Applying a dialogical model of reason in the classroom

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Recently there has been an increasing number of studies in psychology informed by dialogical rather than monological theoretical assumptions. In the area of cognition and learning this ‘dialogical turn’ implies a move away from explanation in terms of underlying cognitive structure toward descriptions of the dynamic construction of meaning in conversations (e.g. Edwards and Potter, 1992). In this chapter I argue that accepting dialogical assumptions does not mean abandoning useful models of cognition but that on the contrary models of cognition that follow from dialogical assumptions can be used very effectively to guide educational practice. I will make this argument through a discussion of the findings of several research studies in which a dialogical model of reason was applied to teaching in classrooms. This chapter has five main sections: the first outlines what I mean by the dialogical paradigm, the second discusses the nature of dialogical models, the third offers an explicitly dialogical model of reason for education, the fourth describes research applying this model in classrooms and the fifth and final section discusses the significance of the findings of this research for re-thinking collaborative learning.

8.1 The dialogical paradigm

Those who use the term 'dialogical' often refer to the Russian writers Bakhtin and Volosinov. Volosinov puts the dialogical position very clearly when he writes:

> meaning is like an electric spark that occurs only when two different terminals are hooked together

and further that:

> In essence meaning belongs to a word in its position between speakers; that is, meaning is realised only in the process of active, responsive, understanding. (Volosinov 1929/86 p102-3).

The claim being made is that meaning is never simply given but is always created out of the interaction between different voices and different perspectives. This implies the further claim that when people understand or know something they do so dynamically in a communicative act and not statically in a structure (Wells, 1999, p 77).

To understand the significance of the dialogical turn it is necessary to consider the contrasting monological paradigm that can still probably be said to represent the mainstream in psychology. The monological paradigm in science generally seeks to find the universal laws and structures underlying surface phenomena. The ideal motivating this endeavour is to produce a single logically coherent model of everything independent of perspective. The monological paradigm is often accused of overlooking the fact that knowledge is never independent of social, historical and biological contexts that give it meaning. One aspect of the contextual background required to interpret knowledge claims is their position within conversations including what could be described as the long-term conversations of a culture. The dialogical claim from Bakhtin and Volosinov is that any utterance needs to be seen as a link in a chain of communication (Bakhtin 1986, p69). Dialogicality means not merely that participants in interactions respond to what other participants do, they respond in a way that takes into account how they think other people are going to respond to them. Rommetveit calls this circularity 'atunement to the atunement of the other' and points out firstly that it influences most human behaviour and secondly that it is impossible to understand the effects of this circularity using monological representations (Rommetveit, 1992). Monological models assume closed systems with regular and therefore discoverable relationships between inputs and outputs. If human behaviour has to be understood in much the same way as we interpret meaning in a continuing dialogue then, as Rommetveit claims, monological models are inappropriate.

In the monological paradigm it is normal to see models as a way of getting a handle on reality which we can use to inform interventions that change things. For those who adopt the assumptions of the dialogical paradigm on the other hand the role of models is not so straightforward. 'Post-structuralist' writers such as Foucault and Derrida apply some of the assumptions of the dialogical paradigm to question both the feasibility and the desirability of producing useful models of human behaviour. This theoretical position is an influence on those discursive psychologists who side-step the issue of the 'reality' or 'usefulness' of their accounts in favour of a focus on examining the rhetorical conventions applied by others (E.g Edwards, 1996). In the following sections I will take 'reason' as a paradigmatic case to show that dialogical models of cognition are possible and can be applied as a useful tool for changing reality.

8.2 The concept of a 'dialogical model' of reason

Models of reason in psychology that refer to logical structures in the mind reflect a strong tradition in the philosophy of rationality linking human reason to formal logic and mathematics. The social philosopher Habermas challenges this monological tradition in accounts of reason and proposes an alternative dialogical account of reason that he calls 'communicative rationality'. I do not intend to outline his argument here but merely to draw from it features that can be used to characterise dialogical models of cognition in general. Habermas begins his account of communicative rationality by drawing a distinction between 'a success-oriented attitude' and 'an attitude oriented to reaching understanding' (Habermas 1991, p 286). While he does not dismiss the strategic or profit-maximising rationality that issues from a success-oriented attitude he argues that this kind of rationality is a parasitic

derivative of the more fundamental communicative rationality issuing from an attitude oriented to reaching understanding.Use of the word ‘attitude’ carries with it the danger of being interpreted as only referring to individual states whereas Habermas makes it clear that he is referring to ways in which participants in a dialogue can orient themselves to each other or what he refers to as the ‘structural properties’ of intersubjectivity. For this reason I will use the term ‘intersubjective orientation’ in place of attitude. I propose that, in some form or other, an account of intersubjective orientation is a necessary feature of dialogical models of cognition.

