OBSERVING THE UNSEEABLE: SOMATIC MARKERS RELATED TO STUDENTS' AND TEACHERS' DECISION-MAKING

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Decision-making, taking place without time for reflection in situations that are often too complex for complete analysis even in retrospect, is a central part of teachers' activity in teaching and students' activity in doing mathematics. Damasio's (1996) hypothesis of what he calls 'somatic markers' (bodily predispositions that inform our decision-making) accounts for the ability of teachers and students to make such decisions. However, somatic markers are by their nature not directly observable. We have reported (Brown and Reid, 2003) seeing evidence for the development of a new positive somatic marker through the behaviours of a teacher and his students. Here we report on progress made in observing the unseeable through a focus on looking for patterns of behaviour in the use of questioning techniques.

WHAT WOULD YOU DO NEXT?

Mr. Hatt's grade 8 (students aged 13 to 14 years) mathematics classes are beginning a unit on using algebraic expressions to describe mathematical situations. He teaches mathematics and science to two groups of students, his "homeroom" class and the class discussed in the following extract from a transcript of a lesson. This is his introductory lesson. The students are building "trains" of trapezia of ever increasing length and calculating perimeters for each train. Mr. Hatt has asked each group to give him an arithmetical expression that describes the calculation they did to find the perimeter of a train of six trapezia. He has written these expressions on the chalkboard. He has also asked the students to use their expressions to calculate the perimeter of a train of eight trapezia. They are now discussing each expression in turn and have come to the last one.

T:	Which one does that kind of resemble?
SS:	The first one.
T:	The first one, the first one, OK.
S:	Which one's the best?
SS:	Ours, ours.

Imagine that you are Mr. Hatt, what are you finding yourself saying next?

SOMATIC MARKERS

This activity began the presentation at the Oxford meeting of BSRLM. Sandra Pendlington, the first participant to offer, reported feeling strongly that she would ask 'Why?'. Where does such a clear image of what would happen whilst teaching come

from? The physical sensations ('welling up') accompanying the awareness of what we might say in such a situation give some evidence for the immediacy of the responses. There is no time for reflection. The experience of teaching has created a bodily predisposition to act in a certain way. Someone who has not been a teacher would not have any strong conviction for what they would do. Damasio (1996) discusses the neurological basis for this process and uses the term 'somatic marker' for the juxtaposition of image, emotion and bodily feeling we have that informs our decision making:

> Because the feeling is about the body, I gave the phenomenon the technical term *somatic* state ('soma' is Greek for body); and because it 'marks' an image, I called it a *marker*. Note again that I use *somatic* in the most general sense (that which pertains to the body) and I include both visceral and nonvisceral sensation when I refer to somatic markers (p. 173).

As we go through life we associate some of our behaviours with events that we experience as pleasurable. That experience changes our bodily structures in ways that mean that the behaviour becomes marked, so that in similar circumstances we are likely to behave in similar ways. Other events we experience as unpleasant, and then our bodily structure changes in ways that mean the behaviours we associate with those events are less likely to occur in the future:

> Somatic markers are thus acquired though experience, under the control of an internal preference system and under the influence of an external set of circumstances which include not only entities and events with which the organism must interact, but also social conventions and ethical rules (Damasio, 1996, p. 179).

Through working as a teacher our behaviours become more flexible and adaptable as a greater number of situations are dealt with. A range of somatic markers pointing to different responses to a given situation are possible. In earlier work on teachers' complex decision-making, Brown and Coles (2000) state:

> Somatic markers act to simplify the decision as to which behaviour to try. Negative somatic markers mean that the behaviours do not even come to mind as possibilities for action. A positive somatic marker means that the behaviour becomes one of a number available for use (p. 168).

