

Dependency and Objectification in a Year 7 Mathematics Classroom: Insights from Sociolinguistics

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This paper examines how the activities, discourse, and artefacts in a mathematics classroom may serve to position students as dependents or to objectify them, rather than encouraging the development of subjectivity by apprenticing them into the valued discourse of the mathematics classroom. The paper uses three sociolinguistic approaches to interpret the interactions between Simon, the teacher, and Dean, a student, in a Year 7 mathematics classroom. Although they have very different goals and methodologies, each approach has the potential to reveal the social function of language in a mathematics classroom.

Introduction: Sociolinguistics

Sociolinguistics is the study of language in society. It asks questions such as why we speak differently in different social contexts, how language can be used to serve social functions, and how language is used to convey meaning. It focuses on issues such as gender, race, social class, power relations, and identity through looking at language choice and variations (Holmes, 1992). Although it is not possible in this short paper to do justice to the huge field of sociolinguistics, nor to any one of the three approaches described, the different sociolinguistic lenses used illustrate the potential of sociolinguistics as a tool for examining interactions in the mathematics classroom.

Critical Discourse Analysis (Fairclough, 1992)

Fairclough (1992) considers discourse as a mode of action in which people act on the world and each other, in addition to being a mode of representation. He stresses that there is a dialectic relationship between discourse and social structure, with discourse on the one hand being constrained by social structure, and on the other being socially constitutive. He sketches a three-dimensional framework for conceiving of and analysing discourse, considering “every discursive event as being simultaneously a piece of text, an instance of discursive practice and an instance of social practice” (p. 4).

The first dimension is discourse-as-text, i.e., the linguistic features and organization of concrete instances of discourse. Building on the work of Halliday (1978), Fairclough maintains that text analysis must include a consideration of vocabulary, grammar, cohesion, and text structure. Halliday describes the ideational function of language, which may be material processes, mental processes, or relational processes. This function is revealed by examining the field of the text and by looking at the use of active or passive voice and at the use of verbs such as “think” or “do”. Aspects of language such as cohesion and the use of given/new structures are important in describing its textual function.

Fairclough’s second dimension is discourse-as-discursive-practice, i.e. discourse as something that is produced, distributed, and consumed in society. He introduces the concepts of “force” to describe what the text is being used to do socially, “coherence” to describe the extent to which an interpreting subject is able to infer meaningful relationships

and to make sense of the text as a whole, and “intertextuality” to describe how texts are related historically to other texts. The tenor and mode of the text, indicated through the use of personal pronouns and the degree of certainty conveyed by verbs, adverbs, or adjectives, reveals the interpersonal function of language.

Fairclough’s third dimension is discourse-as-social-practice, drawing on the Marxist concepts of ideology and hegemony. He claims that ideology is located both in the structure of discourse and in the discourse events themselves. For example, he suggests that the turn-taking practice of a typical classroom implies particular ideological assumptions about the social identities of and relationships between teacher and pupils. Hegemony concerns power that is achieved through constructing alliances and integrating groups. Dominant groups exercise power through integrating rather than dominating subordinate groups, winning their consent, and establishing a “precarious equilibrium”.

Morgan (2005) uses Halliday’s (1978) systemic functional linguistics to explore the notion of definition within two school mathematics texts, one written for advanced students and one for intermediate students. Her analysis reveals that in the higher level text students are included in the community of mathematicians through the use of passive voice, a focus on relations rather than materials processes and through reduced modality, which allows for alternative ways of thinking about ideas.

Thornton and Reynolds (2006) use critical discourse analysis to examine one mathematics classroom in which students argue over the effect of changing the value of a in the graph of $y = ax + b$, suggesting that the discursive norms in the classroom led to heightened levels of personal agency. They conclude that a discourse that is exploratory, tentative and invitational, that contains emergent and unanticipated sequences, and that recognises alternative ideas even ones that are strange, enables students to see themselves as active participants in learning, having power over both the mathematics and the discursive practices of the classroom.