To understand what an account of reason as an intersubjective orientation might mean in practice we have only to turn away from the specialist discourse of philosophy and psychology to ordinary language use. When we describe someone as a 'reasonable' person we do not normally mean that they are good at abstract logic or at mathematics but that they listen to what others say to them and respond appropriately. This everyday idea of what it means to be 'reasonable' describes the ‘intersubjective orientation’ of seeking mutual understanding.

An account of intersubjective orientation may be necessary to a dialogical model of reason but in itself it is not sufficient for a useful model that could be applied to education. In Habermas’s account of communicative rationality a second level of description of reason is often referred to as the social rules governing what he calls an ‘ideal speech situation’ but he neveractually gives details of what these rules are. At one point he quotes approvingly an account by Alexy of the procedural rules that might be used to structure a speech situation in which unforced agreement could be achieved, these are participation rules of the kind that every participant has an equal right to participate and to question claims (Habermas, 1990 p 92). Procedural rules of this kind are not in themselves reasoning but it may be possible that reasoning can result from the interaction of agents each following a few simple procedural rules. One metaphor for understanding how following social ground rules can lead to reasoning is provided by computer simulations of complex adaptive systems.

While computer models of cognition based on the information processing implement monological assumptions, computer simulations of complex adaptive systems are based on a computer implementation of the complex feedback loops used by Rommetveit to characterise dialogicality. Casti argues that such simulations represent a new scientific method distinct from methods of experiment and linear mathematical modelling that were developed in the study of closed and relatively non-complex systems (Casti, 1997). A complex adaptive system is any system in which several agents reciprocally adapt to each other. Once agents reciprocally adapt to each other the circular feedback loops involved produce a level of complexity that makes reduction to a monological model impossible. One solution adopted to studying complex adaptive systems is to simulate them with programmes in which multiple agents are each given a set of rules of behaviour and possibly also rules on how to adapt those rules and then set loose to interact. Such studies have found that the interaction of many agents each following simple rules can result in the 'emergence' of new self-organising systems that can not be predicted or explained by the rules that the agents are following. One striking example is the simulation of flocking behaviour which was achieved by giving virtual birds three simple rules to guide their flight, keep a minimum distance from neighbours, fly at about the same speed as neighbours and always fly towards the perceived centre of the mass of birds. Understanding

flocking had been seen as a hard problem until this simulation clarified how it might work (Waldrop, 1992, p 241-3). An illustration of ‘emergence’ in complex adaptive system closer to dialogues is provided by Robert Axelrod’s various demonstrations of the emergence of apparently co-operative behaviour in simulations of social interaction (Axelrod, 1997).

The conclusion of this brief discussion of approaches to dialogical modelling is that a dialogical model of reason has to take some account of the possibility of different intersubjective orientations and could consist of a description of the social ground rules followed by agents in an interaction. In the next section I will describe the development of a specific and useful dialogical model of reason.

8.3 A dialogical model of reason for the classroom

The dialogical model of reason implemented in research which I describe below began with a characterisation of 'types of talk' found empirically in collaborative learning in classrooms. The three 'types of talk' described by Mercer (1995) can also, as a later article made clear (Wegerif and Mercer, 1997a) be seen as reflecting fundamental intersubjective orientations:

- cumulative talk reflecting an orientation to share and understand each other but without any critical grounding of shared knowledge,
- disputational talk where individuals treat dialogue as a competition which they seek to win and
- exploratory talk which is oriented to sharing knowledge like cumulative talk but with the addition of critical challenges and explicit reasoning

Of these three intersubjective orientations the one found most educationally desirable by teachers was exploratory talk. This combines features of cumulative talk, being a kind of cooperation, with features of disputational talk, because it includes challenges and competition. To turn this idea of orientation into a useful model that could be applied in a classroom we needed to specify it more closely in terms of social ground rules. Teacher-researcher Lyn Dawes, Neil Mercer and I developed the following list of social ground rules partly influenced by a survey of the literature on effective collaborative learning (see review in Mercer 1995, p. 90-95), partly influenced by the philosophy of rationality (see discussion above and Wegerif, 1999) but mainly based on our experience in classrooms. From these different sources seven ground rules were put forward:

1 all relevant information is shared
2 the group seeks to reach agreement
3 the group takes responsibility for decisions
4 reasons are expected
5 challenges are acceptable
6 alternatives are discussed before a decision is taken
7 all in the group are encouraged to speak by other group members

It is noticeable that the first three of these ground rules are shared with cumulative talk. These are rules that help to unite the group and to create a positive atmosphere for group work.

