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**Developing Research Conceptions of Emotion among Adult Learners
of Mathematics**

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The growing emphasis on affect and emotion in studies of adults learning mathematics reflects, and is supported by, increasing attention from social science and educational researchers to the influence of culture, society and language. The work reported here uses a discursive perspective to study the role of emotion in adults' mathematical thinking. I consider emotion to be distinct from thinking, but not separable from it. Further, given that much of our evidence about emotions comes from the use of language and discourse in transcripts of interviews and group interaction, I adopt a provisional characterisation of affect and emotion as 'charges' on ideas (or on the terms in which they are expressed). In this study, I use the idea of 'positioning' in social practices to analyse the context of a person's thinking and emotional experience during problem solving, and I suggest several types of indicator for emotion to be found in transcripts (or videotapes). Illustrations are given from an interview with a mature student studying mathematics at the beginning of her social science degree.

Introduction

Substantial amounts of recent work reported to research conferences on adult mathematics learning, or on mathematics education generally, emphasise the importance of affect, emotion and feelings among adult learners of mathematics and users of quantitative ideas (see e.g. Kaye et al., 2003, Cockburn and Nardi, 2002). This reinforces the attempts of researchers in these fields and elsewhere to take account of the fact that cognition and learning are activities in which affect is integrally involved. I find substantial agreement among researchers in a wide range of fields, from neurology (e.g. Damasio, 1996), through psychology (e.g. Strongman,

(the cognitive), but as nevertheless *attached to* them, though not in a fixed or permanent way. This will be explained and illustrated below. Second, I see affect or emotion as a ‘charge’ attached to (or infusing) ideas or the chains of signifiers expressing them; for example, Freud ([1916-17] 1974, pp. 443-48) sees anxiety as involving ‘motor innervations’ or ‘discharges’. At one level, this idea of ‘charge’ is a metaphor, appropriate in that it captures something of the intensity and energy of emotion. At another level, it seems to me very likely that the charge of emotion may be in principle detectable as a chemical charge (or perhaps an electrical one) in neurophysiological terms (see e.g. Damasio, 1996).

There are several additional features. Emotion should be seen as *socially organised*, not as a simple expression of an individual characteristic or essence. To appreciate what this might mean, it helps to analyse emotional states as having three ‘aspects’ or components’ (e.g. Kitayama and Markus, 1994, Burkitt, 1997).:

- somatic or bodily processes
- overt behavioural (including verbal) expression
- subjective experience or feeling

First, we can argue that these aspects of emotional states are at least partly learned or ‘socialised’ – certainly the behavioural and feeling aspects in human beings (Burkitt, 1997). This suggests – and there is much confirming evidence - that they are specific to cultural and social groups, including nationalities, social class, gender and ethnic groups. More broadly, emotional expression and experience can be seen as embedded in a social context, in the same way as thinking, learning or using mathematics.

There are a number of ways to think about a social context (Evans, 2000a: Ch.6, Evans, 2000b). We must avoid defining it in a ‘naturalistic’ way, as it is named and described in everyday terms – for example, as simply ‘school mathematics’ or ‘shopping maths’ - for that would mean basing our thinking on an a-social, under-theorised approach. The perspective I argue for here and elsewhere is that the context of emotional experience is *part of* that experience; it is formed or ‘constituted’ within pedagogic or other practices and the related discourses. This does not mean that the context can be *reduced* to a set of practices, but rather that the practices at play in the situation highlight, and provide a basis for interpreting, certain aspects of the context. These discursive practices facilitate (and constrain) what subjects can think, say and feel - by making available certain ‘positions’ for

people to take up; these positions would provide the basis, for example, for a subject's understanding of emotional states or experience (Evans, 2000a; Morgan, Evans and Tsatsaroni, 2002). Illustrations of these ideas are given below.