Symbolic Control and Cultural Reproduction (Bernstein, 1990)

Bernstein (1990) discusses what he terms the pedagogic device, considering the distributive rules, recontextualising rules, and rules of evaluation. The pedagogic device is the object of struggle for control, played out within a particular arena. Activities within that arena create pedagogic modalities or generating codes, which have strong or weak values and classificatory or framing functions.

Classification refers to the degree of insulation between categories of discourse, agents, practices, and contexts, and provides recognition rules for both transmitters and acquirers. It is concerned primarily with power. Where school mathematics focuses on the development of skills and concepts such as fractions or algebra it is strongly classified, as it maintains strong boundaries between mathematics and the outside world. Strong classification legitimises and reproduces power relations, whereas weak classification will challenge the boundaries upon which the division of labour is based. Framing refers to the location of control over the selection, organization, sequencing, pacing, and criteria of the communication. Strong framing locates control with the transmitter, whereas weak framing locates it more with the acquirer.

Bernstein distinguishes between voice, which is a function of classification, and message, which is a function of framing. Voice refers to the limits of a category’s legitimate communicative potential; it is what can be said or realised if the identity is to be seen as legitimate within the arena. Message is what is actually said and its form of

contextual realisation. It is dependent both on voice and its potential instrument of change. The principle of the social division of labour necessarily limits the realisation of its practices, yet these practices also contain the possibility of change in the social division of labour.

Bernstein calls pedagogic discourse, the process of moving a practice from its original site to a new site, a process of recontextualisation. Within this process values and ideologies always play a part, thus particular classroom practices produce behaviours that legitimate or disrupt what might be considered appropriate knowing. He distinguishes between instructional discourse, which transmits specialised competencies, and their relation to each other, and regulative discourse, which creates order, relation, and identity.

Lerman and Tsatsaroni (1998) use Bernstein's ideas to look at the systemic failure of certain categories of pupil to engage with the pedagogic processes through which the pedagogic text is produced, acquired, and assessed. They conclude that the forms of school knowledge constructed by certain values of classification and framing will produce different recognition and realisation rules to different categories of students, such as those from different social classes.

Dowling (1998), building on the ideas of Bernstein, describes a "social activity theory", which he uses to analyse mathematical texts written for pupils categorised as of high or low ability. He concludes that the texts written for pupils of high ability invite these pupils into the valued discourse of school mathematics as apprentices, whereas those written for pupils of low ability cast them as dependents.

Evans, Morgan, and Tsatsaroni (2006) describe the link between discursive positioning and emotion in school mathematics. Drawing on Bernstein's concepts of classification and framing in pedagogic discourse, they analyse how the discourse of the classroom makes alternative positions available to students. They describe these contrasting positions as evaluator and evaluated, helper and seeker of help, collaborator and solitary worker, leader and follower, insider and outsider.

Ideology in Discourses (Gee, 1991)

Gee (1991) maintains that ideology underlies all human interactions and their use of language. He states that there are two major motivations underlying all uses of language: status and solidarity. All uses of language situate the speaker and hearer within fields of status and solidarity, which are inherent social goods to humans. Thus all language is always and everywhere ideological, containing and transmitting beliefs, values, and attitudes. It is spoken and written out of a particular social identity.

Gee discusses the notion of a Discourse, a combination of saying, doing, believing, valuing, and being. He distinguishes this notion of a Discourse from discourse, which is a connected stretch of language. A Discourse, for Gee, is an identity kit, coming complete with rules and resources on how to talk and act in order to take on a social role that others recognise. Discourses are effectively clubs with tacit rules about who is a member and who is not, and about how members ought to behave.

Gee distinguishes between acquisition, which is a process of acquiring something subconsciously by exposure to models, trial and error, and social practice, and learning, a process that involves conscious knowledge gained through teaching or conscious reflection. He maintains that Discourses can only be mastered through acquisition, not learning. However learning can facilitate the development of meta-knowledge, but only when the process of acquisition has begun. Gee argues that classrooms that do not properly

balance acquisition and learning simply privilege those students who have begun the acquisition process at home and marginalise those who have not.