Wegerif and Mercer (1997a) characterise dialogical reason through a hierarchy of levels of analysis. Intersubjective orientations are realised within any given social and historical context through the use of specifiable ground rules. Each ground rule is in turn realised by a specifiable range of ‘communicative actions’ by which I mean utterances or gestures classified by their function such as to put forward a claim or to support group solidarity. Similarly each such communicative action is realised in a given context by a limited set of phrases, words, grammatical features, gestures, intonations and so on.

8.4 Applying this dialogical model of reason

We explored the impact of explicitly teaching dialogical reason in three separate studies.
1) Study 1 looked at the effects of explicitly teaching dialogical reasoning on children’s understanding of citzenshipissues and on group reasoning tests over a 10 week period in one class of approximately thirty 8 and 9 year old children with a matching control class.
2) Study 2 was a similar but larger study in which we worked with three target classes of approximately 30 children each in three schools with three similarly sized matching control classes. As in the first study all children were aged 8 or 9. In this study different tests were used to focus on the effect of explicitly teaching dialogical reasoning on individual reasoning. We also looked at the effect of teaching dialogical reasoning on conceptual understanding in science. In addition the study was partly designed to explore the transfer of this method of teaching from the original school to other schools.
3) Study 3 is continuing and is called the Raising Achievement through Thinking and Language Skills. This study was initiated by teachers and is mainly run by teachers with part funding from the Local Education Authority. Our involvement is continuing and focuses on the further development and dissemination of practical teaching methods.

We asked different questions in each study. One of the major themes of the first two studies was the improved use of ICT in the classroom. Another major theme of study 2 and of study 3 was the effect on the whole classroom as a discursive community. In this chapter I will focus on the effect that the explicit teaching of ground rules of dialogical reason described above had on the talk and the reasoning of children. I will limit myself to the published results of the first two studies as study three, which is still continuing, has not yet produced analysed data.

8.4.1 An educational programme to teach dialogical reason

All three studies included the explicit teaching of dialogical reason. In the first two studies Lyn Dawes took the lead in devising a series of ten 'talk lessons' around the ground rules outlined above. Each of the talk lessons had three phases, teacher led discussion, small group work and whole class plenary. The ground rule or rules being taught in each lesson was made explicit at the beginning and re-visited in the plenary. Each lesson began with explicit modelling by the teacher of the use of the ground rule that the lesson was focussing on and possibly some of the language strategies associated with it. (Examples of language strategies might be using 'Why?' to

challenge, 'because' to give reasons or asking all in the group to agree before taking a decision). Each lesson included small group work in mixed ability and mixed gender groups of three. The teacher visited each of the groups in turn to support their use of the ground rules and language strategies. At the end of the lesson the groups reported back to the class and the teacher once again emphasised the aims of the lesson.

The early lessons in the series were designed to raise awareness of different ways of talking together and to teach the communicative pre-conditions of exploratory talk such as effective listening, giving information explicitly and co-operating as a group. Later lessons encouraged the use of all the ground rules in critical discussions of issues in different areas of the curriculum.

Full details can be found in a practical book for teachers (Dawes, Mercer & Wegerif, 2000). To illustrate the 'talk lessons' approach I will describe one of the key early lessons in the series. The class teacher begins by telling a story, she then asks the class to discuss it in groups of three giving each group just one worksheet containing questions to talk about and answer boxes to fill in. After this activity the children are brought together again into a whole class group and asked to give feedback first on what they had thought about the story but then also on the ways in which they had talked about it together. How did they reach a group decision? What sort of thing worked and what didn't? The teacher then leads the children to suggest rules for working together. These rules are written down by one of the children on the board as they are produced. The teacher then goes through each rule to discuss it further. Some of the rules are usually inappropriate like 'don't talk unless you have your hand up' but others will fit the ground rules of dialogical reasoning that we have proposed. The teacher leads this discussion to produce a final set of 'class ground rules for talk'. This list of ground-rules is then to be displayed prominently on the wall of the classroom. In all succeeding talk lessons these rules can be referred to as 'our rules for talk'.