There are further bases for arguing that emotional states and experience can be seen as socially and culturally specific. For one thing, emotional states are not just in the 'here and now': they must be understood as based on a person's *history* of involvement in practices; this history is itself structured, for example by the social class of the learner's family and, in case of learning mathematics (or other school or college subjects), by the form of pedagogic practices they have been subjected to. In addition, emotions can often be seen as an outcome of social *interaction rituals*, such as routine methods of greeting, or established methods of celebrating changes of status (e.g. marriage and graduation), leading to positive feelings of solidarity and emotional energy (e.g. Collins, 1990).

Further, emotional experience is culturally grounded in - expressed in, learned through, but not fully determined by - *language*. Thus past experience is not completely structured (as might have been suggested by a reading of the previous paragraph) - rather, it is *textualised* (Evans and Tsatsaroni, 1998) - because of the properties of language, and its capacity for forming unexpected, and not consciously intended (by any individual), linkages between practices via *intertextuality*. The bases of intertextuality, in turn, are found, both in the cultural linking of practices (e.g. through interaction rituals or through advertisements), and in (the contingencies of) the individual's history of experience; examples are given below (see also Fairclough, 1995). Thus, in including poststructuralist / non-structuralist elements in this analysis, we allow that language may 'have its own dynamics', in this sense.

There are several ways to account for the nature of the *charge* or the energy. We could see it as coming from the *goals* of the activity or practice (e.g. Saxe, 1991), say learning mathematics. Goals can be included as part of the elaboration of a discourse (Evans, 2000a: Ch.6), but, if understood as conscious and 'rational', they may be experienced as somewhat towards the 'cognitive side' of the affect spectrum (see above). Another approach is to attempt to analyse individual or group 'motivations'. There is a wide range of approaches to motivation: compare, for example, Hannula (2002) with Mendick (2002). In my view the most fertile is a *psychoanalytic* approach

emphasising desire (Lacan, 1977, Henriques et al., 1984). Here the main concepts are:

- *desire*: a strong wanting or wishing for certain objects – one’s mother or father, their love, related objects – initially forged during the strong dependency of infancy, but linked with
- the inevitability of loss, pain, distress, contradiction, leading to
- the operation of various *defence* mechanisms, effecting *repression*, into
- *the unconscious* (which can usefully be seen as ‘structured like a language’), involving
- the psychic processes of *displacement* and *condensation* (represented in discourse as metonymy and metaphor, respectively).

Displacement, which can be seen as the movement of an emotional charge along a chain of ideas or signifiers, provides the basis for (much) fluidity of language and emotion. Here we have the basis for an emotional ‘dynamic’ of language, complementary with that of intertextuality. For further on these key concepts, see Laplanche and Pontalis (1973); for a glimpse of how they might be used in educational research, see Evans (2000a) and the case study below.

Methodology for the study of emotions using discourse analysis

The tools to be used include a combination of a structural and a textual analysis in reading texts. The *structural phase* produces an analysis of the discursive practices likely to be ‘at play’ in the research setting(s). We then attempt to determine the range of possible positions made available within these discourses, and the values associated with each position. To analyse the practices at play we can use an initial ‘logical’ approach (see below), which can then be strengthened using theoretical approaches like Critical Discourse Analysis (CDA) (Fairclough, 1995), and pedagogic discourse theory (Bernstein, 2000); see Morgan, Evans and Tsatsaroni (2002). The resources available include documents describing the college course (or other activity), and field notes from the researcher (see below).

The *textual phase* aims at identifying:

- (1a) the *positionings* actually taken up by subjects in interaction;
- (1b) instances of intertextuality; and
- (2) indicators of emotional states / experience (such as emotional expression), including those suggested by insights from psychoanalysis.

Here the first stage focuses on *interactional aspects* of the text. We read the text, so as to establish - or attempt to establish - each person in one or more particular discursive positionings (which may also change over the course of a classroom or interview episode). Thus we read the interview (or classroom) transcript for

- instances of a person making claims to valued statuses, e.g. ‘knowing’ in educational settings;
- the ‘modalities’, or degrees of certainty, of statements (Morgan et al., 2002).

Of course, there may be social differences in the propensities of different groups to behave in such ways; for example, men may tend to be generally more likely than women to utter statements with certainty (Benn, 2001).

