

The roles of feelings and logic and their interaction in the solution of everyday problems

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Abstract

In my ongoing research project investigating the socio-cultural contexts of the maths adults use in their everyday lives, I have been recording discussions in a focus group of women and observing gardeners and upholsterers at work and discussing their use of maths with them. The results concord with Lave's theory of situated cognition (1988:17-18) and with an expanded version of Saxe's model of culture and cognition (1991:17).

I am finding that the participants' accounts of solving everyday problems have a logical structure but it is not clear whether this is part of the problem-solving process or whether it is a function of constructing accounts. The participants' feelings about themselves and other people, and about maths, are also a prominent feature in these accounts and strongly influence what the participants choose to do and how they choose to do it.

Introduction

What maths do adults use in their everyday lives, how is it done, and what are the contexts in which it is used? To investigate these questions I set up a focus group of women and asked them to talk about their everyday activities which involved maths or numbers. I also observed a firm of gardeners and some upholsterers at work and talked to them about the maths they use.

In this paper, I shall be considering data from the focus group. I first briefly describe how the group runs and how I analysed the data. I found a logical structure in the participants' accounts of solving problems and I discuss whether this is actually part of the problem-solving process, or a feature of construction of post hoc accounts. I show that the four parameters of culture which Saxe proposes as being inseparable from cognition (1991:17) are an integral part of each stage of problem-solving in the participants' accounts. Next I demonstrate that affectivity is a fifth parameter in my data. Finally I raise some questions which I intend to explore further with the focus group and in observations of people at work and conversations with them.

The names used in this paper are pseudonyms chosen by the participants in the study. Data collection and analysis The data for this part of the study was collected from discussions in a focus group of women about the maths they use in everyday life. The participants are well-educated people: professional women and mature university students, only one of whom has studied maths beyond GCSE level (the examination

most children take at age 16 in England and Wales). I have discussed the constitution of the group more fully elsewhere (1998, II: 47-49).

I asked the participants to tell stories about their everyday experiences of using maths and numbers. When they ran out of spontaneous stories I gave them a series of questions on individual cards which they could read through and choose any they would like to answer.

The questions were about numbers, time and money, measurement and estimation, shape and spatial orientation. They were worded in a way which would invite the participants to consider specific instances when these concepts had been called into play in their everyday lives, and to encourage them to describe the whole context of the event. An example of the questions is, 'When you were coming here today, how did you decide what time to leave home?'

I asked the questions in this way because I am particularly interested in the socio-cultural contexts in which people use maths, as in Lave's theory of situated cognition. Rather than understanding knowledge as something individuals possess, she sees,

... a more appropriate unit of analysis is the whole person in action, acting with the settings of that activity. This shifts the boundaries of activity well outside the skull and beyond the hypothetical economic actor, to persons engaged with the world for a variety of "reasons"... (Lave, 1988:17-18.)

I recorded the conversations in the group on audio-tape and transcribed the tapes. I coded the data systematically using Lincoln and Guba's system for developing grounded theory (1985: 332-356): I labelled words, phrases and sentences with names that described the content. I then physically cut up the transcript with a scalpel and grouped the pieces of paper in envelopes according to their labels. When a piece of text fitted more than one label, I copied it so that it could be put into all the appropriate envelopes. I then went through each envelope to check whether the pieces of text concorded with each other and with the label. Finally I made a list of the labels and tried to organise them into a schema (see Appendix).

Examples of the labels are: 'calculation', 'tool', 'affectivity', 'identifying a problem'. In choosing these names for pieces of text, I was influenced by what my interests are in the data: firstly, what mathematics people use in everyday life; secondly, how they do the maths; and thirdly, the socio-cultural contexts in which the maths is used.