Encouraging children to take an exploratory orientation and to use these ground rules meant working with teachers not simply to 'teach' these ground rules but to turn the classroom into a social and physical environment that supported and rewarded their use. The ground rules displayed on the wall were important for this as were the seating arrangements and the frequent reminders from the teacher that the way groups talked together was as important and valued as the answers that they came to. Equally important was the way that the teacher talked with the class. Using our talk lessons led the talk of the teachers to changes almost as much as the talk of the children.

In the first two studies these lessons were taught every week for approximately ten weeks with each lesson lasting about one hour. The teachers we worked with were also encouraged to apply the same teaching approach to other lessons.

8.4.2 Impact on curriculum learning

In both study 1 and study 2 we looked at the effect of teaching exploratory talk on the quality of interaction in collaborations around computers. In study 1, using qualitative analysis and quantitative measures we showed that the intervention programme led to longer and deeper discussion of citizenship issues presented through educational computer software and so could be shown to serve the stated aims of the citizenship curriculum in England. In study 2 we also demonstrated that the ground rules we

taught helped conceptual change and learning in science. Pre and post test questions given to 20 children using a simulation designed to prompt reasoning about friction showed a statistically significant learning gain. The more important method for us was the analysis of the talk of groups of children working around this science simulation. This analysis showed apparent learning in the talk of the children. We related this learning to the outcome measures by linking episodes in their talk to changes in the answers they gave to our questions about the nature of friction. These two studies of talk around curriculum related activities used computer-based tasks specially designed to support learning through reasoning together. They are reported in more detail in Wegerif, Mercer & Dawes (1998).

8.4.3 Reasoning test results

To help explore the questions about improvements in group and individual reasoning we used pre-intervention and post-intervention testing with Ravens matrices in both study 1 and study 2. The Raven's test consists of a series of geometric shapes where the children have to discover the pattern in order to continue the series. Results on these tests correlate well with other academic achievement measures and is said to be the best measure of 'g' or the concept of general intelligence (e.g. Carpenter, Just & Shell, 1990, p. 428). The literature on the concept of ‘g’ and the design and normal use of this test is based on a monological model of the nature of reasoning. We used this test specifically to explore the relationship between our dialogical model of reasoning and the more traditional monological idea of reason that these tests had been developed to measure. In this we were not so much concerned to deny the concept of general intelligence as to show how this concept can be usefully re-described as a specific way of using language.

In both of the first two studies we used a similar design giving different versions of the Raven's Matrices test to individuals and to groups in target and control classes before and after a ten to twelve week intervention. The groups were mixed ability and mixed gender groups of three selected by the teacher. In the first study we divided the 60 questions of the Raven's progressive matrices into two equally difficult tests of 30 questions each. We gave one of these tests to the children working in groups of three and the other to the same children working as individuals three days later. The same procedure was repeated at the end of the intervention programme. In the second study we had a similar design but used the full 60 questions of the Standard Progressive Matrices for the groups and the 36 question Coloured Progressive Matrices for the individuals. In the first smaller study with one target class and a matching control class we found a statistically significant improvement in both groups results and individual results (reported in Wegerif, 1996). In the second study using three target classes and three control classes we found a significant difference between conditions only for the individual test score improvements (reported in Wegerif, Mercer & Dawes, 1999). While the target group scores improved overall by 10% and the control scores remained the same this difference between the conditions was not found to be significant. Some of the difference between the results of study 1 and study 2 may also be accounted for by the different tests used since the full SPM of sixty questions proved to take a very long time when each question was discussed in groups. There was also a difference in the results obtained for each of the three classes with the biggest improvement in test scores in the class of the teacher-researcher (Lyn Dawes)

who originated the programme and the test scores staying much the same in the class of the teacher who we had found it hardest to keep in touch with.

In all our studies we have found that the role of the teacher is crucial. To effectively teach the ground rules of dialogical reason each teacher has to change their own way of talking with pupils so as to model and encourage questioning and reasoning. This is not a simple or automatic procedure that can be communicated with a few lesson plans – it requires commitment from teachers and no programme will produce uniform results.

