## The Discursive Construction of Learning School Mathematics

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Identity is becoming an increasingly important focus of mathematics education research. Most studies to date have focused on narrative accounts of students and have explored relationships between these and the learning of or engagement with mathematics. In this paper I examine identity on a more micro scale through the in-depth analysis of classroom interaction. Drawing from ethnomethodology, discursive psychology and positioning theory I use a conversation analytic approach to explore how the identities of mathematics teacher and mathematics student are co-constructed in interaction, and how these identities evolve in the interaction.

**Keywords: classroom interaction, conversation analysis, identity**

## Introduction

Identity is becoming an increasingly important focus of research, exploring predominantly students' engagement with mathematics, and more recently, students' learning of mathematics. The majority of studies within mathematics education have taken a narrative approach, interviewing students and teachers and exploring relationships between these reported identities and the students' engagement with and relationship with mathematics (see for example Sfard & Prusak (2005), Boaler & Greeno (2000), Cobb, Gresalfi, & Hodge (2009)). This narrative approach takes a macro view of identity, viewing it as relatively stable and persistent across times. Identity is something that students and teachers bring with them to the classroom and these identities develop in the interactions that occur. These studies have told us a great deal about the relationship between identity and engagement with mathematics but tell us little about how these identities develop in the moment-to-moment interactions that occur in mathematics classrooms.

In this paper I take an emic perspective to the analysis of identity drawing from the Conversation Analysis (CA) literature, which is widely used to explore issues around identity in health, gender, and legal studies. The approach has its origins in ethnomethodology and takes as its basic premise that social interactions are a continuous display of the participants' understandings of what is going on (Psathas, 1995). The focus of any analysis then examines how the participants demonstrate their understanding through how they design their turns in the interactions themselves, and in the case of identity, how the participants demonstrate their understanding of the particular features of particular identities.

Conversation analysis has developed out of the lectures of Harvey Sacks (1992) and the later work of Sacks and his colleagues Schegloff and Jefferson. It focuses on the tacit structures that create order and intersubjectivity in interactions through the sequential analysis of turns. These turns are reflexively related to the turns that come both before and after them and are specifically designed for the

participants in the interaction and are contingent upon the local and specific context of the interaction.

Analyses that draw upon a conversation analytic approach, such as those in discursive psychology (Edwards & Potter, 1992) or positioning theory (Harré and van Langenhove, 1999), focus on how identity is being used by participants in interactions to achieve particular goals. Some identities infer particular features such as the identity of teacher infers features such as expert, authority, and caring, but "not only do categories imply features, but features imply categories" (Antaki & Widdicombe, 1998, p.4). Therefore particular identities can be inferred from the structure and content of interactions. Identities often also come in reciprocal pairs. So if one participant orients to the identity of teacher, this positions the other participants as students (which they can either accept or resist). These identities are most clearly oriented in classrooms through the use of the IRF sequence (Initiation-Response-Feedback) (Mehan, 1979), the control of turn-taking and the control of topic (Richards, 2006). Interactions in the classroom depend upon all the participants having a shared understanding of the 'rights and obligations' (Sacks 1972, p.37) in relation to each other and these are the focus of the paper here as well as other studies such as the work of Cobb and colleagues (Cobb et al., 2009).

The analysis in this paper does not talk about who the participants are, or who they are perceived to be, but rather focuses on how people interact in terms of identities. It is not about saying Simon *is* a teacher or Sam *thinks* Simon is a teacher but instead is about Sam *treating* Simon as a teacher. Identity is considered to be dynamic, fluid and situated (Wood, 2013). It is multifaceted and co-constructed in interactions and has consequences on the interactions that follow. Identity in this sense is indexical to the interaction in which it is constituted.