The logical structure in the accounts of problem-solving The participants gave accounts of a wide range of everyday activities such as travelling, cooking, crafts, dancing, shopping, video-recording, remembering telephone and personal identification numbers. The analysis revealed a logical structure to their accounts of the solution of problems in four stages: the identification of a problem; deciding how to set about solving the problem; what actually happened; and a review of how far the problem had been solved. In order to solve one problem, many contributory problems may have had to be solved. Also, at the review stage, if the solution has not worked, it might be necessary to go back to any of the previous stages: to reformulate the

problem, to make another decision about what to do, or to try again to carry out the original decision.

I developed the model of problem-solving shown in Fig.1 directly from this analysis of the data. The accounts that the participants in the focus group gave of a wide variety of activities all fit this model of logical problem-solving. Participants did not necessarily have fully developed overall plans for solving complex problems when they began. They may have identified one or more sub-goals which needed to be achieved first, before proceeding to make further decisions.

Decisions do not have to be made on each occasion. When habitual activities are undertaken, it is more appropriate to use the term 'achievement of goals' than 'solving a problem': there is no problem. But this still fits the model: the goal is identified and actions are performed to achieve the goal. The outcome may only be reviewed if there is a change of circumstance.

I am using the term 'logical' because following this four-stage process requires an understanding of cause and effect, if I do this then this will happen, and its corollaries, if I want this to happen then I must do this, and this has happened because of that. Nunes et al describe an investigation by Cheng and Holyoak who found that participants could solve similar logical problems where the contexts were meaningful for them, but found them much more difficult when the problems were non-contextual (Nunes, Schliemann and Carraher, 1993:140-145). However, the real world is far more complex than the psychology laboratory: problems do not arise, and are not solved, in isolation; they are part of the complex web of social relationships and our whole environment. We use our past experiences to predict what will probably happen, but we have to constantly modify our predictions in the light of what actually happens.

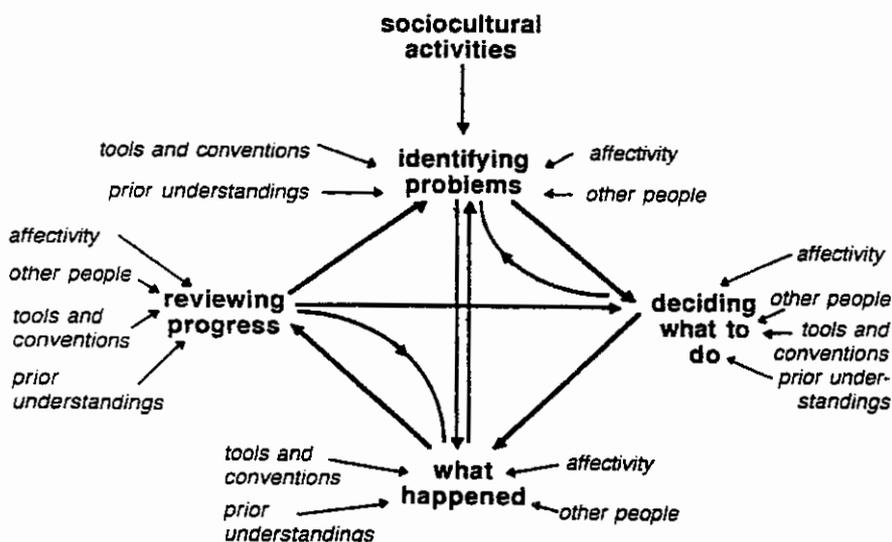


fig. 1: The logical structure in accounts of the solving of everyday problems

I will demonstrate how my model works in detail by an example. Fig. 2 shows how the model in Fig.1 applies to part of this example.

