STUDYING SOCIAL REPRESENTATIONS OF MATHEMATICS LEARNING IN MULTIETHNIC PRIMARY SCHOOLS: WORK IN PROGRESS

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Abstract: This paper reports preliminary findings from an ongoing project on mathematics learning in multiethnic primary schools in England. Four case studies of primary school-children of Bangladeshi origin, containing information from interviews with the children, their parents and their teachers, will be presented. The analysis suggests ways in which the different representations of these groups may contribute to difficulties the children experience in reconciling what they learn of mathematics at home and what they are required to learn at school.

THE THEORETICAL BACKGROUND

Research from several traditions has illustrated how membership in certain home groups influences children's school performance (Bernstein, 1972; Heath, 1983; Tizard and Hughes, 1984). It suggested that particular home backgrounds equip the children with forms of knowledge more similar to the ones required for success in school. Since the seventies a main tendency has been to explore ways of knowing of particular groups

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describing uses of specific systems of representation. For instance, within the sociological tradition, the work of Bernstein (1972) suggested how the uses of language for communication by middle class groups in England resembled what was required in schools, while what he characterised as a typical working class style was more distant from the school norm. Psychologists combining the sociological and anthropological perspectives in their studies showed that human cognitive functioning is strongly influenced by the symbolic tools of the cultural groups to which they belong. Scribner and Cole (1981) found that the impact of literacy on cognitive functioning depends strongly on the cultural practices one is part of. Similar results have been found consistently in the field of mathematical cognition (Abreu, 1991; Carraher, Carraher and Schliemann, 1988; Saxe, 1982). In the 80s this research, initially restricted to non-Westernised societies, began to be undertaken in Western countries. Studies in Brazil (Nunes, Schliemann, and Carraher, 1993), and the USA (Lave, 1988) indicated that the mathematics performance of the same individuals will vary according to the social practices in which they are engaged. Difficulties in applying school knowledge to everyday situations were already a concern among educators (Cockroft, 1981). However, what this research illustrated was a less well known phenomenon. That is, many individuals failing in Western school systems were capable of complex cognitive functioning in outside school practices. The straightforward implication was that children's performance at school could not be accounted for solely in terms of "having" or "not having" certain cognitive abilities (Abreu, 1995b; Benavente et al. 1987; Goodnow, 1990; Saljo, 1996; Schubauer-Leoni and Perret-Clermont, 1997; Wertsch, 1990; Woods, 1990).

The above research furthered understanding of relationships between home cultures and school performance, but was still a partial account. Any psychologist, teacher or parent will be aware of within group differences. Even in groups where very many children experience problems with their learning at school, it has always been the case that some (although few) children have succeeded at school. However, the dynamics that might create within-group diversity in human development have not yet been fully understood (Abreu, 1995b; Lucariello, 1995, Wertsch, 1991). On the basis of a series of studies conducted by Abreu in a sugar-cane farming community in the North-East of Brazil we have been arguing (Abreu, 1995b; Duveen and Abreu, 1996) that the emergence of diversity cannot be accounted for solely in cognitive terms. In that community understandings of mathematics practised by specific groups involved associations with cultural tools (procedures, physical artefacts) and with the social valorisation of activities and roles (e.g. low versus high status). The research showed how mathematical knowledge is socially marked or valued in relation to the status of user groups in society. Empirical observations and data from interviews with school-children, teachers and local farmers lent support to the idea that at group level the mathematical knowledge linked to specific practices can be conceptualised in terms of social representations (Abreu, 1995a). It refers to forms of knowledge historically produced, transmitted and transformed, thus its representation has a double character. It is the representation of something (a cultural artefact) and of someone (belonging to specific social groups) (Duveen and Lloyd, 1990; Abreu 1993; Abreu, 1995a).

At this point our theoretical position was that an understanding of the learning and uses of mathematical knowledge will require an understanding of how social representations are re-constructed at an intrapersonal level. Theories deriving from Vygotsky already offer an account of how a particular aspect of the social representation, namely the cultural tool (such as a number system) are re-constructed by learners (at an intrapersonal level) in the course of social interactions (at an interpersonal level). However, following our argument there is another aspect being re-constructed, which refers to the valorisation of knowledge. This latter aspect brings some controversy to the application of the "apprenticeship" model (Rogoff, 1990). In this model interpersonal encounters were mostly described in terms of levels of expertise and the meanings related to the valorisation of knowledge remained obscure. This approach was sound when the research focused on understanding transmission of knowledge within the context of one practice highly valued by both novices and experts (Duveen, 1997). But, it became problematic when researchers tried to use the model to explain learning in situations of social change, where individuals and social groups are exposed to co-existing forms of knowledge of different social status (e.g. the home and school knowledge of low status social groups). Thus this creates new research questions. Firstly, it suggests that it is necessary to understand how groups value their forms of knowledge. Secondly, it suggests that it is necessary to conduct more research focusing on how groups take decisions about the knowledge that needs to be transmitted to the next generation.

Having established the necessity for deeper understanding of social representations of mathematics practices held by specific groups we still have another key question to be tackled: how similar social representations of mathematical knowledge generate within-group diversity? Among the Brazilian children from the farming community, it became clear that re-construction at the individual level entails (a) understanding of specific tools; (b) understanding of how social groups valorise the tool; and (c) taking positions that are affectively charged towards (a) and (b). This view of learning enables us to explore the tensions, conflicts and resistances (Duveen, 1998), that can emerge as a result of individuals' positioning in relation to their group's social representations. The resolution of these tensions will be the basis for the individual construction of a social identity.

