# Examining Power Relations in an All-Girl Robotics Learning Environment

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**Abstract:** In this data session we present a vignette from a group of three girls working collaboratively to solve a robotics challenge. We introduce a novel approach to interaction analysis that coordinates multiple forms of data (video recordings, transcripts, and screen capture recordings) to understand how individuals negotiate opportunities to learn in small group activity. The CSCL issue addressed in this session is the role of power relationships in a seemingly *more* equitable technology learning settings.

**Keywords:** Robotics, Collaborative Problem Solving, Group Dynamics, Girls' Power Relationships, Interaction Analysis.

In this short paper, we describe a data session in which we present a short video vignette for interaction analysis (Jordan & Henderson, 1995) by a diverse, interdisciplinary group of scholars. The research context the video vignette was drawn from was a one-day long introduction to robotics workshop for girls, ages 8-13. Girls worked in groups of three to solve robotics challenges using EV3 Lego Robotics kits. All of the participants were working with robotics for the first time. The data collected includes audio and video data of collaborative problem solving activity from six groups of girls over the course of the day, as well as real-time recordings of the participants' computer programs as they created and revised them on provided laptops. The data excerpt is 2 minutes and 16 seconds long. In the excerpt a group of three girls (ages 11 -13) work to solve some First Lego League robotics challenges presented on a game board. The interaction begins at the game board and moves between diagnosing programming issues, planning and discussing solutions, revising the program using a laptop and finally to testing the new program. Each of the three group members are involved in the interactions. Our interest in presenting this excerpt regards group dynamics related to control of the material devices and how such control issues affects participation and opportunities to learn within the group.

## Social Status and Collaborative Learning

The success of small-group collaborations is dependent on the creation of a joint problem space (Roschelle & Teasley, 1995) in which members coordinate (1) a mutual understanding of the problem to be solved, and (2) the "interactional challenges and opportunities" (Barron, 2003, p.310) of relations between group members. Barron (2000) argued that such coordination can be achieved through three elements of interaction: shared task alignment, joint attention, and mutuality. Previous research suggests that aspects of social interaction affecting the level of a small group's coordination include competitiveness (Cohen, 1994; Mercer, 1996), cooperation or 'social harmony' (Anderson, Thomas, and Nashon, 2009), level of discourse (Cohen, 1994; Mercer, 1996; Webb, Nemer, Chizik & Sugrue, 1998), and the relative social status of individuals within the group (Cohen, 1994; Sullivan & Wilson, in press). Status has been shown in recent research to significantly affect individuals' negotiations for opportunities to participate in small group activities (Esmonde, 2009; Sullivan & Wilson), and is influenced by a range of sociocultural factors including gender, friendships, academic achievement (Anderson et al., 2009; Strough, Berg, & Meegan, 2001; Webb, et al., 1998), as well as the dominant knowledge domain in which group activity is taking place (Underwood, Underwood, & Wood, 2000). Boys' gender identification with technology, for instance, has been shown to negatively impact girls' participation in computer-based small group activities (Margolis, 2008). Status may also be used to position group members as more or less competent with the practices of the activity domain, and as such, a group's level of shared task alignment and mutuality in working on a problem may suffer (Esmonde). It is therefore critical for examinations of small group collaborative activities to consider how individuals position themselves, and how they are positioned by others, and how this influences negotiations over participation.

## Power Relations and the Materiality of Robotics Learning

The issue addressed in this session is the role of power relationships in seemingly *more* equitable technology learning settings. This issue is relevant to the CSCL community because the focus of our analysis is on the materiality of the robotic device and the laptop. We propose that the devices themselves are central to the robotics learning experience, and arguably, learning in robotics is learning how to work with, understand and manipulate the computational devices that instantiate the activity. In this way, the devices are objects of control, which have a direct affect on learning opportunities (Sullivan & Wilson, in press). Put simply, interaction with the computer-based materials is an important part of learning in the robotics context. If one does not have the chance to use these materials, one's opportunities to learn are foreclosed (Sullivan & Wilson). We are interested in understanding how power relations are formed and expressed in seemingly *more* equitable robotics learning environments and, specifically, the role of the technology in such power-laden interactions. In our previous work, we examined how power relations affected mixed gender groups (Sullivan & Wilson). In this latest project, our work focuses on single gender groups. In eliminating the competition and dominant behavior that may sometimes arise in a mixed gender group setting (Margolis, 2008; Underwood, Underwood & Wood, 2000), we sought to create a robotics learning environment that would offer opportunities to learn for all the participants, one which may be seen as "systemically equitable" from a gender perspective. What we found is that power relations were still relevant, and control of the devices was still an issue for the all-girl groups. This work seeks to understand how the power dynamics arose within the group and how they were negotiated vis-à-vis access to the technology.

## An Expanded Approach to Interaction Analysis and Transcription

In our session, we utilize a novel approach to interaction analysis that coordinates multiple forms of data (video recordings, transcripts, and screen capture recordings) to understand how individuals negotiate opportunities to learn in small group activity. This approach involves the segmentation of group interaction content logs into a timeline of microevents for closely analyzing our large corpus of video-recordings. For each of these microevents, we construct a rich description of interaction utilizing Barron's (2000) markers of high and low levels of coordination (shared task alignment, joint attention, and mutuality). From this microanalysis, we develop a narrative characterization of group coordination during the collaborative activity, including how the group's levels of coordination shifted through verbal interactions, and control of the robotics and programming equipment (for more on this method, see Sullivan & Wilson, in press).

In addition to our novel interaction analysis approach we are expanding the method of Jeffersonian transcription to include student actions upon the computer program (changes to their robotics program) undertaken during the problem solving interaction. We include this additional transcription in the chronological text of the transcript and we provide screen shots of student created robotics programs. This expansion of the method provides analysts with important additional information that bears on creating a more complete understanding of the learning interaction.

The expected outcome of this research study is a more nuanced understanding of how power relationships are negotiated in seemingly *more* equitable technology rich environments. Given the importance of collaborative learning in CSCL environments, it is crucial that educators and designers understand the multiple ways that inequitable circumstances can arise in student groups and to consider ways to create conditions that will mitigate the effects of such circumstances.

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