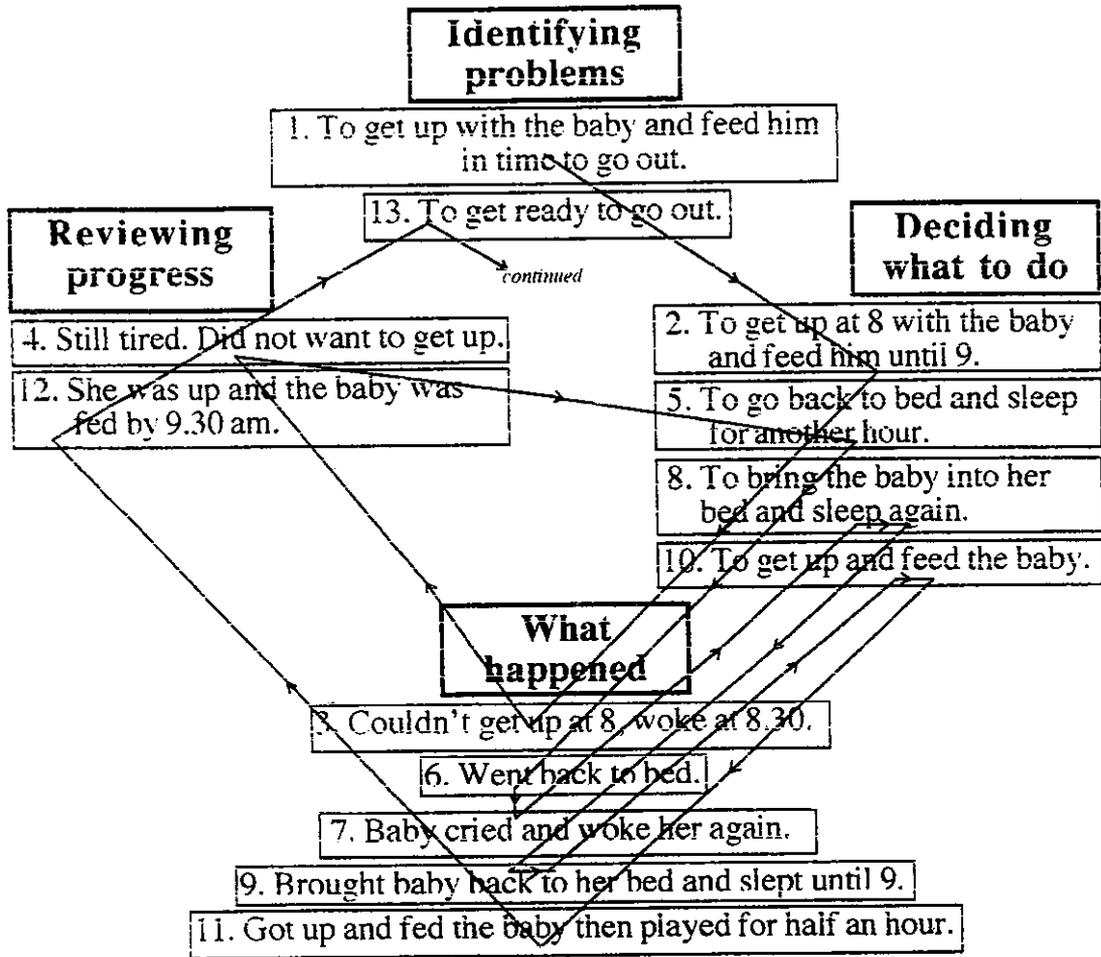


Fig. 2: The stages in Sheda's account of solving the problem of getting ready to go out

Sheda's account of getting up, getting ready, and coming to the group

Sheda gave an account of how she got herself to the focus group that morning. She identified two sub-goals she needed to achieve first, getting up and feeding her son, and she made some decisions.

'Last night I said, "OK, I have to get up at 8 o'clock", because my son, who is a year old, gets up at 8 o'clock. I allocated an hour for his feed. "I will finish feeding him at 9 o'clock."' A second sub-goal was to get herself ready, so she made a plan for this, "'Then maybe an hour will be enough for me to get ready.'"

This would give her time to get to the group by 11 o'clock.

But things did not go according to plan. Sheda reviewed the situation:

'First of all I had broken sleep, because (the baby) was a bit unsettled last night. So I woke up couple of times, then I couldn't get up at 8 o'clock. I woke up at half past eight. I went into the living room to look at the clock on the wall. It was half past eight. I said "Oh." Still I was a bit tired.'