The studies in Brazil (Abreu, 1995b) gave some interesting insights about the relationship between the valuing aspect of the social representation and the way children were constructing their social identities. For example, it showed children’s understanding of the social valorisation of mathematics as the majority denied that mathematics is used at all in sugar cane farming (linked to the very low status of the practice). It also highlighted that success in school mathematics was associated with lower engagement in home mathematics (exclusion of participation in the negatively valued social identity group). But these studies raised several new questions. A fundamental question is the extent to which the social representations / social identity perspective (Abreu, 1993) will provide a useful framework for understanding children's mathematical learning in other contexts. In this study we have extended the model to children in English Schools, adding the following new dimensions:

(a) The inclusion of a sample of children (British South Asian) where we anticipated that the differences between home and school mathematics would be linked to parents' experiences of a different culture and a different school system (e.g. going to school in their country of origin), rather than parents' experiences with a distinctive non- school mathematics as was the case in the Brazilian study.

(b) The inclusion of an English monolingual sample in which the parents have been through the same school system, so that, in theory, the differences between home and school mathematics might be more closely linked to valorisations and affective positioning, rather than to the tools used in mathematics.

A basic assumption here is that parents' social representations of mathematics learning will reflect both their own experiences of a particular culture of schooling and at the same time how they perceive the schooling of their own children, and that this will create distinct home mathematical cultures for the children. This is an ongoing project funded by the ESRC, and this paper reports preliminary findings from four case studies of children of Bangladeshi origin. Before moving to the empirical study let us briefly refer to some of the issues in the study of "culture and cognition", for which social representations brings a new perspective that has recently been articulated in the context of current developments in cultural psychology (Abreu, 1998).

SOCIAL REPRESENTATIONS AND SOCIAL IDENTITIES AS FRAMEWORKS FOR UNDERSTANDING LEARNING AND USES OF MATHEMATICS IN SOCIO-CULTURAL CONTEXT

Research on "culture and cognition" (Abreu, 1998) opened a new horizon in our view of human learning - the acknowledgement of diversity in the ways of knowing of people belonging to different cultures or to different social groups within the same culture. To move forward, however, we still needed to clarify in more detail how diversity is experienced, both at group and individual level.

AT THE GROUP LEVEL - DIVERSITY AND LEGITIMACY OF KNOWLEDGE

Empirical work on social representations theory (Moscovici, 1976; 1984), has clearly demonstrated that there is a gap between any scientific representation of knowledge and the lay representation of knowledge (for an overview see Flick, 1995). Eventually, over time some scientific knowledge is assimilated by specific social groups. In this case we can hypothesise that the representations that psychologists, working in the field of culture and cognition, have constructed of legitimate ways of knowing might be different from the representations held by users of that knowledge. This diversity in views of what counts as mathematical knowledge (Abreu, Bishop and Pompeu, 1997) can be explained in different ways. Naturally, it takes time for knowledge to "travel" from one community of practice to the other. Psychologists' knowledge will take time to be assimilated by teachers and other social groups. An alternative view is that psychologists use different criteria to judge legitimacy of mathematical knowledge. In particular, the cognition and culture theorists concentrated their efforts on understanding the organisation of specific tools (such as what were the principles underlying a body part counting system, Saxe, 1982; or mental arithmetic, Nunes, 1992). Following a

Vygotskian framework learning in socio-cultural contexts was theorised in a quite "romantic" way: all the tools are legitimate ways of knowing and the person will learn and use specific cultural tools in the context of each specific practice .

This position has been criticised by Goodnow (1990) and Duveen (1997). In teachers' and learners' experiences "legitimacy" cannot be taken for granted, or based in the particular technological features of a tool. Historically certain forms of knowledge have been valued as more "proper" and "advanced" than others. For instance, in a variety of academic environments, doing statistical analysis with the aid of computerised tools is considered more advanced even in circumstances where the solution can be achieved simply with the traditional paper-based tools. Consequently, in the eyes of those involved, diversity is not a neutral issue. Social groups construe their understanding of diversity in terms of status as well as knowledge. A central assumption of this study has been that this may affect the way they organise the transmission of knowledge to new generations.

AT THE INDIVIDUAL LEVEL - DIVERSITY AND POSITIONING

The second issue revolves around a grey area in psychology, which is: how the same social representations of knowledge can inform diversity between individuals? In our view, there is a serious omission in studies of mathematical cognition in socio-cultural contexts in that they generally ignore the fact that children learn about both mathematics and its value, and that they experience learning both cognitively and affectively (cf. Abreu, Bishop and Pompeu, 1997). Although the earlier studies showed that the use made of mathematical understanding is linked to the social contexts of practices, researchers did not clarify precisely how values and beliefs influence that process.

Concern over the neglect of affective factors in research into the understanding of human cognition has been the focus of a number of recent publications. Moscovici (1988) stressed that "from the social point of view, cognition is inseparable from its affective basis" (p.234). Goodnow (1990) argued that people do not learn only skills and strategies to solve problems, but also values, which influence the selection of knowledge to be acquired and the circumstances under which a particular form of knowledge is used. A difficulty in integrating the results of research on affect with those of research on cognition lies in the assumptions underlying the studies. While research on affect tends to treat affective factors as located in the individual, research on cognition has moved away from the individualistic tradition and tends to locate cognition in socio-cultural contexts (Saxe, 1990). Recent developments in social and cultural psychology question the assumption that affective factors, such as beliefs and attitudes, are best thought of as located in an autonomous individual (Moscovici, 1988; Bruner, 1990; Goodnow, 1990). Following this trend it appears that it will be fruitful to pursue a theoretical and methodological approach where the individual's affective reactions are interpreted in the light of the socio-cultural contexts of the practices, and cognition is seen as interweaving with affective life.

On the basis of the above discussion we can hypothesise that when confronted with particular mathematical practices children, besides developing cognitive strategies to cope with the practices, learn about the status (the social markers) of the practice in their

society, and assume positions (affectivelly charged) in relation to their particular engagement in the practice.

THE EMPIRICAL STUDY

This paper reports an ongoing project on mathematics learning in multiethnic primary schools in an industrial town in the South of England. One primary school with significant representation of children of Bangladeshi origin, two infant schools and two junior schools with significant representation of children of Pakistani origin are taking part in the study. The average proportion of ethnic minority students in these schools is around 70%.The data presented below refers to the primary school. Data collection in this school was carried out (by the first author) in January and February 1998, with the main purpose of establishing the suitability of the methodology, tools and procedures.