We must also allow for intertextuality, by looking for:

- ‘key signifiers’ meaningful within more than one discourse.

In the second stage of textual analysis, we look for overt indicators for the experiencing of emotions, such as:

- verbal expression of feeling;
- emphasis or repetition of certain terms;
- ‘body language’;
- metaphors; and so on.

Further, psychoanalytic insights serve to point to certain *themes* of emotional experience, as well as to suggest distinctive indicators. In studies of adults learning mathematics, these themes might include: *inclusion / isolation* and *anxiety*. Anxiety was originally seen as ‘the primary affect’ by Freud, and, in its form as ‘mathematics anxiety’, has been emphasised strongly in mathematics education research and practice over the last 25 years (Evans, 2000a). Researching inclusion / isolation might lead us to look for:

- reports of liking and loss in interviews (or expressions of solidarity or competitiveness in classroom interactions).

Researching mathematics anxiety would lead us to look for, besides verbal expressions of anxiety, fear, etc., evidence of the operation of defences against strong emotions, like anxiety (or against other intrapsychic conflicts; see Hunt, 1989):

- ‘Freudian *slips*’;
- *denial* (of anxiety): e.g. ‘protesting too much’, making an assertive,

exceedingly confident ‘statement’ about mathematics.
For discussion of further indicators, see Evans (2000a: 144-45).

The interview data

As part of a study of adult numeracy at a higher education institution, I did semi-structured interviews with a (partly randomly selected, partly voluntary) sample of 25 first year social science students. As part of the study, I set down a general ‘reflexive account’, that is, an account of the ways in which I was part of the social world I was studying (cf. Hammersley and Atkinson, 1985: 14ff.). The passage below is constructed from the methodological chapter of the full report of the study (Evans, 2000a). It can be read as data for the structural phase of analysing the discourses at play in the setting of my research interview, and the positions available to those involved.

I was an experienced lecturer in statistics at the Polytechnic. Most of my teaching was with the BA Social Science students, and I was very involved with the First Year ‘Maths’ course - giving some of the lectures, also as the coordinator. Further, about a third of each student cohort would have had me as a tutor (for Maths or Social Policy, or as personal tutor)....

The interviews were done at the end of their first year with students from cohorts 2 and 3 of the study. They were all conducted in my office. At the beginning of the interview, I offered coffee or tea. I described my work as ‘doing research on people’s experience with numbers, and on what sorts of things help people feel comfortable with numbers, and what stands in their way [...] So what I would like to do in this interview is to give you some space to talk about your experience with numbers, and your feelings about them’....

I asked the student’s agreement to record the interview. I emphasised to the student that he/she did not have to answer any question if they did not want to. I began with the ‘life history’ questions, and then moved on to the problems to be solved, each preceded by the first *contexting question*, and followed by the second....

The student was given at most only neutral feedback while attempting the problems. Towards the end of the interview, I gave

further feedback, if I felt the student needed it, or discussed ‘the answers’ to the problems, if requested.

(Evans, 2000a, Ch.8)

Structural Analysis of Available Positions

First, we can ask what discourses are at play in this setting? The main practice or activity that is shared by the tutor and the students is teaching and learning mathematics. This practice is ‘regulated’ or organised by a set of ideas, rules, values, standards, and so on, which we might call the ‘official’ *discourse* of college mathematics. The positions available in this discourse are ‘teacher’ and ‘student’. It is of course the former who is positioned to assess, and the latter to be assessed. Further value is usually attached to individual students according to performance on academic criteria: thus, we have the positions of ‘*good / normal student*’ and ‘*bad / failing student*’ (Morgan et al., 2002). In the Polytechnic at that time, this pair was moderated, for Year 1 students only, to: ‘*good / passing student*’ and ‘*student needing extra work*’.