She had a new goal of getting more sleep, so she made another decision,

'I say "Let me go back to bed and sleep for another half an hour."' But that did not work out either. 'Hussain got up and start crying.' Sheda made a fourth decision, 'I took him out of his cot and put him beside me in the big bed.' She got half way to getting her extra hour's sleep, 'Finally I get out of bed at 9 o'clock.'

She then continued with her original plan.

'Then I start feeding Hussain his milk and his breakfast. I think I finish it at half past nine.' Then she did something she had not previously decided to do, 'For another half hour I play with him.' Then she continued with her original plan of getting herself ready to go out, 'I have my breakfast.'

A new sub-goal emerged, to leave the baby with her husband. To achieve this she first had to wake him (another sub-goal).

'... at 10 o'clock ... he was still in bed and he wanted to continue. He said, "Oh, I'm tired."' Sheda made a decision and carried it out, 'I took Hussain and both of us walked to his room, and we say "OK, get up. Hussain, wake up your dad, it's time Mum should leave.'"

This plan eventually worked, 'He managed to get up at half past ten.'

At a quarter to 11, when she tried to carry out her plan of leaving the house, the baby stopped her.

'But Hussain cried when he saw me leaving. He wanted to be picked up and he wanted me to walk with him.' So she revised her plan, played with Hussain for ten minutes and then left the house. 'I left home at 7 or 8 to 11.' She was now on her way to the group. She had decided to walk to Archway to catch the bus. At this point she reviewed her progress again, 'I thought, "Oh, I'll be late.'"

Then her plan went wrong again,

'The bus didn't come. I waited for about 5 minutes.' So she reviewed the situation again, 'Then I thought, as it was Sunday maybe it won't come soon, so I said, "Oh, I shouldn't wait any longer." She made another decision, 'I walked. Always I was checking behind to see if it was coming so that I could run to it at the next stop. But I didn't see one.' At the

group she reviewed her decision, 'It took me about 35 minutes from home, so good exercise. I was quite right that I didn't wait, because I wouldn't be here, I would wait for bus.'

As she was giving her account to the group, she reviewed the whole situation, 'That's why I was late, things didn't happen the way I plan it.'

Sheda started off with a clearly identified overall goal: to get to the group at 11 o'clock. She recounted piecemeal the decisions she made which identified the main sub-goals she needed to achieve in order to reach this main goal: to get her baby up at 8 o'clock and feed him by 9 o'clock, to get herself ready by 10 o'clock, to get her husband up so that she could leave the baby with him, to walk to Archway and catch a bus to the group venue. She had calculated the time she needed for each sub-task. She reviewed what had actually happened from when she woke up late, and at each stage of the proceedings, and reformulated her goals and how to achieve them as she went along.

Sometimes she does not state her decision and describe carrying it out separately, 'I walked. Always I was checking behind to see if (the bus) was coming so that I could run to it at the next stop.' She is recounting what she did, and the decision to do it is implied. If she had not decided to walk she would have waited at the bus stop until the bus came. She may have made the decision to keep looking behind her, either before she started walking or while she was walking.

Some of the sub-goals only emerged during the process of achieving her main goal, for example to get her husband out of bed. Others, though formulated at the outset, were modified during the process, for example getting up at nine instead of eight.

The participants' accounts of their activities all fit this model of identifying problems or goals, of making decisions about what to do, of carrying out those decisions and then reviewing how far the goal has been reached or the problem solved. However, it is the participants' accounts of their past experiences which reveal this logical structure, rather than the experiences themselves. The question arises of whether the logical structure might be part of a reconstruction of a past experience, which happens during the formulation of the experience into the account. In telling a story about what has happened to us, do we unconsciously make it fit a logical framework which is part of our culture, the way we give accounts of ourselves? In the focus group, I only have access to accounts of previous experiences, not the experiences themselves. I am therefore being cautious about assigning the logical structure to the participants' solving of problems, and only saying that it appears in their retrospective accounts.

