* as in need of help. In this way, helping, in this episode, is racialized and gendered.

Centering space and spatiality in physics education research opens up new questions and areas of inquiry in pursuit of a racially just physics classroom. Not only does it recognize the limits of "cognitive-centered" interventions, it considers how power is reproduced in "benevolent," ahistorical, and seemingly decontextualized acts. In a field that couches knowledge production as "neutral" and "objective," these acts become particularly insidious. How might physics education research advance its aims to increase diversity, equity, and inclusion by seriously considering the role of space and spatiality in the reproduction of white supremacy (and other forms of power) in classrooms?

Lastly, it is important to note that while we explore the oppressive relationship that conventionally exists between "helping" and power, we also believe that "helping" can operate toward more emancipatory ends, e.g., when situated within a spatiality that organizes around mutuality (rather than racial hierarchies). What might a *liberatory social choreography* look and feel like? How might educators create the conditions for such a (re)orientation?

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