At the same time, the fact that I ‘invited’ selected (see above) students to an interview, addressing them from within a ‘research interview’ discourse (as illustrated in the previous section), juxtaposes a second sort of practice to the first. Here the positions are of ‘researcher’ and ‘interviewee’; it is noteworthy that the former is in some ways now positioned as a learner, and the latter as an authority, concerning her/his own activities at least. The interviewee is also generally much freer - to not agree to attend the interview, to refuse to answer (or to evade) questions, and so on. Thus we can see that both student-interviewees and teacher-researcher are *multiply positioned*, and in ways that are very possibly contradictory. This itself may generate emotion.

Textual analysis of positioning and emotion: the case of Fiona

From the 25 semi-structured interviews conducted, seven were selected as case studies for the full report of the study (Evans, 2000a: Ch. 10). One interview, that with Fiona, is selected here, because of its capacity to illustrate a wide range of themes relating to emotions.

Fiona was a mature student in her mid-20s, from a middle class family. She previously had worked as an unqualified social worker, and was now aiming to qualify, after entering the training via the Psychology track. She was a member of a group to whom I had taught ‘Maths’ in the earlier part

of their first year; that group had worked well, and had included me in some of their socialising.

After some discussion of her 'life history', especially concerning the study of mathematics, I asked her to 'solve a few problems'. She responded with what I later called 'mock-anxiety' (Evans, 2000: 192). In response to Question 1 (about reading a pie-chart):

S: I always had difficulty with that, I didn't enjoy it at all. School wasn't a particularly happy time for me anyway, so you might well find that a lot of my answers are negative ... [4 lines] ...
I was never explained how to work through it step by step so it certainly makes me feel very *anxious* [...] I don't actually trust my own perception to actually give the correct answer, because I don't feel I [...] know how to work it out properly, so therefore I don't think I would give the right answer - if that makes sense....

(Interview transcript; my emphasis)

Here we can see the possible importance of her 'not particularly happy' history of positionings in mathematics, and in school. We can also see that her feeling of having missed a 'step by step' explanation, and her lack of confidence about 'trusting her perception' tend to position her as less competent in mathematics. And she expresses an explicit emotion - anxiety.

When I pose Question 3 (about reading a graph depicting changes in the price of gold):

JE: ... which part of the graph shows where the price was rising fastest?

S: Maybe it's me being ignorant..., but there doesn't actually seem to be any time specification along the bottom [axis of the graph] - which I find quite *confusing* [...] my father's a stockbroker, so I *do understand* a little about opening and closing.... ... [6 lines] ...
I mean there actually appear to be two peaks here, but I should say maybe when gold is at 650, it seems to rise very rapidly in the afternoon until close, and afternoon business, you know, afternoon trading

(Interview transcript; her emphasis)

Here we might say that she uses the possible differences in the positions available in the two discourses of college mathematics and research interviewing to attempt to shift the discourse from college maths, where she seems to be uncomfortable, to that of stockbroking. This allows her to establish a claim to knowing. But this, it transpires, does not avoid the possibility of uncomfortable emotion. She takes up the story:

S:...my father dealt with money all the time, um, because he was a stockbroker, and therefore it was the essence to him and his making a living, but *it wasn't anything that we were allowed to sit down and discuss*, or even talk about, or offer advice [...] we were always told we wouldn't understand [...] - because *time is money, money is time*, and *he hasn't got time to explain to me* the information that he thinks is going to be relevant to me at a later date because I'm a woman and I don't understand...

JE: Is it - a woman, or you're a child?....

S: I think it's very much both....

JE: What about your mother? Does she, is she allowed to ask questions?

S: Well, no, no, just the same. *Family and business should never mix* [...] my mother wasn't ever allowed to ask and it certainly affected her far more than it did us because as a stockbroker, your home and your material valuables are on the line all the time [...] on a couple of occasions the family home was under great threat [...] *It wasn't something that family and children discuss ...* [2 lines] ... *he was the man of the household* and he could deal with it [...] ... most of the time, it was *like living under a time bomb* (JE: mmm, mmm, I can appreciate that) especially if you don't quite know how the time bomb's made up or when it's going to explode....