Cultural factors in solving problems

As well as revealing an essentially logical structure, the participants' accounts also accord with Saxe's four-parameter model of culture and cognition (see Fig. 3), where

he demonstrates that problems emerge out of cultural activities and are solved by people interacting in social relationships, with artifacts and conventions, and by drawing on their prior understandings.

... culture and cognition are constitutive of one another. ... Social conventions, artifacts, and social interactions are cognitive constructions and cannot be understood adequately without reference to cognizing individuals. At the same time, individuals' cognizing activities are interwoven with conventions, artifacts, and other people in accomplishing problems of everyday life (Saxe, 1991: 184).

These parameters appear at each stage of the process of problem-solving in the participants' accounts. The problems or goals which the participants described emerged from the socio-cultural activities in they were engaged. The participants interacted in social relationships, used artifacts and conventions, and drew on their prior understandings, during the identification of problems and goals, deciding what to do, carrying out the decision, and reviewing the results. I have shown Saxe's parameters in Fig.1, but I have called what he terms 'social interactions', 'other people', and what he terms 'artifacts', 'tools'. Fig.1 is therefore an expansion of Saxe's model (Fig. 3).

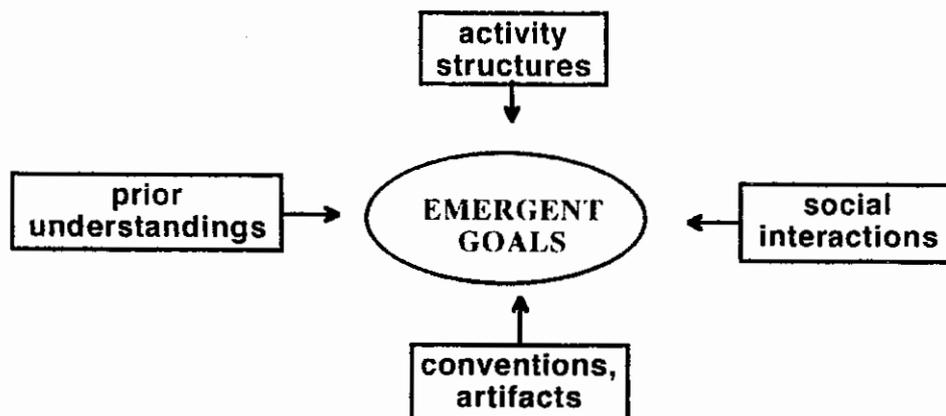


Fig.3 Saxe's four-parameter model

For example, in Sheda's account of getting up and getting ready to go out, her relationship with her baby is central to the whole process: her first consideration is his health and happiness in deciding what she has to do, in carrying out the decision, in reviewing her progress and in modifying her decision and the way she carried it out. She used her previous experience of feeding him and getting herself ready to go out to estimate how long these activities should take and she used the convention of clock time and the tools of the clock and calculating in hours to work out what time she should get up and to monitor her progress as she went along.

I shall be considering the roles of social interaction, artifacts and conventions and prior understandings in other papers. In this present one I shall focus on the role of feelings.

The role of feelings in problem-solving

There is an additional factor which does not appear in Saxe's model: affectivity. In the participants' accounts I found that they used many emotive words and talked a lot about their feelings. These were factors at every stage of the problem-solving process. The rest of this paper will focus on affectivity in problem-solving and its relationship to the logical process.

The role of feelings seems to fall into three categories: self-identity and choice; relationships; and feelings about maths and the avoidance of calculation and the use of formal tools.