THE CONTEXT OF THE STUDY

Multiethnic primary schools in England seem to be an interesting situation in which to study the emergence of diversity. Firstly, recent surveys show substantial evidence of an interaction between ethnicity and achievement in mathematics (Gillborn and Gipps, 1996; Rasekoala, 1997). Secondly, studies of ethnic minority students highlight "the wider gaps between their lives at home and at school" (McIntyre, Bhatti and Fuller, 1997) and problems in the way they are assessed at school (Cline, 1993). Thirdly, in the area where the study was conducted the schools tend to have a dominant group of pupils on roll according to ethnic origin. This context has some similar ingredients to the one that generated the development of theory, ideas and new questions reported above (see also Abreu, 1995b). Our central focus of analysis is on the extent to which different levels of school mathematical performance can be linked to the way children experience the relationship between their mathematical practices at home and school. In addition, we are interested to study how the children's constructions of their experience are influenced by the way parents and teachers structure their children's practices.

The primary school where the study was conducted is situated in an urban area. It caters for boys and girls, between the ages of 4 and 11, with substantial representation of the Bangladeshi community. The school serves an area where rates of unemployment and numbers of pupils eligible for free school meals are well above local and national averages. As a whole the teachers interviewed saw no difference in performance across the board between different ethnic groups in the school. They reported, nevertheless, one key difference, which is that they have no Asian children with "statements" (special needs). This was attributed to differences in social background of the families. A teacher who had worked in the school for more than 20 years gave the following account:

> "One factor that might have a bearing on this is the fact that Asian families who move into this area usually do so by choice. It's the kind of area where they can afford housing or businesses where.. It's the kind of area where there is housing available for them, and there are other Asian families and so there is that comfort of moving to somewhere slightly more familiar. White families who move into this area very frequently do so because nowhere else will have them,

> and they come in with very great social problems. So that's one factor to bear in mind about the differences there, and quite a lot of the children [she meant white children] we have at the very bottom end of the attainment and behaviour, have moved in from other areas because perhaps parents have been taken out of their housing because of the way they were and dumped here, or perhaps the child has been excluded from school (…) and I think that's the difference."

In terms of mathematics curriculum the school has followed the National Numeracy Project since 1996. Within the context of this project "Numeracy means knowing about numbers and number operations. More than this, it requires an ability and inclination to solve numerical problems, including those involving money or measures. It also demands familiarity with the ways in which numerical information is gathered by counting and measuring, and is presented in graphs, charts and tables." (DfEE, 1998, p.6). A characteristic of this project is the well defined structuring of mathematics teaching. Thus in the school: (1) all the children had a one hour maths lesson every day; (2) all the maths lessons were timetabled at the same time in the morning; (3) all the maths lessons followed a characteristic structure starting with 10 minutes of oral work and mental calculation work with the whole class, going on to about 30 minutes of main teaching activity, which could involve group work, and finishing with a plenary session; (4) the content of each lesson was determined in the project framework; (5) all the children from Year 1 (aged 5-6) were grouped according to ability. (On the basis of assessments the children in this school are allocated to different maths sets).

THE RESEARCH METHODOLOGY

Data collection took the form of a balanced series of case studies. Selection of children for case studies took into account three factors: school performance in mathematics (high versus low achievement as judged by the teachers); ethnic membership (Asian-Bangladeshi); level of schooling (year 2 and year 6). For each case study information was collected from the classroom teacher, the child and one parent.

The children selected for the case studies

Child 1, Zafar (all the names are fictious), boy, aged 6.5, selected as low achiever in year 2 (on the basis that he was allocated to a low maths set). He was born in Bangladesh, started school two years earlier and had no English language skills at that point. His mother speaks only Bengali and his father works away coming home just one day per week.

Child 2, Sabina, girl, aged 7, selected as high achiever in year 2 (on the basis that she was allocated to the top maths set). She was born in England. At home she speaks English with her older sister and father and Bengali with her mother, who does not speak English.

Child 3, Parvin, girl, aged 10, selected as high achiever in year 6 (top maths set). She was born in England. Her Bangladeshi origin is through her mother. Her father comes from Mauritius. At home she speaks English and sometimes "Broken French" with the parents.

Child 4, Ahmed, boy, aged 11, selected as low achiever in year 6 (low maths set). He was born in England. His mother is from Bangladesh and usually they speak Bengali at home. The mother does not speak English.

Research methods and procedures for data collection and analysis. Qualitative research methods were employed focusing on two levels of analysis defined above. Understanding of mathematics was explored in cognitive, affective and valorative terms. For data collection with the children and teachers techniques used before by Abreu (1993), Bennett (1991), Schubauer-Leoni and Perret-Clermont (1997) were adapted. Additionally, an interview schedule was developed for use with parents, applying to mathematics learning basic principles mentioned by Davidson, Howe, Moore and Sloboda (1996) with regard to the role of parents in children's musical performance: (a) parental involvement in lessons at different stages; (b) parents' role in the initiation of practices that involve mathematics; (c) parents' own involvement in supervising the child's practice at different ages; (d) parents' own involvement in mathematics; (e) change in parents' own involvement with mathematics over time.

Data collection involved the following steps:

Step 1: Consultation over planning with the Project Advisory Group (which included representatives from the Research Community, the Local Education Authority and Parents) and with the local schools;

Step 2: Explaining the aims of the project to the teaching staff of the schools and obtaining collaboration from specific classroom teachers;

Step 3: Seeking parents' consent for their children to participate in the study (BPS guidelines were followed);

Step 4: Interviewing the teachers of the classrooms selected for the study about their experiences and views on children's mathematics learning. The teachers' interview schedule adapted from Abreu (1993) focused on teachers' experiences and views of the relationship between home backgrounds and school performance;

Step 5: Exploring children's representations about mathematics. The interview schedule and materials were adapted from Abreu (1993) with a new set of local photographs as stimulus materials. The schedule focused on: (a) what children count as mathematics; (b) beliefs about more and less successful performances and their consequences;

Step 6: Exploring relationships between teachers' expectations and children's understanding of their maths lessons (adapted from Schubauer-Leoni and Perret-Clermont, 1997);

Step 7: Exploring parents' understanding of and participation in their children's mathematics learning.