(Interview transcript; my emphasis)

Here we find a recurrent theme of *being positioned as not understanding* her father's work, and thus of *exclusion*, from knowing, from his work, perhaps from his love; this is reinforced by the injunction in the text (presumably repeated from her father) that 'family and business should never mix'. Elsewhere we see a quasi-repetition 'time is money, money is time', which may *exhibit* (though not express) anger; retrospectively, we can see that this 'reverberates' (intertextually) with her earlier 'complaint' that her teachers would not give 'step by step' explanations – and

consequent feelings of not understanding, disempowerment, and anxiety. And we see the powerful metaphor of ‘living under a time-bomb’, where the time bomb is an unpredictable financial disaster: such a way of living would certainly include anxiety, too.

Is there a link between her father, his work, and her feelings about and way of engaging with mathematics? I ask how she saw her father’s work, to pick words, adjectives to describe it:

S: capitalist, corrupt, business-like, ... mathematical, calculating, devious, unemotional...

(Interview transcript)

Discussion

For Fiona, the relevant positionings taken up include the positions made available as ascertained by the structural phase of the analysis, and further positions made available by discourses emerging in the textual phase; see Figure 2.

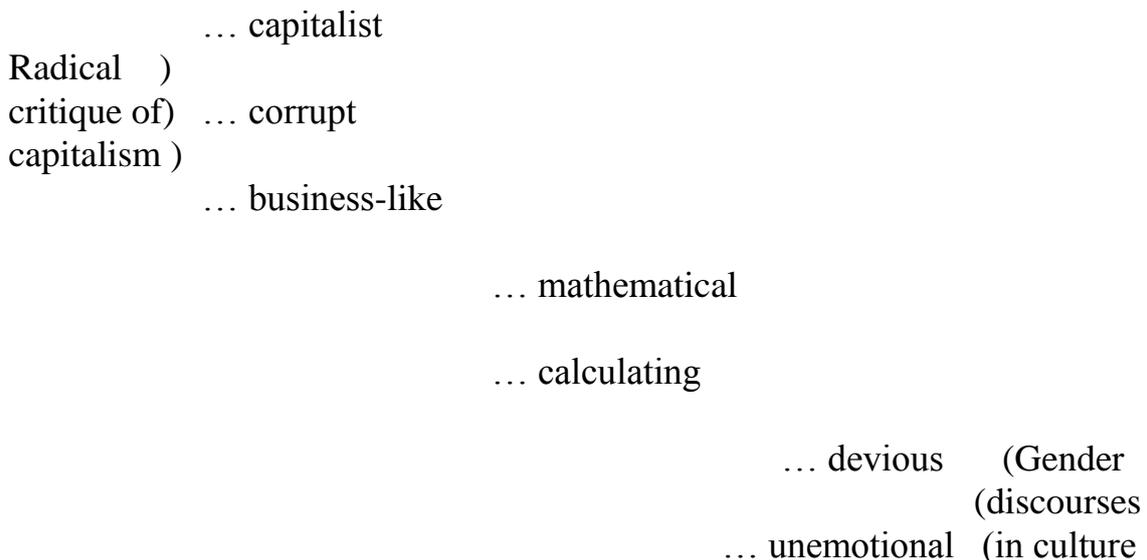
Figure 2. Positions Made Available to Fiona and Positionings Taken Up

<i>Structural Analysis</i>	<i>Discursive Practice</i>	<i>Positions Available</i>
(Assessor)	College Mathematics	Teacher
		Student (Assessed)
	Research Interviewing	Researcher Interviewee
<i>Textual Analysis</i>	<i>Discursive Practice</i>	<i>(Further)</i>
<i>Positionings</i>	Stockbroking	Stockbroker Client
	Family Discourses	Father Daughter

Once she has called up the stockbroking practice, Fiona has access to ideas and knowledge that would not be available to her straightforwardly in her position as college mathematics student. Similarly, once she has called up family discourses, she has access to, or is ‘subject’ to, feelings that do not *originate* with the college maths graphical problem presented, though the latter may ‘recall’ these feelings for her. In psychoanalytic terms, the feelings may be *displaced* from her father to the mathematics.