The children in study 2, showed an improvement in their individual test scores after a programme teaching essentially social ground rules. These findings support the claim that children learn to reason better as individuals through personally appropriating strategies used first in dialogue with others. This finding fits well with Vygotsky's claim that, as he put it: ‘all that is internal in the higher mental functions was at one time external’ (Vygotsky, 1991, p 36) meaning that the ability to perform cognitive tasks when acting alone stems from a prior socialisation process when the same or similar tasks are performed with the help of others.

However these test results do not tell us very much about the effects of the ground rules of dialogical reasoning on group processes. It was clear from our observations that these ground rules were not taught equally effectively in all classrooms, were not appropriated equally by all groups and were not used all of the time even by those groups who did use them effectively some of the time. In addition to test results it is obviously important to look at the actual talk of children together.

8.4.4 Exploring changes in the talk of children

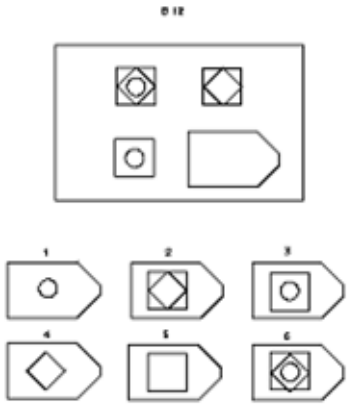
In both study 1 and study 2 we selected focal groups, three per class, said by the teacher to be representative of the ability of the class and we video-recorded their talk around Raven's test problem before and after the intervention. When we transcribed these sessions and analysed the differences between the talk after the intervention programme and that before we found marked differences for most target groups. These changes included an increased overall amount of talk as well as an increased use of terms associated with explicit reasoning such as 'because', 'agree' and modals and an increase in the number of long turns at talk. We were able to link these general features of language change to specific instances of successful problem solving. In other words groups successfully solving problems in the post-test that they had failed to solve in the pre-test tended to use the key words we had noted and longer turns at talk. The aim of our analysis was to explore the effect of changes in the ground rules that groups were using on the way that they used language as a tool for thinking. We did this using quantitative methods such as counting key words and long turns and also by using a computer-based concordancer which enabled us to quickly produce lists of key words in their immediate contexts in order to explore changes in the way that key words were used. These methods were used to demonstrate that the findings of more detailed qualitative studies could be generalised (see Wegerif & Mercer 1997b for an account of this approach). Detailed qualitative analysis is crucial to our claim to provide evidence for the effectiveness of our dialogical model of reason. The next sub-section gives a small illustration of this kind of analysis.

8.4.5 An example of children thinking with language

The group we illustrate below, Susan, George and Trisha scored 39 SPM questions right in the pre-test and after our lessons they got 47. There were eight questions that they had failed to solve in the pre-test which they managed to solve in the post-test. Focusing on the talk around these questions enabled us to compare successful talk with unsuccessful talk with the same problems and the same children.

What follows is a shortened version of the full analysis that can be found in Wegerif and Mercer (2000). Line numbers refer to the original full transcripts. Other than the use of line numbers the transcripts are presented without special conventions and punctuated to be readable.

Figure 8.1. Problem B12. Raven's SPM



A. Extract from Susan, George and Trisha talking about the problem before our talking lessons

1	Trisha:	Square and diamond, it's 2.
2	George:	No it's not.
3	Trisha:	It is 2.
4	George:	No it's not
5	Trisha:	It is.
6	George:	No it's not.
7	Susan:	It's that one, 6.
8	Trisha:	It is.
9	George:	No it's not it's got to be a square and a circle.
10	Trisha:	Its that, it has to be that, it has to be that, it has to be 6 because look they've only got that (*pointing to the pictures*).
11	Susan:	Look first they are starting with one of them things over (*pointing*) and then it has to be black
12	George:	Right, 6.
13	Susan:	No it isn't George. (*talk continues around problem B12 for a further 11 turns with dispute over the correct answer turning into a physical struggle over control of the pencil*)