More recently Gee (2003) has analysed the structure and learning principles inherent in video games, identifying principles related to the semiotic domain, to learning and identity, to situational meaning, to telling and doing, to cultural models, and to the social mind. Learning principles such as low cost failure, strong identities, amplification of input, just-in-time information, and belonging to an affinity group, are all inherent in the structure of video games and lead to acquisition of a Discourse.

Thornton (2006) uses Gee's notion of Discourse to discuss the potential mismatch between students' "first space" (Moje, Ciechanowski, Kramer, Ellis, Carrillo, & Collazo, 2004), the historically and culturally accumulated funds of knowledge and skills that enable people to function effectively as individuals and in society, and the "second space" of the mathematics classroom, the valued knowledge and academic norms of the formal school environment. He suggests that rather than seeing the mismatch between first and second spaces as a problem, both students' home and community funds of knowledge and their school funds of knowledge should be seen as a resource through which to empower them as effective learners in the school situation.

Context of this Research and Data Collection

The research reported in this paper arose from a study (Thornton, 2006) that originally set out to examine high school students' funds of knowledge (Moll, Amanti, Neff, & Gonzalez, 1992) in mathematics. In an endeavour to obtain data relating to these funds of knowledge, eight case study students were given digital voice recorders and asked to reflect on any issues they felt strongly about, particularly as these issues affected their learning and participation in school mathematics lessons. The digital recordings were saved onto a secure computer, and then transcribed. Unfortunately the students in the study seldom used the recorders, often forgot to bring them to school so that the recordings could be downloaded and, with one exception, provided only one or two sentence recordings that merely stated the topic of the mathematics lesson.

To obtain data relating to second space, mathematics lessons were observed in each of three Year 7 classes at the school. Field notes were taken and transcribed as soon as possible after the lesson. Interviews with individual students and groups were then conducted, using the lesson observations as a stimulus for discussion. These interviews were recorded and transcribed.

Due to the difficulties of obtaining voice recordings that might illuminate the students' funds of knowledge, the original research became a pilot study, informing further research. This paper uses a portion of the data from the original research. Rather than using qualitative data analysis software or coding systems to study the data, extracts from the field notes and interviews are used to illustrate the potential contribution of sociolinguists to understanding how students are positioned and position themselves in the classroom.

Results

The data below are arranged in five stanzas, representing different activities during two lessons I observed. Stanzas 1 to 3 are taken from a lesson related to converting from 12 to 24 hour time, and differing time zones. Stanzas 4 and 5 are taken from a lesson introducing percentages a few weeks later in the year. The focus of the observations was on the

interaction between the teacher, Simon, and one student, Dean. Rather than providing a transcript of a whole lesson I have selected extracts typical of the interactions between Simon and Dean. I spoke with Dean after the lessons to obtain his impressions of various incidents.

The class is a Year 7 class in a middle- to low-socioeconomic area of a capital city. It is a mixed ability class containing eleven girls and fourteen boys. The teacher in the study, Simon, is a young teacher who has been at the school for 3 years. He is trained in science, physical education, and mathematics, and teaches the Year 7 class for both science and mathematics. The case study student discussed in the paper, Dean, comes from a single parent family. He lives with his mother, but visits his father interstate. He frequently has a “blue card”, which he takes to lessons and asks teachers to sign to report on his behaviour and participation. During the time I spent at the school it was not unusual to see Dean being brought to the year level coordinator for disciplinary action. Dean scored relatively low marks in the school’s tests of mental computation.

Stanza 1: Cajoling and resisting. Simon handed the students a worksheet, explaining that it was revision for a forthcoming test on time.

Simon: Dean, get on with your work so you won’t be staying in.

At this stage Dean had not picked up his pen to start the questions on the worksheet, and did not do so for a further 10 minutes. Fifteen minutes into the lesson Dean walked over to another boy, Matthew, to look at the picture on the wall behind him.

Simon: Dean, if you don’t do your work, you will do it at lunch time.

Stanza 2: Helping and receiving.

Simon: Dean, sit up in your chair and I’ll give you a hand.

Simon sat next to Dean, who responded to a question about 24-hour time. He nodded his head as Simon counted 12, 1pm, 2pm, 3pm, etc. Simon sat next to Dean for about 5 minutes, writing answers on Dean’s worksheet.