Interviews were recorded on audio-tapes, and supplementary written notes were taken when necessary. Data analysis followed the qualitative character of the research. A protocol was produced of each interview. Then, the analytical work (still in progress) adopted a thematic approach: (a) focusing on elements shared by particular groups, thus trying to highlight the most salient "social representations of mathematics learning" for each group; (b) focusing on the differences between individual children, using case studies to illustrate contrasts between high and low achievers within the same ethnic group.

SOME FINDINGS

Findings presented here are based on preliminary analysis and focus on three themes. Firstly, children's representations about mathematics are explored in terms of (a) what they count as situations where mathematics is used; and (b) their beliefs about more and less successful performance at school and its consequences, in terms of the jobs to which people gain access. Secondly, we analysed three perspectives on the importance of children's schooling and performance in mathematics - the perspectives of the child, the parent and the teacher. Finally, accounts of differences between home and school mathematics are explored from the perspective of the child and the parent.

In the process of analysis some parallels are traced with observations in Abreu's previous studies in Brazil and Portugal. This reflects the main purpose of this analysis in helping to establish whether dynamics of the kind observed in the previous studies would also emerge in this context and to provide a framework for analysing the data collected in the other schools. We present these preliminary findings tentatively as they are based on a very small number of case studies. However, our confidence in the conclusions that are reached is increased by the fact that the findings are in line with data collected in other situations.

CHILDREN'S REPRESENTATIONS OF MATHEMATICS

In exploring children's representations of social practices where people use mathematics and their beliefs about performances and jobs, we encouraged them to explain their understanding of the valorisation of mathematical practices (see Abreu, 1995b, in press and Abreu, Bishop and Pompeu, 1997). This aspect of the representations of mathematics was not investigated in previous studies of culture and cognition, and consequently is one that requires the development of adequate research tools. For this study we adapted the technique developed by Abreu (1993) which involved (1) preparing a set of photographs of people doing things in local settings, and (2) using the photographs as the materials for sorting tasks and as the stimulus for conversations about learning and uses of mathematics. With the help of a colleague from the University's Learning Resources Department pictures were taken in the town where the study was conducted, sampling: (1) children involved in (a) school activities and (b) home activities and (2) adults involved in (a) white collar professions and (b) blue collar professions. Care was taken to ensure that there was representation of males and females and people of White and Asian origin in each context. The final set of stimuli used in the study comprised the twelve pictures described in Table 1. This was considered to be close to the maximum number of pictures that would be easily manageable by young children in sorting tasks.

We would like here to focus on two of the activities that the children were asked to carry out using the set of pictures described in Table 1: (1) separating the pictures into two groups putting on one side of the table the ones where they thought people need to use mathematics, and on the other side the ones where they do not need mathematics; (2) choosing among the pictures of adults those who they thought were the best and the worst pupils in mathematics when they were at school. These activities were carried out in the context of an individual interview. For each task they were asked to explain their choices. The younger children (Zafar and Sabina) had difficulty in task one, that is

separating the pictures into two groups. The alternative adopted was to present the pictures one by one and ask the child to decide for each one whether it depicted people using mathematics or not. They were then asked to explain the reasons for their choice.

TABLE 1
Description of the pictures used in the representations interview

Social practice	Description of pictures
Children at school	1. Two school girls operating a calculator (White girls, picture taken in a maths lesson). 2. Two school boys reading a book (One White and the other Asian, picture taken in an English lesson. Contents of book not visible.). 3. Children playing hopscotch in the school playground (A White girl in the foreground, and several children of different ethnicity and gender in the background).
Children at home	4. Young girl weighing sugar in the kitchen, helped by her mother (Both White). 5. A boy and a girl playing computer games at home (Both Asian). 6. A boy measuring the length of the fireplace in his sitting room (Asian).
Adults in white collar professions	7. Pharmacist measuring the volume of a red liquid. He is working in the area of the pharmacy used to prepare the "prescriptions". Around him there are shelves full with medicines, and labelled bottles of liquids (Asian- Male). 8. Office administrator working at his computer. He is typing, and on the desk there is what would be expected in an office (paper, pen, phone, a mug, etc.) (White-Male). 9. Pharmacy assistant working in the reception area. She is writing in a book and surrounded by shelves with various pharmaceutical products (White-Female).
Adults in blue collar professions	10.Taxi driver, sitting in his taxi and communicating on his radio (Asian-Male). 11. Shop assistant weighing sweets in a market stall. The digital weighing machine where she is working is surrounded by transparent containers full of sweets (White-Female). 12. Shop assistant using the cash till in an Asian food stall in the local market. She is looking at the till as if checking some information (Asian-Female).

Findings with this very small pilot group of case studies highlighted similar processes to the ones already observed in Brazil (Abreu, 1995b) and Portugal (Abreu, Bishop and Pompeu, 1997). Firstly as summarised in Table 2, the children seem to have developed ways of categorising the uses of mathematics in common social activities. For instance, while all the children stated that operating a calculator involves mathematics, none of them asserted that mathematics is needed when school-children are reading a book. Also all of them stated that market stall workers need it, but only one saw driving a taxi as an activity that requires mathematical knowledge. Even Zafar, who was the youngest of the four children and who had difficulty in identifying whether the people needed mathematics or not in several pictures, seemed to have no doubts about associating calculators and shopping with mathematics.

Secondly, as in the Brazilian study, the children seem to have developed ideas that enable them to associate levels of achievement in school mathematics with certain professions. This seems to involve processes of social comparison regarding the social status of the jobs. As shown in Table 3, three choices of who might have been the best in school mathematics went to white collar professionals. (Parvin made a joint choice

TABLE 2

Summary of children's sorting of situations where people need to use mathematics and some key words they used to justify their choices

Description of the Pictures		Mathematics needed	Mathematics not needed	? - Not clear
Children at school	1 Two school-girls operating a calculator	4 (calculator)		
	2 Two school-boys reading a book		3 (reading)	1 (Z)*
	3. Children playing hopscotch	1 (counting)	1 (playing)	2 (Z + S)
Children at home	4. Young girl weighing sugar	1 (weighing)	2 (making a cake)	1 (Z)
	5. A boy and a girl playing computer games		3 (playing)	1 (Z)
	6. A boy measuring length at home	1 (measuring)	1 (measuring)	2 (Z + S)
Adults in white collar professions	7. Pharmacist measuring the volume of a liquid	1 (buying)	3 (doing a drink, making medicine)	
	8. Office administrator working at his computer	2 (computer)		2 (Z + S)
	9. Pharmacy assistant working in the reception area	3 (shop , buying, price)		1 (Z)
Adults in blue collar professions (semi-skilled jobs)	10. Taxi driver, communicating on the radio	1 (money)	2 (driving)	1 (Z)
	11. Shop assistant weighing sweets in a market stall	4 (numbers, money, weighing)		
	12. Shop assistant in a food stall in the market	4 (number, till, price, money)		

Note: * Z (Zafar) and S (Sabina)

TABLE 3

Children's choice of who they thought as the BEST and the WORST pupils in school mathematics when they were at school.

	Pictures selected	Justifications
The best	Office administrator (2 children)	Z - He is using a computer. P - In the computer.
	The pharmacist (1 child)	A - Because he has learnt to medicine.
	Shop assistant sweets-stall (1 child)	S - That's why she went in a shop and worked in the market.
	Taxi driver (1 child joint with the Office Adm.)	P - He has to put up with money people give and give change back (chosen by excluding the ones that use external aids, e.g. till).
The worst	Taxi driver (3 children)	Z - He is a "taxist". S - He is in a car. People do not do maths in a car do they! A - He is just driving a taxi.
	Any of the three women working the pharmacy, food stall or sweet stall (1 child)	P- They use the till to work their sums.

with the taxi driver, and this is strongly associated with her belief that being good at mathematics is linked to the ability to perform oral calculations, or in other words, working with numbers without using any external aids.) All the choices of who might have been the worst pupil in school mathematics went to blue collar professionals, three of these being of the taxi driver.

Being a taxi driver is a profession of very low status in the town where the study was conducted. So, this type of result is similar to the one obtained in Brazil where there was a tendency to link "failure" in school mathematics with low status jobs and vice versa. The justifications given by the children also seem to follow a similar line of argument. This is illustrated in the following extracts.

Extract 1: from an interview with a 14 year-old girl, Brazilian school, a sugar-cane worker's daughter, described by the teacher as a low achiever (Abreu, 1995b, p.136)

I: Why doesn't that man [in a picture] on the tractor know mathematics?
C: He doesn't know. He doesn't have a job. He works in sugar-cane.

Extract 2: from Ahmed in this study

I: If you could keep with the same pictures. Who do you think was the worst pupil in mathematics when they were at school?
C: This one [picture number 10 the taxi driver].
I: Why do you think he was the worst?
C: Because he is not doing stuff like these people are doing like computer stuff. He is just driving a taxi.

To sum up, these children have developed representations of activities that involve the use of mathematics. They also seem to be developing understandings of the role success in school mathematics can play in allowing entrance to certain professional groups. In other words, the case studies give some indication of the children's understanding of social representations of mathematical knowledge and of social identities as given by the society they live in.

THE PERFORMANCE OF EACH CHILD IN SCHOOL MATHEMATICS

Tables 4 and 5 provide summaries of the accounts collected from the child, the parent and the teacher about the child's performance in school mathematics. All the data come from individual interviews conducted separately with each of them (The interviews with Zafar's and Ahmed's mother were conducted with the help of an interpreter). Table 4 presents data for the two children selected as low achievers, and Table 5 for the two high achievers.

Analysis of Table 4 shows some similarities between the two cases: both parents value school education, the mothers cannot communicate with school due to linguistic barriers, and the fathers are not present. (Ahmed's father had died before he was born, and Zafar's father works away coming home once a week.) There are, however, key differences between the two cases. Zafar, the younger child, still believes he is very good, and this is also the view of the mother. This does not seem to be the view of his teacher, and it is not reflected in his placement in the low maths set. So, there is a mismatch between the school perspective and the perspective of the child and his

mother. In the case of Ahmed the three perspectives are consistent. He is not sure about where he stands with regard to schooling, describing himself as in-between. His mother shows awareness that he is struggling and does not maintain motivation for achievement. His teacher perceives him sometimes as not showing evidence of "internal drive".

TABLE 4

School performance of the low achieving children from the perspectives of the child, the parent and the teacher

	The child	The parent	The teacher
Zafar Year 2 Low set	Likes school. Described himself as "I am very good".	The mother thinks Zafar is doing fine at school. Relies on the information Zafar himself is able to pass to her about his experiences in school, since she is not able to read or speak English. Wants her children to do well at school: "school is good". The mother does not have direct contact with teachers, because of linguistic barriers, but she fetches her children from school everyday.	The classroom teacher described Zafar as a child who started school with very little English, pleasant child who spends a lot of time listening , and who tries his best. The maths teacher for the set expected Zafar to work in the maths lesson with support: "do not expect Zafar to ask questions (…) he will not do this due to lack of confidence or language - does not know how to phrase question."
Ahmed Year 6 Low set	When questioned if he likes school Ahmed answered: " A little bit, but in between". Maths is one of the subjects he likes. However in terms of performance he thinks that he is "in between" (…) "Because I can do some sums, some I get right and some I don't".	There is awareness that Ahmed sometimes struggles with school learning. This information is taken from school reports. The family value education, but the mother cannot communicate with teachers or participate in school meetings due to language barriers. (She does not speak English). The family shows awareness that Ahmed easily loses motivation to study at home.	Described by the classroom teacher as "one of the brighter pupils" in the low maths set. As someone who comes from a "conscientious family", but sometimes does not have the "internal drive": "sometimes he is just happy to sit there". Described by the maths teacher for the set as someone who will be able to understand the content of the lesson and willing to answer questions.

Table 5 also show some similarities between the two high achievers. As with the low achievers, both parents value school education. However, they differ in their level of communication with the school. The parents of both children follow their progress very closely, meeting with teachers after school or in formal parents evenings. This is facilitated by the parents' ability to communicate in English. For the younger child, Sabina, the father assumes this role, because the mother cannot speak English. For the other child, Parvin, both parents speak English. The other similarity between these two

TABLE 5
School performance of the high achieving children from the perspectives of the child, the parent and the teacher

	The child	The parent	The teacher
Sabina Year 2 Top set	Enjoys school and sees herself as quite good in science. Had a struggle with maths in the past, but had one teacher that helped her. Sees herself as good at maths "I'm good at maths, but I'm not good at English". Said that she comes to school to learn "because my dad says that, that I have to be a doctor when I grow up, because then I'll get lots of money".	It is a tradition to value education in this family. The father keeps a close eye on the way Sabina performs at school. He comes to all parents' meetings and contacts the teachers at other times if necessary. The priority is to enable the child to follow English schooling: "English comes first … it is their mother tongue". "She is a bit weak in English but she is good at maths" He wants Sabina to study to be : "Doctor, or nurse, if she can't reach to be doctor".	The classroom teacher described Sabina as a bright child. The maths teacher for the set described her as someone who applies herself to finish the tasks and who understands maths well.
Parvin Year 6 Top set	Likes school. Maths and history are her favourite subjects: "Because I am quite good at maths and I like doing maths it is very enjoying and history I like finding about upper-class". Being good at maths results from home environment "parents bring their child up with maths" and liking the subject. In her family they play maths games: "When I go home sometimes me and my dad have like a maths quiz".	Mother thinks children should be stimulated to learn as much about numbers as language. She also referred to making children use their minds. All the family enjoys to get involved in language and maths quizzes presented on television. There is a close follow up of the child's school performance through various means: school reports, books, parents' evenings and talking to teachers after school. Often needs to be reminded to sit down to do homework.	Described by her classroom teacher as someone very keen on maths, so keen that she participated in a Maths weekend competition and did very well. Her mother is also perceived as being very supportive. Both the classroom teacher and the maths teacher for the set described her as confident, able to understand, but sometimes prone to boredom, sometimes needing encouragement.

cases is that both families have high expectations for their children. Sabina's father defined these expectations in terms of a future professional career. Parvin's mother expressed her expectations in terms of the child having a "brain" that is able to demonstrate intellectual agility in solving puzzles. A key difference between the two cases, from our perspective, is that Sabina's motivation seems to be internalised. Her

behaviour in the maths lesson seems to be stable as we can see in the teacher's comments. Parvin's motivation, however, seems to be more volatile. Both her mother and teacher see her as keen, but difficult to sit down and engage in tasks.

ACCOUNTS OF HOME AND SCHOOL MATHEMATICS KNOWLEDGE

Tables 6 and 7 summarise how children and parents described differences between home and school mathematics. This time there is no reference to the teachers' perspective. Although in the interviews with teachers we asked their views on the relationship between home background and school performance, they did not mention differences between home and school mathematics. One can hypothesise that this issue was not salient for them. It is interesting to note, however, that one of the teachers, the school mathematics co-ordinator was very aware of the difficulties children experience when exposed to different ways of thinking about numerical operations. Her views were expressed in the context of the implementation of curricular changes. She was concerned about the introduction of the National Numeracy Project which would catch children at different stages of schooling. In her opinion children who were exposed to the new programme in Years 5 and 6 would have more difficulty in adjusting to the new ways of thinking than the ones who were in Years 1 and 2. Following the same line of thinking exposure to different approaches and methods in mathematics at home could generate similar difficulties to the ones now observed by this teacher in the implementation of the new programme. But it did not seem to be salient for the teachers interviewed that some children might learn maths at home in ways that differ from the ways they are taught at school. Children and parents, however, expressed clear views on this issue.

TABLE 6

Accounts of home and school mathematics by the low achieving children and their parents

	Child	Parent
Zafar Year 2 Low set	Not yet able to describe similarities and differences between maths at home and maths at school.	Zafar's mother had enjoyed learning mathematics at school in Bangladesh. She said that there is a lot of difference in mathematics between the two countries. She believes the mathematics is the same, but the differences lie in the teaching. She was more involved in mathematics when she was younger because she was studying it. Zafar's father has studied in England, and when he teaches his children mathematics it is in the same way as they learn at school.
Ahmed Year 6 Low set	For him his mum does maths in a different way. He calls the way he works in school the "English Way", and for him this is easier to follow.	It was not possible to articulate this aspect with Ahmed's mother due to her difficulties in communicating in English. (According to the interpreter "she does not remember that much" of her school maths, which covered the basics, such as sums).

Table 6 shows that Zafar is not yet able to identify differences between maths at home and maths at school. His mother thinks there are differences, which for the moment she thinks are related to differences in teaching. Ahmed is convinced that the way he learns mathematics in school, which he called the "English Way", is different from his mother's mathematics. With Ahmed we start seeing a possible source of tension and conflict. He clearly stated a preference for the way he learns at school, but will the family have the means to support him? Are they aware that he finds the school mathematics different from the home mathematics? It was not possible to articulate this aspect with his mother due to her difficulties in communicating in English. In both cases the mothers seemed not to feel confident that they could provide help for their children to improve their school mathematics learning.

TABLE 7

Accounts of home and school mathematics by the high achieving children and their parents

	Child	Parent
Sabina Year 2 Top set	Her mother helps only a younger brother who is four years old. Her father helps both her and her sister. Her father tends to format sums by writing them vertically and the teacher more often writes them in a horizontal FORMAT (e.g. 2+6). She sometimes finds the way her father does it more difficult. "Even my sister does not like it" (…) "I tell him to do it my way".	Sabina's father mentioned the difficulty he and his wife have in helping her, because he finds maths in this country to be different. "In here, I'm afraid I didn't know how to help". His wife has difficulties because of linguistic barriers. He described some of the differences between Bangladesh and England as: -The way mathematics is taught in Bangladesh is "better". - There is more respect and submission to teachers' judgements at home. - Different criteria are used to say someone is "very good" ("in this country they say very good (…) I find it very strange (…) My teacher never said very good)." - There is difficulty in understanding teaching methods in England and getting specific information from teachers.
Parvin Year 6 Top set	She is not sure about differences between home and school maths. "Because I have not really asked my mum. Because my mum did not really learn maths that good. She is not keen in maths. My dad is good at maths". She thinks he explains in the same way as the teacher, but using different words.	Parvin's mother used to enjoy mathematics when she was at school in her country. However, she does find it different from the school maths her children learn here in England. She felt more confident with basic mathematics, and thinks she has already forgotten some of what she learned at school.

Table 7 shows a different picture. Although the parents also perceive differences between their mathematics and their children's school mathematics they are able to provide support. In Sabina's case she is able to point out the differences to her father

and ask him to adjust or “tell him to do it my way”. Thus, like Ahmed she is aware of the differences, but unlike him she seems to be able to negotiate the differences at home. In Parvin’s case the problem is avoided by interpreting her mother’s differences as lack of competence. This is mutual as the mother assumes she does not have the skills and the daughter that the mother is not very keen. In this way the responsibility for support is transferred to the father who seems to be able to operate in a way more similar to the school.

In summary, these last two sets of observations offer some initial insights into possible dynamics behind the evident diversity among children in the same group. Firstly, the case studies highlight a possible link between children’s achievement and parents' knowledge, skills, expectations and availability to support their children’s participation in the English School System. Linguistic barriers were more marked for the two low achievers (but it is important to note that Sabina's mother also experiences a linguistic barrier). Differences between home and school mathematics seem to be tackled more confidently in the high achievers' families. Secondly, the high achieving children seem to have clearer ideas about the importance of school mathematics in their personal development, and these ideas are supported, albeit in different ways, by their teachers and parents.

CONCLUSION

The preliminary observations that are reported here represent a first step in our attempt to extend the model developed by Abreu (1993). In her model concepts from social representations and social identity theory were incorporated into theory of culture and cognition, in order to explain children’s learning and uses of mathematics in a rural community in Brazil. We sought to explore the extension of that model to account for the learning and use of mathematics in a multiethnic primary school in South East England. In addition, in conducting these initial case studies, we also aimed to establish the suitability of the methodology and tools to collect relevant data in this different situation. We have subsequently adapted the child interview to make it simpler for children at the lower end of the age range. But, in general, apart from the development of appropriate local stimulus materials, the approach needed little alteration for this new context.

The data reported here are a small selection from a rich resource. They support Abreu’s conceptualizations of home and school mathematics in terms of social representations. The case studies confirm children's understanding of the social character of mathematics. They have ideas about practices in their society which are primarily defined as requiring the use of mathematical knowledge. There was also evidence that children have ideas about how mathematics can be associated with social identities as given by their society. They saw success in school mathematics as opening the gate for participation in white collar professions, and they thought that not doing well at school mathematics just leads to blue collar types of work. There was also some indication that this understanding of social representations of mathematics informs the way some children construct their own social identities. (For example, a factor in Sabina's aspiration to be a doctor was her knowledge that she was doing well at maths and science.)

This study also expands Abreu's earlier empirical research as greater attention is given to understanding parents' influences on maths school performance of children from home cultures that differ from the school culture. A comparison of the data presented for low achievers in Table 4 with what is presented for high achievers in Table 5 suggests that the children' school performance is facilitated where that gap is reduced for any reason and where parents are able to communicate successfully with teachers. For both children and parents the level of the parents' confidence in their ability to help seems to be an important factor as well as their actual ability to understand and negotiate the methods used in school mathematics. In the next phase of the project, in which we are working with the white monolingual parents and children as well as those from an ethnic minority community, we will be interested to learn whether the confidence issue has a similar significance for them and their children as it does for those in the Bangladeshi case studies.

At a group level, the preliminary observations from the case studies support previous social representations studies which assert that the most salient aspects will vary according to the experiences groups are exposed to (Mugny and Carugati, 1989). In this case we have seen that specific differences in mathematics knowledge (even if it is just a matter of how a sum is written) are seen as salient by children and parents, but not mentioned (or perhaps known) by teachers. Awareness of these differences seemed to play a role in the way parents interacted with their children to support their school learning and also in the way children reacted to their parents' support.

At the individual level our eventual aim is to investigate the interaction between performance in school mathematics and representations of mathematics learning, taking into account the way these representations: (a) vary between children from different backgrounds; (b) relate to their parents' expectations and the experiences their parents provide at home; (c) relate to the teaching practices and teachers' expectations to which they are exposed; (d) change over time with experience in school. These preliminary findings offer some insights on (a) and (b), but not on (c) and (d). We hope to develop these further when analysing the results from the whole project.

REFERENCES

Abreu, G. de (1991). Psicologia no trabalho, um enfoque cognitivo: o uso da matematica por agricultores de cana-de-acucar. Psicologia, Teoria e Pesquisa. 7 (2), 163-177.

Abreu, G. de (1993). The relationship between home and school mathematics in a farming community in rural Brazil. Doctoral dissertation. University of Cambridge, UK.

Abreu, G. de (1995a). A teoria das representacoes sociais e a cognicao matematica. Quadrante, 4 (1), 25-41.

Abreu, G. de (1995b). Understanding how children experience the relationship between home and school mathematics. Mind, Culture and Activity: An International Journal, vol. 2, no. 2, 119-142.

Abreu, G. de (1998). Reflecting on mathematics in and out of school from a cultural psychology perspective. In A. Olivier and K. Newstead, Proceedings of PME 22 -

The International Group for the Psychology of Mathematics Education (pp. 115-130). Vol1. Faculty of Education, Stellenbosch, South Africa.

Abreu, G. de, Bishop, A. and Pompeu, G. (1997). What children and teachers count as mathematics. In T. Nunes & P. Bryant (Eds) Learning and Teaching Mathematics: an International Perspective (pp.233-264). Hove, East Sussex: Psychology Press.

Benavente, A. Costa, A. F., Machado, F. L. and Neves, M. C. (1987). Do Outro Lado da Escola. Lisboa: Instituto de Estudos para o Desenvolvimento.

Bennett, N. (1991). The quality of classroom learning experiences for children with special educational needs. In M. Ainscow (Ed.). Effective Schools for All (pp. 120 - 133). London: David Fulton.

Bernstein, B. (1972). Social class, language, and socialization. In P.P. Giglioli (Ed.). Language and Social Context. Harmondsworth: Penguin Books.

Bruner, J.S (1990). Acts of Meaning. Cambridge, Mass.: Harvard University Press.

Carraher, T., Carraher, D. and Schliemann, A. (1988). Na Vida Dez: Na Escola Zero. Sao Paulo: Cortez.

Cline, T. (1993). Educational assessment of bilingual pupils: getting the context right. Educational and Child Psychology, vol. 10, no. 4, 59 - 69.

Cockcroft Committee of Inquiry Into the Teaching of Mathematics in Schools (1982). Mathematics counts. London. HMSO

Davidson, J., Howe, M., Moore, D. and Sloboda, J. (1996). The role of parental influences in the development of musical performance. British Journal of Developmental Psychology, 14 (4) 399-412.

DfEE - Department for Education and Employment (1998). Numeracy Matters: The preliminary report of the numeracy task force. London.

Duveen, G. (1997). Psychological development as a social process. In L. Smith, P. Tomlinson, and J. Dockerell (Eds.). Piaget Vygotsky and Beyond. London: Routledge.

Duveen, G. (1998). The psychosocial production of ideas: social representations and psychologic.Culture & Psychology, 4 (4) 455-471.

Duveen, G. and Abreu, G. de (1996). Representations of home and school mathematics. Paper presented at the XIVth Biennial Meetings of ISSBD, Quebec, Canada.

Duveen, G. and Lloyd, B. (1990). Social Representations and the Development of Knowledge. Cambridge: Cambridge University Press.

Flick, U. (1995). Social representations. In J. Smith, R. Harre and L. Van Langenhove (Eds.) Rethinking Psychology. London: Sage.

Gillborn, D. and Gipps, C. (1996). Recent Research on the Achievements of Ethnic Minority Pupils. London: HMSO.

Goodnow, J. J. (1990). The socialization of cognition: what's involved? In J.W. Stigler, R.A. Shweder and G. Herdt (Eds.). Cultural Psychology: Essays on Comparative Human Development (pp. 259-286). Cambridge: Cambridge University Press.

Heath, S.B. (1983). Ways with Words: Language, Life, and Work in Communities and Classrooms. Cambridge: Cambridge University Press.

Lave, J. (1988). Cognition in Practice: Mind, Mathematics and Culture in Everyday Life. Cambridge: Cambridge University Press.

Lucariello, J. (1995). Mind, culture, person: elements in a cultural psychology. Human development, vol. 38 (1) 2-18.

McIntyre, D., Bhatti, G. and Fuller, M. (1997). Educational experiences of ethnic minority students in Oxford. In B. Cosin and M. Hales (Eds.) Families, Education and Social Differences (pp.195-220). London: Routledge

Moscovici, S. (1976). La Psychanalyse, son Image et son Public. Paris: Presses Universitaires de France.

Moscovici, S. (1984). The phenomenon of social representations. In R. Farr and S. Moscovici (Eds.). Social Representations (pp. 3-69). Cambridge: Cambridge University Press.

Moscovici, S. (1988). Notes towards a description of social representations. European Journal of Social Psychology, 18, 211-250.

Mugny, G. and Carugati, F. (1989). Social Representations of Intelligence. Cambridge: Cambridge University Press.

Nunes, T. (1992). Cognitive invariants and cultural variation in mathematical concepts. London: Institute of Education, London University.

Nunes, T.; Schliemann, A. and Carraher, D. (1993). Street Mathematics and School Mathematics. Cambridge: Cambridge University Press.

Rasekoala, E. (1997). Ethnic minorities and achievement: the fog clears [Part 1: pre-16 compulsory education]. Multicultural teaching. 15, 2, 23-29.

Rogoff, B. (1990). Apprenticeship in Thinking. Oxford: Oxford University Press.

Säljö, R. (1996). Learning and Discourse: A Sociocultural Perspective. The sixteenth Vernon-Wall Lecture. Leicester: The British Psychological Society.

Saxe, G.B. (1982). Culture and the development of numerical cognition; Studies Among the Oksapmin of Papua New Guinea. In C. G. Brainerd (Ed.) Children's Logical and Mathematical Cognition (pp.157-176). New York: Springer-Verlag.

Saxe, G.B. (1990). Culture and Cognitive Development: Studies in Mathematics Understanding, Hillsdale, N.J.: Lawrence Erlbaum Associates.

Schubauer-Leoni, M-L, and Perret-Clermmont, A-N, (1997). Social interactions and mathematics learning. In T. Nunes & P. Bryant (Eds.) Learning and Teaching Mathematics: an International Perspective (pp.265-283). Hove, East Sussex: Psychology Press.

Scribner, S. and Cole, M. (1981). The Psychology of Literacy. Cambridge, Mass.: Harvard University Press.

Tizard, B. and Hughes, M. (1984). Young Children Learning: Talking and Thinking at Home and at School. London: Fontana Press.

Wertsch, J.V. (1990). The voice of rationality in a sociocultural approach to mind. In L.C. Moll (Ed.). Vygotsky and Education (pp.111-126). Cambridge: Cambridge University Press.

Wertsch, J.V. (1991). Voices of the Mind. Cambridge: Cambridge University Press.

Woods, P. (1990). The Happiest Days? How Pupils Cope with School. London: Falmer Press.