- Self identity and choice

Choice is a strong strand of Western culture: people feel they have a right to make choices about things which affect them. For example, the participants in the group had strong feelings about being early or late. Some of them did not like being early, for example Claire said, 'I hate arriving anywhere early. I go for being on time, but I don't like being early.' Others took the opposite view, like Eileen who said, 'I prefer to be a bit early.' Only Jean said she is not consistently early or late, 'Sometimes I'm very early, sometimes I'm horribly late. I tend to sort of go with the flow.' But she describes being late as horrible, indicating a strong emotion.

These feelings about punctuality affect the way the participants make decisions about time for their activities. For example, Eileen said, 'If it will take half an hour, I allow three quarters of an hour. I need to get up at eight, so I'll get up at half past seven.'

The participants were aware that their attitudes to punctuality often either made them late or meant that they were wasting time. Eileen said, 'I allow too much time: I get to lectures half an hour early. I end up waiting for people for ages. I'll end up faffing round because I've got so much time on my hands, which I could be using better, if I organised myself better and realised I was leaving too much time.' Claire said, 'I never allow for the fact that I might not be able to find my shoes or my keys'. However it seemed as if these patterns of behaviour were ones people did not want to change: they were describing situations which had occurred many times. Jean said, 'There's not a lot I intend to do about it. It's something that I accept what I do.' It seems as if each person had a view about their own punctuality which was an element of their self-identity.

- Relationships

Social relationships are an important factor in problem-solving in everyday life, as Saxe showed (1991: 17). How people feel about the important relationships in their lives also affects how they resolve problems that emerge as part of their day-to-day relationships, like managing their time and money together.

Ruth talked about her feelings about the financial side of her relationship with her partner. 'He used to make jokes when I was working part-time that he was keeping me, which I didn't like, despite the fact that I've kept him before when he was on the dole...' Even though she said, 'It's not really serious', she seemed to feel this was an attack on her identity as a woman who can support herself, as well as being unfair.

Until recently Ruth and her partner had not kept accounts together, 'We lived together 10 years without structuring who paid what.' But buying a flat changed the way they managed their money together.

... since we moved into this flat that we bought, I've started putting the big things on a spreadsheet, like the bills. Because he believes he pays a lot more than me. I wanted to prove to him that although he does pay more it's not a vast amount. I pay the gas, he pays the electricity. I pay the phone, he pays the water. Now my little computer has it in black and white, I do pay hundreds and hundreds of pounds every year, despite his beliefs to the contrary.

Ruth's position in the relationship as nearly financially equal is important enough for her to go to the trouble of creating the spreadsheet of their expenditure. She did not do this to help her manage her money, but to demonstrate her position to her partner.

On the other hand, Ruth is adamant that she does not want to be meticulous about everyday spending. She was horrified by the behaviour of some friends of hers,

... a couple who have just moved in together, keep a note of everything so that they can balance it out, so one person didn't pay more than the other and all that. I couldn't do that, not for anything in the world. Can't bear to do that sort of thing somehow, it's horrible isn't it? I wouldn't like to keep a record of, we went out for dinner and I paid for that. It's too much really.

Ruth's relationship with her partner and the way they manage their money are deeply intertwined: their management of their money defines their positions relative to each other, and their feelings about their relationship structures the way they manage their money. Feelings about maths: the avoidance of calculation and formal tools Although the participants in the group did describe using tools like clocks, money and spreadsheets, there was a lot of evidence of the avoidance of other formal mathematical tools like timetables, measures, and of exact calculations. The participants employed strategies to solve some of their everyday problems which did not require the use of such tools. Cathy recounted her procedure for catching trains from Harrow,

There's two trains going into central London. There's the fast train and the slow train, and I never know which it is going to be. I know there's a train every ten minutes or so. I have to allow for the fact that it's going to be the slow train which takes an extra 15 minutes. Quite often I might catch the fast one. I allow an hour to get into the centre of London and quite often I'm there half an hour early. But if I didn't plan that, I could be late.

So Cathy's method of getting to London at a certain time is to calculate what time she needs to leave Harrow if she is travelling by slow train and to arrive at the station at that time.