Our current collaborative research looks at the ways in which somatic markers influence teachers' decision making and students' reasoning, and the degree to which those markers can be observed by us, by colleagues, and perhaps by the teachers and students involved. Because somatic markers are a part of unconscious mental activity they cannot be observed by introspective reflection, so even the stories we tell after the fact about our decision-making are unlikely to be actually what went on. We make post-hoc rationalisations, whereas in the moment we simply act. We cannot tell what somatic markers are guiding our decision-making in the moment. How then can we research something we cannot observe?

A BREAK IN THE PATTERN

The process described above, of examining decision points in a person's actions, seemed to hold promise. At the BSRLM meeting of November 2002 (Brown and Reid, 2003) we reported how we had seen a new somatic marker developing in the teaching of Alf Coles as he attempted to stop using the word 'pattern' in his invitations for the children to act and started to use the word 'action'. His positive interpretation of what the students did and his awareness of liking the work the students produced in response to his change of behaviour imply that he will choose to make this decision to use the word 'action' again and that this change will become an unconscious part of his practice over time. In reflection on what we were doing after reporting on this work, however, we realised that we had been avoiding the real issue. In our excitement at seeing something, we had to admit that we were still not actually seeing somatic markers in observing the creation of one. So, instead of observing changes in an individual teacher's behaviour, seeing these as indicative of developing somatic markers, we wanted to get at the unconscious decision making and consider what markers based on past experience might account for those decisions.

WHAT DID WE DO?

Instead of focusing on an individual teacher David suggested that we use his videotape data of a classroom where he had been studying students' decision-making and this time focus on the teacher's behaviours to see if comparing behaviours gave us any insights. In studying transcripts of this new teacher alongside those of Alf Coles that we had used before, we were interested in the style of interactions that were somehow similar in both cases. Both these teachers encourage discussion and reflection in their classrooms. In supporting those discussions, however, we were struck by the fact that they both did use questions, but that they also used statements in a way that seemed to provoke students into a more active role. We became interested in this phenomenon and wondered if the behaviour was an example of a somatic marker for Mr. Hatt, an unconscious choice, known in practice but not in the conscious awareness of the teacher.

At BSRLM in Oxford many people shared what they would do and also shared some of the post-hoc analysis of why they thought they might respond in that way. For such a short piece of transcript it was striking the range of interpretations of the phrases there were and what individuals stressed and ignored. There were some emotional reactions from some participants to the question, *Which one's the best?* that was asked by one of the students. Here are some of the many things we can imagine Mr. Hatt doing at this point, for instance, he could walk out of the room saying nothing or he could say any number of things:

"'Best' is a moral judgment; this is math class."

"I won't tell you."

"I'm not so sure we're at the best one yet."

"I'm asking the questions here!"

"In what way does this one resemble the first one?" (ignoring the question entirely)

"Strawberry Fields Forever."

"Summum bonum."

"The homeroom class had a better one."

"The third one is the best. Now, how does this one resemble the first one?"

"Which one's the best? Good question. Let's discuss that."

The typical pattern in this class is that, after Mr. Hatt asks a question, the students respond and Mr. Hatt mirrors what they say. This provokes a question from the students. So, what did Mr. Hatt actually say when this happened?:

T: I'm not so sure we're at the best one yet.

S: Both.

T: But, I'm not sure, uh, my home room had – I think – I believe there were two different ones here –

As teacher educators we are aware that we work on questioning techniques with our student teachers to promote the use of discussion. At another BSRLM session that Laurinda and Alf presented (Coles and Brown, 2002), Anne Watson commented that in an analysis of lessons looking for 'open/closed questions' she would not have picked up statements that provoked rich activity amongst students. We were already aware of the use of statements in supporting developing classroom cultures where students ask and answer their own questions. This time when we noticed the use of statements, as well as recognising the return of a theme that had been present before we were developing a somatic marker because our practices as teacher educators were changing in relation to how we might run our sessions focusing on questioning techniques. Mr. Hatt does not ask a question such as 'Why?' but makes a statement about a response to the use of the word 'best' that he questions through a statement that acts as a question. He projects uncertainty. There's some more work to be done by the students. He then reports on another experience with his other class.