Simon: Can you do the rest?

Dean: Yeah.

Stanza 3: Questioning and responding.

Simon: Class, face the front. We’re gonna go through the answers to page 60 first.

Simon asked selected students by name, in rapid succession, to read out their answers to the worksheet. The students responded with single word or number answers.

Simon: What’s the difference between the two planes, Dean?

James: 45 minutes.

Dean: 45 minutes.

Simon did not respond to Dean’s answer and moved on to the next question.

Stanza 4: Eliciting and contributing.

Simon: Where might you have seen percentages?

James: At the shops where they have a discount. For example, a 20% off sale.

Dean: Biscuits are 97% fat free.

Mark: Home loan ads. Interest is 8%.

Simon: What do they mean?

Dean: I don't care.
 Simon: Taking 20% off, what does that mean?
 Dean: 100% is full price. 50% is half price.
 Simon: What might 20% mean?
 Dean: A little less than 50%.
 James: 0.2.
 Simon: What sort of fraction might 20% be?
 Mark: $\frac{1}{4}$.
 James: That's 25%.
 Simon: What do you think 97% fat free means?
 Dean: That's only 3% fat.

Stanza 5: Summarising and copying. Following the above exchange Simon wrote notes on the whiteboard (Figure 1), and told the students to copy the notes into their books.

Percentages
Percentages are used all the time in the world around you – discounts, home loans, bank interest, etc.
The term “percent” literally means “per hundred” or simply “out of a hundred”.
This means that when you see a percentage e.g. 30%, you can write it as a fraction by taking the number in front of the % sign and putting it as a fraction over 100.

$$30\% = \frac{30}{100}$$

E.g.

$$5\% = \frac{5}{100}$$

Figure 1: Text on whiteboard.

Discussion

The discussion below is neither a systematic unpacking of the observations line by line, nor is it a rigorous analysis of the data using a particular sociolinguistic perspective. Rather it is a discussion of the data using insights from each of the perspectives discussed above.

Stanza 1: Cajoling and resisting. Stanza 1 is a struggle for control. The appellation “Dean” at the beginning of each of Simon’s statements presents a strong message about power relations. Dean uses subjunctive clauses, “get ... so” and “if ... you will”. In doing so he locates responsibility with Dean, rather than with himself, suggesting that staying in is a natural consequence of responding inappropriately to work. In neither sentence does Simon use the personal pronoun “I”, thus he locates himself as impartially present to fulfil his role of ensuring that the students do their work. The respective roles of the speaker and listener are thus made very clear. It is Simon’s role to set work and Dean’s job to “do it”.

The verbs “get” and “do” have strong modality. They are concerned with material, rather than mental processes. It is not the purpose of mathematics classrooms to think or understand, but rather to “do”. These verbs, together with the use of appellation present a strong social message. These discursive practices construct students as doers, not as learners or contributors. Simon exercises power through domination, sitting behind an

ideology of work/test and the hegemonic assumption that if students do their work they will perform better in their test.

Simon's language and action is characterised by strong classification and framing. The situation does not permit alternative agents, practices, or contexts, thus the power relations are maintained through a clear division of labour between the teacher and students. Selection, organisation, and pacing are controlled by the teacher, who requires a given amount of work to be covered in a given time. At the same time Dean resists this control, setting up a situation marked by struggle. Simon's attempts to reproduce culture through pedagogic devices such as threat are ineffective.

The stanza illustrates a clash of Discourses. Simon's primary Discourse is one of school as a place in which students do work and teachers make sure that it is done. His solidarity is with students in the classroom who ascribe to his beliefs and values about schooling. Dean takes on the role of resistor, maintaining solidarity with Matthew rather than Simon.