Then she said, 'I should look at the timetable and work out when (the fast train) is, but that's a bit too organised.' She is displaying a reluctance to use a mathematical tool, the timetable, and to be 'organised', to behave in the most efficient way. She prefers to arrive at the station with enough time to get on whichever train comes along and still be early enough for her appointments.

But she said she 'should' look at the timetable: she is expressing a moral imperative to behave efficiently, which she is choosing not to obey. I suspect that this may be a response to her perception of me as a mathematical person, representing maths teachers in her past, who in turn represent the view of the wider society's institutions: that people should behave efficiently. It is one of the rationales for providing universal formal maths education: to equip future citizens with skills which are supposed to enable them to function efficiently in a post-industrial society.

But the well-educated adults in my group choose not to read timetables, not to calculate their money exactly, not to measure things exactly, and not to calculate exact times, in many of the situations they described. When they did do calculations, they often did not use the standard methods taught in schools. Rhiannon tried to divide the three hour span of an exam into equal time for four questions by using an informal method: I worked it out using a circle. I drew a circle to represent a clock-face at the top of the page. I kind of imagined 40 minutes for each question first of all. Then I traced from the top, the 12 o'clock point, to 40 minutes, and made a mark for one. (She indicated this with her finger.) Then let's see, another 40 minutes would be 20 past, so I made another mark. Then another 40 minutes would be up to the hour. So that's two hours for three questions. Another hour for the other, so that was wrong. It was this kind of not very exact testing out of how much time.

She did not complete her calculation, 'At this point I abandoned (it), I decided I better start' (answering the exam questions). She had worked out enough to know that she could spend 40 minutes on each question and have some time left over. She did not feel it was necessary to complete the calculation.

Discussion

The cultural factors identified by Saxe, social relationships, artifacts and conventions and prior understandings, are an integral part of every stage of the problem-solving

process. Affectivity is an additional important factor at every stage in my data. The focus group seemed to be a particularly fruitful way of collecting such data. My data also demonstrates that people's accounts of the way they solve problems that emerge from their everyday activities have a logical structure: they employ the law of cause and effect. This might appear to be a contradiction: that people solve problems logically but that their feelings are factors which contribute to the logical process. But people are giving value to their feelings in making decisions, both in what they choose to do and how they choose to do it.

The question of whether people put the logical construction on their activities afterwards when they are giving an account, or whether the logical structure is present throughout the problem-solving process, requires further investigation. I am planning to inquire into this in the focus group by asking the participants to consider it themselves. In the other part of my research project, where I am observing people at work and therefore have access to problem-solving in process (1998, I), I intend to follow the whole restructuring of a garden and upholstering of a piece of furniture. I will discuss with the workers their perspective on their progress as they proceed. They will still be formulating accounts of what they are doing, but these will be as the problems are being solved, not afterwards, so the accounts should be closer to the workers' thinking process.

Another area which I think would be worth focusing on is the point at which people decide to review their progress during the process of solving a problem, especially when the activity is an unfamiliar one, or when things go wrong. What makes them stop what they are doing and consider whether they are likely to achieve their goal if they continue? I am planning to investigate this by asking both the participants of the group and the workers.

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Appendix: Everyday maths group coding list

- identification of goals
 - affectivity (preference)
 - description of goals
- planning the process of achieving the goal
 - conceptualisation of the result
 - visualisation
 - tools
 - obtaining information
 - remembering previous experience/knowledge
 - cultural patterns
 - intuitive/subconscious
 - from elsewhere
 - measurement
 - standard units
 - tools
 - traditional or natural units
 - tools
 - estimation without tools
 - calculation
 - methods
 - making comparisons
 - representation
- affectivity

- execution of task
- process
- learning
 - process of learning
 - by observation of other people
 - from instruction
 - practice
- resources/tools
- affectivity
- reviewing the execution of the task / achievement of goal
- affective issues
 - perception of ability
 - habits
 - relationships
 - others' reactions