What can we say about Mr. Hatt's somatic markers based on his response to the question? This is not easy without collecting more information from somewhere, but we can begin to speculate and raise questions. It is clear that he does not want the groups to end their work yet. How aware is he of using statements to support the questioning of his students? Is this something he does in other lessons? Has he a gut feeling that he does not want to answer the question yet? Was Mr Hatt aware of using statements? Or was this simply what he did? How could we find out more about this? In the end we decided to talk with the teacher.

INTERVIEW WITH THE CANADIAN TEACHER

The interview was semi-structured in that we knew that we were going to invite the teacher to talk about the details of his practice. Although the lessons had been given

some two years beforehand, fortuitously whilst Laurinda was in Canada for another purpose, the same focus had been used recently for a sequence of lessons. The teacher, consequently, spoke out of his recent experience. He made the following comments, chosen to illustrate a range of what was talked about, related to supporting discussions and questioning:

~ Students have to be actively engaged or they are not learning.

~ …, they want you to tell them, but they don't learn unless they are actively engaged.

~ I like to begin most things with a physical hands on activity, then to have a lot of representations, pictorial symbolic, students can flip back and forth.

~ Can … they come up with expressions, then explain to the class how they obtained their expressions. And there are a number of explanations.

~ They are formulating in their own minds the easy way to do it. Then they are going to ask me, but I don't answer their questions.

LB Why don't you answer?

~ They would like the easy way out, but they have to have time to know that it is a problem. That it isn't as simple as they might have thought. I provide very little information until they have found a method. There are a lot of methods.

~ My biggest nightmare would be if everyone did 3 n plus 2. I'd ask them to come up with another. And they might say 'Why, I have one that works?'.

~ I might have my own method, but then I saw an easier way, so they write that, but others might stay with a more difficult way that they understand. In a 14 year old mind they are not always willing to accept a different picture of what is happening.

~ To them they think the formula has to work for everything, so when they find the formula is different this is a discrepant event.

~ If they ask me ‘why?’ I turn it back to the class. I think that comes up in their groups. They come and ask me why, but I want them to go work on that.

~ A friend of mine who is a doctor works with Medical students and he focuses on questioning. And he says if you don't know the questions and you don't know the answers you'd better listen.

~ Don't be too quick to answer questions, or to ask them. The psychiatrist doesn't answer the question "Am I mad?" He invites the patient to tell more.

In talking about his practice the teacher does give insight into what motivates his teaching. These images are strong such as a belief in beginning with something physical and looking for different solutions and not finding ways of getting students to do more. The range of behaviours that somatic markers point to are not so clearly here, the image is of something else like holding the conversation in the way that the psychiatrist does. Given this conversation the analysis of the lesson is then that the teacher is operating to support the continuing discussion of many different strategies

not rushing to fix on one alone. The actual form of the statements and range of responses is not fixed but contingent upon what happens. Having invited detailed descriptions of practice this teacher talked more of his intentions and this feels natural. The somatic markers are pointing to the behaviours that actually happen given these motivations and we can go back to the videotapes to check those out.

THOUGHTS

As teachers continue to learn about teaching they accumulate somatic markers appropriate to teaching that guide them to make decisions differently than when they were new teachers. The experiences that student teachers undergo are important in beginning that process and the identification of the motivations that will direct their accumulation of effective behaviours for those motivations. We are questioning our focus as teacher educators on questioning techniques rather than on analysing more general strategies in which discussion can be supported in the classroom. The parallel with teaching mathematics is apparent to us, as teachers we support learners in making their own connections and exploring a range of methods of solution to problems, why not work on transcripts with student teachers and allow them to think through a range of responses for different purposes? The journey that we are on as teacher educators of developing our own awarenesses of ways of working with student teachers who are working on the teaching and learning of mathematics has been supported by this focus on seeing the unseeable.

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