How this displacement may be effected is elucidated if we consider the ‘chain of signifiers’ presented at the end of the last section. We can present this chain as resulting from three shorter chains that can be read as relating in turn to her father’s work practices, to school / college mathematics, and to her family discourses, as in Figure 3.

Figure 3. Chain of Signifiers Presented by Fiona and (Possibly) Related Discourses



Here ‘calculating’ is a *key signifier*, which has meaning within the three discourses - family discourses, school mathematics, and stockbroking – and hence provides a link between them. The disappointed desire, frustration, and anger that she feels towards her ‘unemotional’ father is likely to place her in a position of strong psychic conflict. Thus these

negative emotions may be displaced from her father onto his ‘corrupt’ work, and onto school mathematics. This may then lead to ambivalence or resistance to engaging with mathematics - behaviours which this student manifested in mathematics classes – and possibly to similar ambivalence or resistance to mathematics teachers, which might be analysed further using the psychoanalytic concept of *transference*; see the full account of Fiona’s story in Evans (2000a: 191-6), and those of other interviewees (Evans, 2000a: Ch.10).

Conclusions

In this article I aim to show how one might study emotional experience in the learning and use of mathematics by adults, using discursive perspectives. Both structural and textual phases of analysis are important. The structural aims to set out the positions available to all subjects in this specific setting; here I argue that both a college mathematics and a research interviewing discourse are ‘at play’. The textual analysis investigates what other discourses may be called up by a particular subject, on the basis of the interaction observed or transcribed, and as a result of her history of positionings in other discursive practices.

As part of the textual analysis of this episode, I have considered in some detail the chain of signifiers presented by Fiona, in response to my request to describe her father’s work. (What was a spontaneous move on my part in this interview is used more systematically in Karsenty and Vinner’s (2000) request to all interviewees to ‘free associate’ to the term ‘professional mathematician’.) This particular chain of signifiers is, in my experience, unusually fertile in suggesting relevant intertextualities, here reverberations with discourses on a corrupt capitalism, and on gender and age relations in a late 20th century English businessman’s family. It also shows reasonably clearly how feelings may be displaced along semiotic chains, such as the one here linking the interviewee’s family discourses, those relating to her father’s work, and school or college mathematics. Using the types of indicators for emotion set out earlier in the article, we can argue that the range of feelings includes desire / love, disappointment, exclusion, frustration, anger, and anxiety. The advantage of using the deeper psychoanalytic analysis of the interview is that we are able to go beyond seeing some of her expressed anxieties as simply ‘mathematics anxiety’. This insight is reinforced by my readings of some of the other interviews (Evans, 2000a: Ch.10).

My claim that at least one of the key findings from Fiona's interview can be replicated in other interviews raises the issue of generalisability. This thorny but crucial issue for 'qualitative' or ethnographic work cannot be pursued in detail here. In this particular project, I attempted to combine 'qualitative case study' analysis with 'quantitative' (survey) and 'qualitative cross-sectional' work. The latter approach allows a systematic analysis of results from the entire corpus of interviews (n = 25 in this case), and, in projects where reasonable care has been taken with the representativeness of the sample, some cautious pointers towards generality of the analysis. For further discussion of this issue, see Evans (1994) and Evans (2000a).

The interesting and suggestive findings invite us to reflect further on the methodology. Does the fact that the interviewer and interviewee had known each other as teacher and student affect the interview material produced? This question is addressed, in ethnographic work generally, by the use of 'reflexive accounts'; in this study I produced both a general reflexive account for the research setting and group of interviewees as a whole, and also an individual reflexive account for Fiona (Evans, 2000a: 195-6) and the others. (Such reflexive accounts are of course produced subject to processes of selection and interpretation, as are any data.) Moreover, there is scope for further discussion, as to whether one could have produced similar findings, or even broadly similar research material, if we had been using videos and transcripts of small-group problem solving sessions. For further discussion of such methodological issues, see Matos et al. (2002) and Evans et al. (2003).

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