**Data**

The transcript examined in this paper comes from a collection of 22 video recordings of mathematics lessons. The data is considered to be naturally occurring in that the classroom interactions would have occurred anyway without the researcher being present and is also seen as "containing everything relevant for analysis" (Cameron, 2001, p.88). In any ethnomethodological approach such as the one adopted here, any assumptions about the relevance of particular identities such as female, white, student, are ignored unless an analysis of the sequential context demonstrates that the participants themselves draw upon these identities. When a researcher imposes their own categories of identity in any analysis, it is the researcher who is deciding which categories are relevant, and consequently not relevant, not the participants themselves (Schegloff, 1997). Consequently, few details are offered about the classes included in this study, except that they are all taught by experienced mathematics teachers and drawn from a range of schools in a range of contexts with a range of students aged between 12 and 14 years old. Each teacher used a variety of tasks and activities in their teaching but the analysis here focuses on teacher-led whole class discussions that occurred in these lessons. The teacher is referred to as male and the students as female in this paper for ease of reading, though this may not be the actual gender of the speaker, as gender is not made relevant by any of the participants in the interaction. The transcript uses the conventions developed and detailed by Jefferson (2004) and is widely adopted in CA research. The specific transcript used here is from a lesson focusing on the mean, mode, median and range and the class is

currently looking at a frequency table (of the number of days students were absent in a year) that is projected onto the whiteboard.

**Discussion**

In just these few turns of the interaction we can see that the participants are orienting to the identities of teacher and student. In line 1 the next speaker is specifically nominated by name, and at the end of the turn, and similarly in line 10. The speaker in line 4 and 13 is not specifically nominated to speak but takes the turn without delay or interruption. The speaker in turn 1 similarly controls the topic of what the speaker in line 2 can speak about. Another feature of the talk which shows the participants are orienting to the differing roles in terms of the turn taking is the use of pauses by the speakers. Simon pauses throughout his turns, both in the middle of sentences and at points where a change of speaker could be relevant (a Transition Relevance Place or TRP). However, during the pauses that occur at TRPs, no other participant speaks and the turn is retained by Simon. The two other speakers only take the turn when they have been nominated to take it. The other two speakers, Kieran and George, only pause in the middle of saying something and at the TRPs in their turns Simon begins speaking.

Kieran in line 2 phrases her turn as a question. This can be taken to mean that the student is uncertain in her answer (Rowland, 1995) but also indicates how the turn is designed within the framework of the IRF sequence that dominates classroom interactions. The turn that follows this students' response usually contains some sort of evaluation or feedback, implicitly or explicitly, and by phrasing the response as a question the student is mitigating any possible feedback that would indicate that there was a problem with the response, be that with the accuracy of the response or its form. This also serves to position the next speaker as the person to make the judgement as to the appropriateness of the response. This also treats the next speaker has having the authority and the knowledge needed to evaluate the response.

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1    Simon:   ↑u:::m (0.4) >go on then< Kieran
2    Kieran:  is the ra:::nge a hundred and seven- (.)
3             seventee::n
4    Simon:   range a hundred and seventeen (.) the
5             ra:::nge is the ↑biggest number (.) take
6             away the smallest number (.) the ↑biggest
7             number is a hundred and twenty fi:ve
8             (0.4) the ↑smallest number is eight, (.)
9             a ↑hundred and twenty fi:ve (.) take away
10            ↑eight (1.4) George?
11   George:  no cos the, (.) the range is gonna be in
12            days absent so it'll be (.) eight
13   Simon:   °a:::h° (.) re↑member Kieran (0.6) this
14            ↑table does ↑not have any numbers a
15            hundred and twenty five in there (0.4)
16            this ↑table only consists of (.) days
17            absent from zero (0.6) up to ↑eight,
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In lines 4 to 10 Simon exactly repeats the Kieran's response then adds an explanation for this response. By doing this, Simon is both demonstrating his

knowledge of the mathematics but also his interpretation of what Kieran has done in order to reach her answer of a hundred and seventeen. In this particular instance the answer Kieran has given is not correct, as indicated by George's turn in line 11 and Simon's turn in line 13. Therefore, Simon is demonstrating his knowledge of the mathematics but also his knowledge of the common errors students are likely to make in this mathematical context and therefore which specific numbers Kieran used to perform her calculation. Simon's turn in lines 4 to 10 does not explicitly state that there is problem with Kieran's turn but throughout he is emphasising the procedure to calculate the range, emphasising the words biggest and smallest throughout, and not emphasising the numbers then used in the calculation. Additionally, Simon does not move the topic on and initiate another IRF sequence in this turn and therefore closing down the IRF sequence he initiated in line 1, which would indicate that there is a problem with the response to his initiation. Instead, by nominating another speaker to take the next turn, Simon is giving the opportunity to another student to evaluate and/or correct the error in Kieran's turn. This positions George has having the knowledge to do this and George has indicated that she has this knowledge by raising her hand to bid for the next turn.