B. The same group doing the same problem after the lessons: extracts from the beginning and the end of the session.

1	Trisha:	That has got to be a diamond, a square with a diamond with a circle in that one, number 6, do you agree?
2	George:	No, what do you mean?
3	Trisha:	OK, no it's got to be square
4	Susan	I think it's number 6 – that's the one
5	George	No it ain't
6	Susan	I think it's number 6
7	Trisha	No 'cause it's got to swing round every time, so there is a circle in it
8	Susan	Yes but it hasn't got a circle in there has it and that one has (*indicating*)
9-20		(*They continue for 12 turns looking at different options but getting no nearer a solution, then Trisha comes up with something new*)
21	Trisha:	Look that's got a triangle, that's got a square, look that's got a square with a diamond with a circle in, that's got a square with a diamond in and that's got a square with a circle in so that's got to be a square
22	George:	I don't understand this at all
23	Trisha:	Because look on that they've taken the circle out yes? So on that you are going to take the circle out because they have taken the circle out of that one
24	George:	On this they have taken the circle out and on this they have taken the diamond out and on this they have put them both in, so it should be a blank square because look it goes circle square
25	Susan:	It's got to be a blank square. Yeah it is.
26	George:	Do you agree on number 5, do you agree on 5?
27		(*George writes '5', which is the correct answer*)

In the pre-intervention talk George challenges Trisha's first suggestion ('It is 2' line 3) without giving a reason. Trisha offers no further justification for her suggestion. This leads into a series of exchanges typical of the type of talk we call 'disputational', in which participants simply assert their opposing views without reasoning.

After the intervention Trisha is the first to propose an answer (line 1), but this time she does this not as a statement ('it is 2') but as an elaborated hypothesis with a question encouraging debate ('That has got to be a diamond, a square with a diamond with a circle in that one, number 6, do you agree?' line 1). George asks for more explanation (line 21). This time his challenge prompts Trisha to attempt to be more explicit. Through this effort Trisha appears to see that she is wrong and changes her claim.

Many features of the talk are different in the second transcript section. Explicit reasons for claims are given (e.g lines B8, B22, B25), challenges are offered with reasons (e.g line B7), several alternatives are considered before a decision is reached

(in the full transcript answers 6, 3 and 4 are explicitly suggested in turn and decided against before 5 is agreed upon), and the children can be seen seeking to reach agreement together (e.g lines B23-27). Explicit reasoning may be represented in talk by the incidence of some specific ways of using language, and we can see here some 'key features ': the hypothetical nature of claims is indicated by a preceding 'I think' (line B4 and B6), reasons are linked to claims by the use of 'because' or "cause' (lines A10, B7 and B24) and agreement is sought through the question 'do you agree?' (line27). Explicit reasoning requires the linking of clauses and leads here to the incidence of a greater number of longer utterances in the post intervention talk than in the pre-intervention talk. As I wrote earlier this same group solved a total of eight new problems in the post-test which they had failed to solve in the pre-test. When we compared talk that led to the group solving these problems correctly with talk that led to wrong answers, we found that there was a clear association with the number of these key linguistic features. We used a concordancer not only to count terms but also to explore the contexts in which they were being used (See Wegerif & Mercer, 1997b). We found that terms such as 'because', terms introducing a reason clause, were used to point to verbal context in the more successful talk whereas in less successful talk 'because look' frequently occurred on its own with children pointing physically at the picture. This different way of using 'because' is illustrated in the transcript extracts above:

A10 Trisha: Its that, it has to be that, it has to be that, it has to be 6 because look they've only got that (*pointing to the pictures*)

(*Unsuccessful talk. Pre-intervention*)

B23 Trisha: Because look on that they've taken the circle out yes? So on that you are going to take the circle out because they have taken the circle out of that one.

(*Successful talk. Post-intervention*)

In comparing these two ways of using because we see a shift in the talk from pointing to the physical context (Line A10) to pointing to a verbal context which the children construct together (line B23). This is a general finding of the impact of explicitly teaching the ground rules found also in the first study. This shift is also apparent in the far greater number of long turns at talk found in the more successful talk.

Figure 8.1 about here

In pointing to the process of 'taking the circle out' (Line B24) Trisha is pointing to something that cannot be pointed to directly in the picture. It exists only in words. In the next line (line B25) George repeats what Trisha says and applies the same process of ‘taking out’ to the diamond as well saying ‘they have taken the diamonds out’. Turning back to Figure 8.1 we can see that this combination of taking the circle out and taking the diamond out described the solution to the problem. Once Trisha has

made this relationship verbally explicit George is able to see it and he echoes Trisha's construction repeating her ‘taken the circle out’ construction and applying it to the diamond as well the circle (perhaps the element of repetition in language here helps George appropriate this ‘concept’ or way of using words for himself).