Stanza 2: Helping and receiving. In stanza 2 Simon constructs a tenuous alliance with Dean. His physical positioning next to Dean suggests solidarity with a student who struggles to do the work. Dean nods while Simon writes on his page, suggesting at least a partial acceptance of this alliance. Rather than using subjunctive clauses that suggest staying in at lunch time as a logical consequence of not doing work, Simon uses the phrase "sit down ... and". Simon uses the personal pronoun "I", suggesting that helping is a personal choice and that he is choosing to express solidarity with Dean's situation rather than an adversarial position of forcing Dean to stay in. Simon's use of the phrase "give you a hand" reinforces this expressed choice and solidarity. In this way Simon's conversation foregrounds a relational process.

Yet at the same time Simon continues to use the word "do", promoting mathematics as a material rather than a mental process. By audibly counting 12, 1pm, 2pm, he attempts to introduce Dean to the Discourse of school mathematics, yet he stresses a procedure rather than a relation. Dean is expected to become part of this Discourse by learning rather than by acquisition. Simon asks Dean if he can "do" the rest, to which Dean rapidly responds "Yeah". Gee (1991) calls this an example of "mushfaking", making do with a partial understanding through learning, rather than entering legitimately into the Discourse.

In this exchange Simon uses a distributing strategy which constructs Dean as a dependent¹. By spending 5 minutes with Dean and by writing on his page he limits Dean's potential response to one of agreement with what Simon writes. There is no potential for Dean to realise his own voice. Simon maintains strong classification in that he maintains clear boundaries between his role and Dean's.

Stanza 3: Questioning and responding. This stanza is characterised by extremely strong classification and framing. Simon permits only single word or number answers to questions, and only those that relate to the questions on the worksheet. By rapidly asking questions of selected students in the class he is maintaining control over pacing. Voice is strictly limited, and the messaging strategies construct students as receivers. Simon selects only the boys at the back of the room, including Dean, and one girl as candidates to answer

¹ I asked Dean in a subsequent conversation if he could do the worksheet, and how often he needed help. He said he could do them now, but that he "always needed help in maths".

questions. In this way he was using the question and response technique as a regulatory discourse, rather than as an instructional discourse.²

In this stanza Simon is maintaining a hegemony of mathematics as being about correct answers. The pattern of response constructs the teacher as the arbiter of that correctness. He maintains strong boundaries between the roles of the teacher and the students, using appellation to add force to the discourse. Simon foregrounds the material process of getting correct answers, rather than a mental process of understanding. His use of the verb “go through” implies that correctness is a destination to be reached rather than a process of understanding.

The strategy of singling out students by name introduces high cost failure to the exchange. Unlike video games in which players learn through failure and can recommence at the point of “death”, the students cannot redeem themselves. Dean reduces the risk of failure by repeating an answer given by James.

Stanza 4: Eliciting and contributing. Stanza 4 is the only stanza in which classification is weakened. Simon asks students to draw on their primary Discourse to suggest everyday situations in which percentages are used. In this way he weakens the boundary marking what is permitted as legitimate content in the mathematics lesson, allowing the students a measure of power. However he maintains tight control of the pacing and sequencing of the discourse. At no stage do more than three students take turns to speak, and in almost every other case each student utterance is a direct response to a question asked by Simon.

The discourse is marked by limited coherence. The three consecutive student utterances are disconnected examples of the use of percentages. With the exception of Simon’s follow-up questions on the meaning of 20% off and 97% fat free, there are no given/new structures in the discourse. Although Simon asks for the meaning of these phrases, students provide only simple answers.

Simon’s use of the verb “mean” suggests that the discourse focuses on mental, rather than material processes. In the initial question he uses the verb “see”, which implies awareness rather than action. Simon’s conversation in this stanza is marked by significantly reduced modality. He uses the word “might” three times, and asks students what they “think”. In this way he permits a level of uncertainty and allows an apparent element of choice in how they answer. However the students make a succession of confident statements, and seem unable or unwilling to embrace that uncertainty or to exercise that choice. Dean’s statement “I don’t care” expresses his unwillingness to engage in a mental process. It is significant that this is the only example of a student using the personal pronoun in an utterance, again suggesting that students in the class are focused on the material process of giving answers rather than on mental processes such as thinking, which are more likely to be expressed using the personal pronoun I.

In this stanza Simon foregrounds students’ primary Discourse of the real world. By linking mathematics and the real world he attempts to increase intertextuality and thus to construct an alliance with students, recruiting them into the Discourse of school

² I asked Dean why he thought Simon only asked the boys at the back questions, and especially why he asked Dean. He said it was because Simon knew he understood the work because he had helped him, so it was a strategy to give him confidence. I also asked Kath why she was the only girl to whom Simon had asked a question. She said it was to make sure she was paying attention, because she was often disruptive in class. My observation of Kath suggested that, unlike Dean, she was able to play the game of school by “switching on and off” at will.

mathematics. In contrast to students' knowledge of the world, the Discourse of school mathematics remains learned rather than acquired³. The concept of 20% as a fraction is an isolated piece of knowledge, unconnected to James' initial observation about a 20% sale as a use of percentages.

Stanza 5: Summarising and copying. In stanza 5 Simon recontextualises everyday language into the formal symbols of mathematics. The possibility for change afforded by the weakened classification of stanza 4 is not realised. The messaging strategy of text privileges a particular form of knowledge and expression. The structure of the text valorises mathematical understanding as being on a higher plane than everyday language, propagating what Dowling (1998) terms the “myth of reference”.

The text contains strong modality. Simon writes phrases such as “all the time” and “when(ever) you see” and adverbs such as “literally”, implying that the text contains universal truth. He uses verbs such as “write”, “take” and “put” as actions that “you” do. This use of personal active voice is in stark contrast to the impersonal “this” or the noun “percent” that precede the verb “means”. Meaning is thus cast as inherent in mathematics, but the role of the learner is to do things.

The use of the word “simply” makes a strong statement about the relative positions of students in relation to teachers or to mathematics itself. It suggests that the word “per” requires recontextualisation to become “out of”. Thus students are cast as being incapable of accessing the strongly classified discourse of school mathematics.

The structure of the text reinforces a hegemony that casts teachers as authors and students as copiers. The bold heading “percentages” draws attention to the presumed importance of the notes, giving them priority over student generated text. The everyday context is quickly replaced by mathematical symbols, reinforcing the priority of the academic over the everyday. The message is that reading notes will promote true understanding. Whether the teacher writing notes and students copying is an act of instructional or regulative discourse is open to question.

Conclusions

The above discussion draws on ideas from three sociolinguistic frameworks to look at some episodes in two mathematics lessons. The discussion is neither rigorous nor systematic, but paints a vivid picture of the struggle between the teacher, Simon, and one student, Dean, in the arena of a mathematics classroom.

Critical discourse analysis shows a precarious equilibrium, with Simon alternately wielding power over Dean and constructing an uneasy alliance with him. Throughout the interchanges Simon emphasises mathematics as being a material rather than a mental process, in which correct answers are more valuable than thinking. The discursive practice casts the teacher as instigator and the students as responders. Classroom practices such as question and answer and writing notes are unquestioningly accepted by both the teacher and students as being an integral part of school mathematics.

The classroom interchanges are generally marked by strong classification and framing. Simon permits only certain content and allows students a limited voice in the classroom. He maintains tight control over the sequencing, pacing and evaluation of the activities of

³ I later asked Dean how he knew so much about percentages and how he knew that 97% fat free meant 3% fat. He said that he hadn't learned it, he had just “picked it up”.

the classroom, using what appear to be instructional practices as regulatory devices. He valorises mathematics over the everyday, recontextualising intuitive knowledge into formal symbols, thus placing student knowledge as of lesser value than teacher knowledge.

Students are invited or cajoled to learn the valued Discourse of school mathematics, rather than being permitted opportunities to acquire it. Within the classroom both the teacher and students take on clearly defined roles as members of a particular group. Yet this is also the site of struggle as Dean resists and expresses solidarity with another student rather than with the teacher. This resistance is also apparent when Dean claims that he “doesn’t care”.

Throughout the exchanges Simon objectifies the students as little more than producers of work and objectifies mathematics as little more than something to be done. Students are positioned as dependent on the teacher, and their own knowledge is positioned as subservient to mathematics. In turn, Dean casts himself as a dependent in the classroom.

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