In lines 11-12, George firstly negatively evaluates the answer one hundred and seventeen given by Kieran and repeated by Simon before explaining what the range is in this context, and consequently indicating what was wrong with Kieran's response, before giving a new answer of eight. The positioning of the pauses, and absence of particular pauses, in George's turn allows her to offer both an explanation and an answer as there is no pause between these two parts that could be interpreted as a TRP. George's explanation also explicitly references the specific context of the initial question, drawing attention to the interpretation of the range in this context and not to the procedure of calculating the range. This demonstrates that George does not only know how to calculate the range using the procedure given in Simon's turn, but also she knows how to apply this procedure to the particular context given in the question.

Simon's final turn in lines 13-17 begins with a change-in-state token (Heritage, 1984), "ah". This token indicates that something has been remembered or that something has now made sense, rather than that there has been a knowledge exchange. The information that George offers is not new to Simon but does acknowledge that the information is new to the interaction and changes the state of knowledge in the interaction. It is at this point that Simon explicitly points out the problem with Kieran's turn, referencing both the incorrect numbers used by Kieran in the calculation and the context referred to by George. The emphasis is on Kieran remembering, positioning Kieran as someone who has the knowledge but has not remembered it in this situation. This also positions Simon as someone who knows that Kieran has this knowledge. The remembering focuses on the interpretation of the table rather than the calculation of the range. Whilst the number one hundred and twenty five does appear in the frequency column of the table, Simon's turn focuses on the interpretation of the meaning of the numbers in the table and the values of the categories rather than the frequencies. In doing so, Simon reiterates the context of dealing with the number of days absent but also provides the numbers that George used in her calculation of the range in the turn before. The calculation or procedure for calculating the range is not mentioned.

In this short transcript it is evident that the participants are orienting to the roles of teacher and students. However, each of the participants is treated as knowledgeable by the others. Even when Kieran gave an incorrect response, Simon treated him as having the required knowledge, and in particular the knowledge for

calculating the range and identified the difficulty as remembering how to interpret a frequency table, not not knowing how to interpret a frequency table. Simon also treats both students as capable of reasoning in that he infers the reasoning that Kieran did in her turn and accepts the reasoning that George offered in her turn. The job of explaining is an interesting feature of this interaction. Both Simon and George offer explanations in their turns, but neither position the other participants as someone with the role of explaining. Whilst the role of explainer is often inferred from the position of teacher, it is only part of the role of a student in particular mathematics classrooms with particular ways of working (Boaler & Greeno, 2000; Cobb et al., 2009). It is notable that George offers her explanation before her answer and without any opportunities for a turn to be taken by the teacher until the end of her turn. George positions herself as someone who can explain but this is not endorsed by the teacher who does not directly build on George's explanation in his own.

**Conclusion**

This paper focuses on one short transcript from a teacher-led whole class discussion. As such, it can only offer a limited insight into how identities can be constructed and oriented to in mathematics lessons. However, the analysis here illustrates not only that the participants use the identities of teacher and student, but also how this is achieved. In particular, how the different features of these identities are oriented to and co-constructed through the interaction.

Whilst earlier studies tell us a great deal about the relationship between different teaching styles and the students' identities in respect to mathematics, these studies do not explain individual variation in these identities or how the particular teaching styles affect students' identities. As the analysis in this paper demonstrates, the identities of mathematics teacher and mathematics student are shifting in interaction, and how these shifts affect what the role of student of mathematics entails. This approach to the micro-analysis of identity offers a means for exploring how students might develop particular identities and both the teachers' and the students' roles in this development. This may then used by teachers and teacher educators to develop a more nuanced understanding of the complexity of learning mathematics, leading to the possibility of enhancing mathematical learning in the classroom.

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**Transcript notation**

| | |
|---|---|
| (.) | Indicates a gap of less than 3 tenths of a second |
| (0.7) | Pause timed in tenths of a second |
| . | Falling intonation |
| , | Continuing intonation |
| ? | Rising intonation (not necessarily a question) |
| °word° | Talk quieter than surrounding talk |
| ↑word | Marked variation in pitch in the following word/syllable |
| wo::rd | Lengthening stretch of the sound, number of colons indicates length |
| >word< | Talk much faster than surrounding talk |
| <u>wo</u>rd | Stressed syllable |