Further exploration showed that this use of language to make relationships and processes visible was generally found to be the case in the more successful talk of all the groups. Expressions such as 'the same', 'getting fatter', 'that and that make that' or 'add that to that and you get that' were all used for this purpose.

8.5 The significance of these findings for a dialogical understanding of collaborative learning

It is interesting that in the example just quoted we can see the group learning to use language to think about virtual operations such as subtraction ('taking the circle out'). In the transition from the language of the pre-test to the language of the post-test there is a shift from performing quasi physical operations on the picture without naming them to using language to describe, reflect on and generalise those operations. This shift is accompanied by the use of more complex utterances with increased use of embedded clauses - in other words a new kind of structure is visible in the language used. The results of the individual reasoning tests that we used suggest a connection between the way that the children used language to think together and the way that they then solved problems working on their own. All this suggests the possibility that applying the ground rules of exploratory talk is leading here to the genesis of structures of thought within dialogues which are then appropriated by individuals. This does not necessarily imply a model of cognition incompatible with the idea that cognition is also located in the brain. As Harre & Gillet (1994) propose it is possible that the neural pathways of the brain are organised to reflect rules originating in the social use of language rather than the other way round. (Harre & Gillet, 1994, p77)

The new science of complexity theory can provide useful metaphors to think about collaborative learning. The idea that agents each individually following simple rules can produce an emergent self-organising system that is not reducible to those rules has already been applied by many writers to suggest a possible account for such higher mental faculties as reason and self-consciousness (Juarrero, 1999: Edmonds, 1997). It is also useful for thinking about how our dialogical model of reason worked in the classroom. We succeeding in increasing the quality of reasoning and learning in group work by influencing the social ground rules that the children followed when working together. We did this by working with teachers to change the kind of behaviour that the social and physical environment of the classroom supported and rewarded.

The use of computer simulations to explore complex adaptive systems has led to claims about some general features of such systems which can offer a further analogy for thinking about the nature and role of the 'intersubjective orientations' or 'types of talk' that our model of reason started with. Some initial sets of rules given to interacting agents, will tend to produce dissipation into uninteresting randomness, while other rules will lead the system to move towards a rigid structure where no creative change can occur. The transition point between these two extremes,

sometimes evocatively referred to as 'the edge of chaos', is where the most interesting creative evolutionary 'emergence' is found (Coveney & Highfield, 1995, p273). In the classroom exploratory talk, talk supporting reasoning, was defined in relation to two other fundamental types of talk found in classroom groups, cumulative talk in which children tend to agree uncritically and disputational talk in which they compete with each other. Taken to their extremes both cumulative talk and disputational talk do not lead to the construction of new understandings. With cumulative talk the group always tend to lock in too quickly to solutions without critically considering alternative possibilities and disputational talk tends to fragmentation reflected in short disjointed turns at talk. The ground rules of exploratory talk do not directly teach children how to think. They serve to open up and maintain an intersubjective space of creative diversity in which alternative solutions to problems are generated and allowed to develop and compete as ideas without threatening either group solidarity or individual ego-identity. However if our pedagogy served to open up and maintain a creative space between collaborators it was also successful in making that creative freedom work to support the needs of the education system. In other words effective collaborative learning opens a space free from the constraints of identity in which difference is allowed free play within a framework in which the products of that creative diversity are put to work to serve social ends.

8.6 Conclusion

Thinking about collaborative learning from a dialogical perspective shifts the focus of attention away from abstract cognitive structures and toward the ways that people respond to each other in dialogues. Our research explored this perspective by developing and applying a dialogical model of reason consisting of an intersubjective orientation that we called ‘exploratory’ and a set of ground rules specifically designed to support collaboration in the classroom. This dialogical model proved an effective support for teachers. Its implementation resulted in a significant improvement in the quality of collaborative learning and reasoning. A fine grained analysis revealed that the ground rules of exploratory talk worked to create a situation in which the evolution of ideas was supported. This situation promoted the generation of a variety of responses and then encouraged these alternatives to compete within a collaborative social framework that allowed the best ideas to be shared between all participants and jointly developed. This analysis suggests that one potentially valuable direction to pursue in the project of re-thinking collaborative learning might be the application of models and concepts drawn from the use of simulations to study emergent properties in complex adaptive systems.

8.7 References

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