(the reader, in this case) who can "fit a graph model to a set of data" and "can use it to make predictions". It is the sentence with the generalized doer that the teacher is most interested in, as it makes the point that the purpose of a graph model is to enable predictions to be made. Introduced with "once" construing the conditions under which predictions can be made, it is this sentence that makes the more general point about the purpose of utilizing a graph model. But without having the general nature of this point highlighted and put into focus, the students do not grasp the point.

As we see in the ensuing discussion, the word "prediction" never comes up again. The teacher repeats the definition of graph model that points out that the graph model can be a "straight line or a curve", but without specific attention to the possibility of a curve, this never becomes salient to the students. When we look at the *being* processes in the text, we see that the linear nature of the pattern is what gets repeated again and again, with a focus on the line: "the pattern looked somewhat linear"; "This line is a good model for the relationship; the points on the line are close to points from the experiment"; "The line […] is a graph model for their data". The students' understanding of what the graph model is useful for remains focused on the linear relationships apparent in the particular examples of their own and the Maryland class's work.

When Abram offers, in line 27, that the purpose is "to show the linear relationship", the teacher adopts an unassertive and non-authoritative stance in responding. He accepts Abram's contribution ("yeah"), but suggests that the linear nature of the relationship could be seen even without the graph model, from just examining the plotted points. He does not mark this as a view that is contrasted with Abram's, however (we can imagine a "but" after the "yeah" although this is not expressed). But the teacher is clearly not satisfied with Abram's answer and goes back to his question, which Abram has now obviously not answered correctly, "Why did I draw the line in?", again wanting the students to focus on the purpose. When Christy's contribution also does not focus on the predictive nature of the graph model, the teacher unenthusiastically accepts her contribution ("well, maybe that's part of it") and then refocuses students on the definition again. His redirection of the students' attention back to the definition shows that the students have not answered in the way he wants them to.

While the teacher may not have been able, in that moment, to recognize why the students were unable to answer his question about the purpose of the activity, we can see from the transcript that, in fact, there was little time spent during the discussion on the general utility of the graph model, nor did the discussion bring to the fore the point that not all relationships will be linear. I believe that this highlights a key pedagogical challenge; raising the knowledge that students develop in discussing contextualized examples like that in the textbook to the level of generalizability that enables them to apply the knowledge in new contexts. Key to this is being able to understand and use the technical language, in this case, the notion of a graph model. The teacher focuses the students on the meaning of the term, but does not recognize the crucial elements of the definition and statement of purpose that can help students develop the more general principle. The students needed more opportunity to focus on the notions of prediction and the possibility of a non-linear relationship, in order to understand and respond to the teacher's question.

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Hedged maxims

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The teacher, Josh, puts his finger on the really important question when he asks the class "Lance, what's the purpose here? Why do we even bother doing this?" (lines 34-35). We never find out what answer Josh has in mind, but it probably has something to do with prediction (which is, literally, the textbook answer). It would be interesting to know whether the TMM definition of a "graph model" is either meaningful or helpful to the students. The problem with modeling "real" data with mathematics is that interesting mathematics rarely "fits" the data very convincingly. A glance at the table of results in the textbook suggests that no straight line will fit this particularly well, because the weight/pennies increments for unit thickness increments vary from 4 to 14.

Given the general messiness of the situation, perhaps it is unsurprising that there is vague language in abundance (Channell, 1994; Rowland, 2000; Cutting, 2007). Vague language occurrences include, at the outset:

Cory: Theirs is like heavier or something.

Josh: Maybe. Maybe it was thicker.

Cory's utterance is a tentative response to a question from Josh about the differences between their data and that of the Maryland students. He qualifies his proposal that theirs was "heavier" with the hedge "or something", which leaves open the possibility that what he is claiming might not be quite correct. "Or something" is an example of an adaptor, a hedge located inside the proposition itself, marking some fuzziness in connection with class membership (Prince *et al*., 1982). The word "like" is very versatile (Andersen, 2000): here, it seems to be acting as a discourse marker (as with "you know"), and could be expected to precede a moment's hesitation before "heavier". This in turn suggests some uncertainty on Cory's part about the claim he was about to make.

Josh's "maybe" is a classic plausibility shield (Prince *et al*., 1982), a type of hedge located outside the proposition (that it was thicker). Channell (1994) identifies a number of goals, which speakers and writers achieve by the use of vague expressions. These include: giving the right amount of information; expressing uncertainty; protecting oneself against making mistakes; expressing politeness. The first of these readily connects with Grice's (1975) maxims of conversation, specifically those of quality and quantity. Cory is vague because to be otherwise might mislead his audience.

His use of these hedges implicates his uncertainty and protects him from accusation of being wrong. Josh, on the other hand, is responding to something (inaudible, in the transcript) that another student has said, presumably an explanation involving the thickness of the layers for the difference in the two sets of data. Josh's hedged response marks a dispreferred turn (Levinson, 1983), a disagreement when agreement would be the preferred second part of the adjacency pair. It shows sensitivity on Josh's part and the word "politeness" would not be out of place.

Hedged language is in evidence, even in the textbook, albeit in an account of the activity of the Maryland students, who "thought the pattern looked somewhat linear". Here we have the suggestion of a double hedge: they "thought" (a plausibility shield) and "somewhat" (an adaptor). Josh's exposition of the textbook (lines 6-13) is hedged throughout (*e.g.*, their data was "a little bit scattered", a line that "seemed to" fit the data "pretty" well, no point is "really" far away). Finally, when he is trying to draw out the purpose of graph models from the class, Christy obliges with an answer (line 31), interestingly unhedged. It would seem that Christy's reply is not the one that Josh was looking for, any more than Abram's earlier attempt. Josh's response (line 32) includes "maybe", as his earlier one did (see above). It also includes the interesting particle "well", which, here, functions as a maxim hedge (Levinson, 1983), suggesting that the speaker is serving notice to the hearer that the contribution about to come will fall short in some respect of the requirements of one or more of Grice's maxims of cooperation. Here, it could be argued that Josh's reply to Christy is deficient with respect to both the maxim of quantity ("let your contribution be as informative as is required, neither more nor less") *and* the maxim of manner ("let your contribution be clearly expressed"). In any case, Josh's interchanges with Abram and Christy reveal his enquiry (lines 25-26) to be something other than a request for information (Ainley, 1988). Teachers' questions in classroom situations are exempted from the usual sincerity conditions for a question, *e.g.*, that the enquirer does not already know the answer to their question (Labov, 1970). My guess is that Josh is looking for an answer that brings out the predictive relationship between the model (the graph) and the phenomenon being modeled (the breaking weight), because that is what the textbook says. Arguably that is the *only* reason why one would take the trouble to plot points from the table of values and draw the line: apart, perhaps, from the sheer pleasure of noting the way each system mimics the other, although this potential satisfaction is distinctly dampened, as I observed earlier, by the at-best rough-and-ready correspondence between the two semiotic systems in this instance.

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Lexical density and the mathematics register

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In US reform-based mathematics curricula, such as the Connected Mathematics Project (CMP) (Lappan *et al.*, 1998), mathematics is to be embedded in real-life situations and problems that students are expected to investigate and solve using mathematical tools. Learning mathematics thus appears to be a process that originates in students' everyday experiences and which consists of converting everyday (familiar, concrete, particular) knowledge into mathematical (new, abstract, generalized) knowledge. The texts to which students are exposed in such curricula aim to support this conversion through several of their features, two of which I will discuss with regard to this transcript—the embedding of mathematical genres within more familiar genres and the embedding of the mathematical register within the colloquial register. In discussing the latter, I will use Halliday and Matthiessen's (2004) definition of register as "the lexical and grammatical features that realize a particular situational context" (p. 9). The context includes what is talked about ("field"), the relationship between speaker and hearer or writer and reader ("tenor"), and expectations for how particular texts should be organized ("mode").

The first five sentences of Problem 1.2 (see Figure 1) contain many of the ingredients of the narrative genre. They tell a story about a class (protagonist) in Maryland (setting) who, in an indefinite past (setting), encountered and solved a problem (plot). Just as in any story, the focus is on the protagonist, who is the subject of all the five sentences ("a class in Maryland", "they", "they", "the class", "they") and is involved in a series of material and mental processes or actions ("did", "combined", "found", "organized", "made, "thought", "drew"). The plot unfolds in time ("The class *then* made a graph of the data") and its development is spurred on by the protagonist's reasoning and purpose ("They thought the pattern looked somewhat linear, *so* they drew a line to show this trend"). Even though they contain technical vocabulary ("average", data", "table", "graph", "pattern", "linear"), the five sentences are closer to the colloquial register than to the mathematical register at least in two of their characteristics: