Mothers' experiences of their children's school mathematics at home: the impact of being a mother-teacher

Rachael McMullen and Guida de Abreu*

Oxford Brookes University, Oxford, UK

This study seeks to understand mothers' participation in their children's school mathematical learning. It focuses on the majority White-British cultural group, in terms of how they experience historical changes between their own school education and the education of their children. The study also explores the impact of mothers' personal histories in terms of direct participation in current methods of learning. The experiences of two different groups of White-British university-educated mothers were explored; those with teaching experience (direct participation in current teaching practices) and those without. Although the two groups showed similarities in the way they interpret their past experiences, those with teaching experience were able to construct more positive representations of current methods, and were able to bridge the gap between differing mathematical practices more easily. The study suggests, however, that even those mothers with positive representations of current practices may revert to the methods they formerly depended on, when confronted with their child's continuing confusion about mathematics.

Keywords: parental involvement; home-school mathematics; mothers' representations, identities and practices

Introduction

In England, the importance of parental involvement in children's school mathematical learning has received considerable attention in recent policy-oriented research reports (DfES 2007; Peters et al. 2008; Rose 2008; Williams 2008). Generally, these reports propose that parental involvement in a child's school education is considered to be beneficial from a policy perspective, and desirable from a parental perspective. There is emerging evidence, however, which suggests that not all parental involvement has a positive impact on the child's school achievement. A meta-analysis of the literature in the US and Canada showed a negative association between parental involvement in homework and children's mathematics achievement (Patall, Cooper, and Robinson 2008). Recent surveys and reviews of mathematics teaching in the UK also pointed out parents' difficulties in supporting their children's school mathematical learning (Peters et al. 2008). Whilst the vast majority of parents feel it is extremely important to help with homework, confidence amongst parents about becoming involved has decreased in recent years (DCSF 2007).

Research indicates that parental involvement in children's school mathematics is complex and multifaceted (Allexsaht-Snider 2006; Hyde et al. 2006). Parental involvement is affected by parents' own past experiences of learning and using

^{*}Corresponding author. Email: gabreu@brookes.ac.uk

mathematics, and by geographical and historical transitions they may have undergone. These transitions may result in differences between the way in which parents learned mathematics at school and the school mathematical practices of their children. Several studies have examined parents' responses to perceived differences in their own school mathematical practices and the way in which their children are learning mathematics. However, these studies have mostly focused on minority social, economic or cultural groups, and changes experienced due to different cultural settings (Abreu 2008; Abreu and Cline 2005; Civil and Andrade 2002; Jackson and Remillard 2005; O'Toole and Abreu 2005; Quintos, Bratton, and Civil 2005). In these studies, it was apparent that differences in methods/strategies because they were educated in another country, or because of curricular changes, impact on parents' understanding of their children's mathematical learning. In addition, studies conducted in the US indicate that mathematical confidence (Hyde et al. 2006) and mathematical identities (see, for example, Jackson and Remillard 2005) play a part in the way parents support their children.

The current study seeks to understand further parental participation in children's learning of school mathematics at home. It explores how mothers experience their children's mathematical learning in the context of historical changes between their school education and the education of their children. The mothers were educated in England before the introduction of the National Numeracy Strategy in 1999, which introduced new methods of teaching mathematics. The study builds on, and contributes to, the literature outlined above in several ways. It focuses both on the majority cultural group, i.e. White-British, and on highly educated parents, i.e. university-educated mothers. In this way, the study can shed light on issues that are specific to curriculum changes over time within a society, and issues that are more related to being part of particular socio-cultural groups. The other key contribution is the investigation of the impact of direct participation in current methods of learning. The study seeks to explore the impact of mothers' personal histories on their involvement with their children's learning, in terms of their experience of direct participation in current methods of learning. It examines the experiences of two groups of mothers; those with direct experience of current methods through training and working as primary school teachers, and those whose experience of current methods is constrained to their role as parents helping their children. The study focuses on mothers, as they tend to take the major role in helping children with homework (Peters et al. 2008), and also because the majority of primary school teachers are women.

Theoretically, the study was informed by a socio-cultural perspective, which draws both on Vygotskian ideas and European Social Psychology (as elaborated in Abreu 1995; Abreu and Cline 2005; Abreu, Cline, and Shamsi 2002). Within this perspective, mathematical practices are conceptualised as forms of knowledge that have been historically produced, transmitted and transformed. The representations of these practices have a double character, which includes the representations of something (cultural tools) and of someone (those who engage with the practices). This conceptualisation requires examining mathematical practices in terms of the mastery of specific cultural tools (for example, written algorithms of calculation, times tables, etc.) or forms of mathematical knowledge in specific contexts of practice, but also in terms of the impact of valorisation and identification processes on the transmission and learning of knowledge. Within this broad framework,

mothers' experience of historical changes between their own school education and the education of their children, and their personal histories of involvement, were investigated. Issues around constructions of mathematical identities, representations and valorisations of mathematical practices, and the role of these representations and identities as mediators of practices were considered. The background to each of these three aspects of the research is outlined below.

Mathematical identities

One of the aims of this study is to examine mothers' perceptions of their own mathematical identities, i.e. their sense of themselves as learners, thinkers and 'doers' of mathematics, and how they consider that these identities influence their practices with their children. Past research suggests that parents construct this identity according to their enjoyment of the subject, their mastery of the cultural tools of mathematics, and the importance they perceive it may have in their lives. The perception of one's own ability in comparison with significant others, and an awareness of the identities created for us by those others, also influence the construction of identity (Abreu and Cline 2003). Bibby (2002) proposes that personal and social aspects of identity can be threatened by feelings of inadequacy or humiliation, and that school mathematics provides the right conditions for the engendering of these feelings. Socio-cultural researchers have also emphasised the need for accounts of mathematical learning, both in school and in the home, to consider issues of status, power and identities (see, for example, Anderson and Gold 2006; Cobb and Hodge 2002; Esmonde 2009).

Research has shown that parents' past experiences of learning and using mathematics influence the construction of their mathematical identities. We propose that these identities are not fixed, but evolve as a result of the personal, geographical and historical transitions parents may experience, or wider societal and cultural changes (for example, the new National Numeracy Strategy in the UK; immigration: Crafter and Abreu 2010). Socio-cultural theory suggests that it is through participation in socially organised activities that psychological processes are developed. This enables individuals to appropriate cultural tools and to understand how these are valued socially. The opportunities afforded to parents to participate in mathematical practices may influence their evolving mathematical identities and the development of these processes. Thus, it is possible that the mathematical identities parents developed as children shift with their participation in new mathematical practices as adults. This study explores how the experience of teaching current mathematical practices influences mothers' own evolving mathematical identities. It is the different experience of mathematical learning which is explored, and its impact on the way in which mothers feel confident about their participation in their children's learning.

Representations and valorisations of mathematical practices

A second aim of the study is to examine mothers' representations of their children's school mathematical practices. Drawing on a socio-cultural perspective, the current study expands previous research with parents by Abreu and her colleagues in England (Abreu 2008). Societal and cultural changes are among the factors which

have resulted in very different experiences of mathematics learning by both parents and children. Abreu and Cline (2005) found that many parents were confronted with differences between their own ways of tackling mathematics and alternative methods their children learned at school. The differences between parents' strategies and school methods were also stressed in the Williams' (2008) review of mathematics teaching in the early years, and in the DfES report (2007) on pupils who fall behind in Key Stage 2. Studies in the UK and other countries have shown that responses by parents to perceived differences in mathematical practices vary. The main concern for parents in a number of studies (Abreu and Cline 2005; Feiler et al. 2006; Hughes et al. 2007) was that by offering a strategy they had previously depended on, they might confuse their children. For this reason, some parents deliberately do not show their children their own strategies. Other parents, however, focus on helping their children to learn mathematical skills and strategies they feel are not emphasised sufficiently at school (Abreu and Cline 2005). The way in which parents respond to differences between mathematical practices, therefore, may be influenced by their perception of these new tools as advantageous or disadvantageous to their children. Parents' confusion about new methods of mathematics compromises their own independence and confidence as a parent committed to playing an active role in their child's schooling (Remillard and Jackson 2006). Green et al. (2007) argue that parents are motivated to become involved if they feel they have the skills and knowledge that will be helpful in specific domains of activity. If parents believe they cannot understand their children's homework, they have little incentive to act, or to persevere in the face of difficulties with their children's learning, and are unlikely to pass on a positive attitude (Williams 2008).

When differences between numeracy practices are perceived, comparisons are inevitable. The difference between school and home practices may not simply be a cognitive one, or one located in cultural tools. It may be that home and school mathematics have different values. School mathematical activities may differ between home and school because of the use of distinct cultural tools, and also because of the way in which they are invested with expectations or significances which go beyond the immediate goals of the activity. The notion of valorisation (Abreu 1995) explains how particular social groups attach value to their own mathematical practices. Numeracy practices may be valued differently by schools, parents and children. Baker, Street and Tomlin (2001) suggest that schools and educational policy emphasise school mathematical practices over those of parents, assuming the role of parents to be to understand the numeracy practices of the school before reinforcing these practices at home. Quintos, Bratton and Civil (2005) propose that parents, however, have an initial tendency to value their own form of mathematics over the school's, whilst Abreu and Cline (2005) found that many parents devalued methods, for example, the use of calculators, which they perceived inhibited basic arithmetic skills. There is some evidence to suggest, then, that the way parents structure their support to their children is coloured by their own position about which form of knowledge they value more (Abreu and Cline 2005).

Representations and identities as mediators of practices

Although there is no doubt that parents' past experiences and representations play a significant role as mediators of practices with their children, the influence of this past

is complex. Using the concept of 'prolepsis' (Cole 1995), O'Toole and Abreu (2005) explored how parents' own experiences in the past framed their construction of an imagined future for their child, which mediated the way they interacted with their children in the present. They suggested that parents use their past experiences to mediate internalisation, i.e. to reproduce valuable and positive past experiences with their children, and at other times to promote externalisation, where they wish to create experiences for their children which are different from their own. Therefore, the ways in which parents choose to support their children are not neutral. In intentionally encouraging their children in certain practices and not in others, parents' projection of their children's future becomes a fundamentally important material and cultural constraint, structuring the child's life experiences in the present. It is clear, then, that both parents' past representations of mathematics, as well as projected hopes for the future, may have the potential to mediate in the child's current identity as a learner of mathematics (O'Toole and Abreu 2005).

It is evident that there are several factors which influence parents' engagement with their children's school mathematics at home. The research has shown that parents' past experiences of learning and using mathematics, and geographical and historical transitions they may undergo, influence the construction of their mathematical identities. Parents use these identities to inform their representations of current school mathematics. Both parents and children invest varying mathematical practices with value, and this affects how they position themselves in relation to different forms of knowledge. This positioning may be affected by parents' perceptions of their child's mathematical ability, and by whether they view different cultural tools as advantageous or disadvantageous to their child's learning. Parents' engagement with their children's learning is therefore mediated by their own mathematical identities, both past and current, and the mathematical identity of their child in the present and in an imagined future. The mathematical identities of those involved, their valorisations of different practices, and the position they adopt towards mathematical practices are all factors which influence the success of interaction between parent and child.

The current study furthers research into the effect of transitions on parental participation in their children's mathematical learning, in particular, the effect of curriculum change on mothers' ability to support their children's learning. Within this context, the study seeks to explore the impact of mothers' personal histories on their involvement with their children's learning, in terms of their experience of direct participation in current methods of learning. This will contribute to a deeper understanding of issues surrounding the involvement of parents in the support of school mathematical learning in the home.

Methodology

Fieldwork consisted of a small-scale interview study with 12 White-British mothers, six of whom had teaching experience. The specific research questions aimed at investigating the similarities and differences between the mothers of these two groups in the way that they:

• constructed their mathematical identities, and how different adult experience affected these identities;

- constructed representations of current school mathematics, and how they valued perceived differences between current school mathematics and their own;
- drew on their representations and valorisations of school mathematics to mediate interaction with their children to support their learning.

The design was based on principles of socio-cultural psychological investigations. Qualitative analyses are "the empirical core of cultural psychology" (Valsiner 2009), and this focus intends to capture the meanings and processes involved in human experience and action. It involves a methodological stance where production of new knowledge is achieved from the analysis of single cases to explain the phenomena in other cases (Sato et al. 2007). Thus, the comparative approach we followed included cases of mothers who had more direct access to schools (teaching experience) and others who did not.

Participants

All mothers had attended schools in the UK during the late 1960s to early 1970s, were university-educated, and most had children currently attending primary school. One group ('mother group') had no teaching experience, and was recruited through a primary school in Oxford. Their professional status included solicitor, scientist, marketing manager, publisher and postgraduate students. The other group ('motherteacher' group) had varying teaching experience. Four mothers in this group had taught prior to the National Numeracy Strategy (introduced in England in 1999), then had taken a career break, and for the current study were selected from a Return to Teaching course organised by the Teacher Development Agency. These mothers had undertaken recent placements in primary schools which involved teaching numeracy, and could therefore compare their experiences of teaching numeracy before and after the educational reform. The remaining two motherteachers had recently trained as primary teachers, and were able to draw on their experience of helping their children with homework prior to their training. All participants had children currently in primary school, or who had recently moved to secondary school. Between the mothers, there were 16 girls and 6 boys, ages ranging from 4-13 years.

Procedure and tools for collection of data

An episodic interview format was used, as this method of questioning encourages participants to give their opinions about the subject matter, and to give concrete examples of situations in their past (Flick 2000; O'Toole and Abreu 2005). The interview technique draws on narrative-episodic assumptions around forms of knowledge which are expressed through examples that connect experience to concrete situations. Thus, the questioning involves both general narrative questions such as: "What do you remember about learning mathematics at school? Did you find learning mathematics a positive or a negative experience?" followed by episodic questions such as: "Can you tell me about a situation that was typical of that?" The interview covered basic information, and explored the interviewee's biography in relation to their mathematics learning, current uses of mathematics, and their

experiences of and feelings about helping their children with school homework. For mother-teachers, their teaching experience was also explored. All participants were interviewed in their own homes for approximately 45 minutes, and interviews were audio-recorded.

Analysis of data

The interviews were fully transcribed and analysed using thematic analysis (Braun and Clarke 2006), taking into account the research questions, key concepts from the literature, and new information emerging from the data. The coding was supported by NVivo qualitative analysis software¹, as this facilitates the refining of the coding, and identification of patterns across the cases. Initial thematic maps grouped subthemes together into superordinate themes, as described in Table 1. The data were then examined for similarities and variability between the two groups of participants.

Findings and discussion

Mothers' mathematical identities

Three main themes were revealed in participants' perceptions of themselves as mathematics learners: their perception of their mathematical ability; memories of the

Superordinate themes	Sub-themes
1. Mothers' mathematical identities	 Memories of mathematics learning – emotions Perceptions of own ability Social value of mathematics in family/ peer group Effect of mother's identity on child's
2. The effect of adult experience on identity	1. Effect of work experience on identity 2. Effect of teaching experience on identity
3. Mothers' representations of school mathematics	 Knowledge/understanding of current methods Perception of own school mathematics as same/different Effect of teaching experience on representations
4. Mothers' valorisations of different practices	1. Equivalence of/confidence in different methods
5. How different representations and valorisations influence interaction	 Effect of representations and valorisations on interaction Valorisation of methods by mother and child Effect of teaching experience on interaction Emotional aspect: frustration/fear of confusing child

Mother group	Mother-teacher group
I can remember saying, "I don't understand", and him trying to explain it, and I was none the wiser. I can actually remember saying, "Help!" I mean, he tried but it was no good, and then I can just remember being lost for ever, for ever after I think I was always quite good at just basic maths, but with algebra or anything like that, I'd always be frightened. I felt a sort of terror, fear. <i>Tilda</i> , <i>mother</i>	I think it got to that point where sometimes you'd go, "Oh, I can't do that!" and your brain freezes, and your brain would stop working and decide that it can't do this. <i>Rebecca, mother-teacher</i>

Table 2. How emotions mediate mathematical identity.

emotive nature of their mathematics learning experiences; and their status as a learner amongst family and peer group. Participants in both groups were similar in that their assessment of their cognitive competence in the cultural tools of mathematics formed a significant part of the way in which they constructed their mathematical identity. The data also indicated that participants' views of their mathematics ability did not rely solely on their perception of their competence, but was strongly influenced by their feelings about their experiences. For example, Table 2 shows that there were mothers from both groups for whom learning mathematics was remembered as a struggle and associated with fear and panic. Tilda² talks about "feeling lost for ever, for ever after".

For both mothers and mother-teachers, their mathematical identity relied strongly on how they were identified by significant others, for example, parents and teachers, and their perceptions of their ability in comparison to siblings and peers. Mothers in both groups hoped that their child would construct a positive mathematical identity, and for many, it was more important that their child have a confident relationship with mathematics than that they be expert in the subject. The consequences of mothers identifying themselves, or their children, as less competent, resulted in participants from both groups positioning themselves, or their child, as an 'arts' person rather than a mathematician. In positioning themselves in this way, they devalued mathematics as something not necessary to succeed in. Consequently, this may have limited their own capabilities in mathematics, or their expectations for their

Mother group	Mother-teacher group
I've got a friend that says, "I was crap at maths, so my kids are crap at maths," that's what she says. And she has a daughter who isn't doing so well in maths, but she's taking it as an absolute given that that is how it will be and I suppose I don't. I've never said to Lily I wasn't any good at maths because that would be a dirty little secret I would keep to myself! <i>Tilda, mother</i>	My dad was a maths teacher for a while, and he used to get really frustrated with me, helping me with maths, because he's sort of mathematically gifted, he sort of finds it easy. So there was this conflict in my relationship with my dad and I didn't see myself as a natural mathematician. <i>Clare, mother-teacher</i>

Table 3. How mothers' mathematical identity can affect their children's.

child. Many showed awareness of how their own parents' mathematical identity had influenced the way they perceived themselves as mathematicians, and how this could, in turn, influence their children's identity. As illustrated in Table 3, Tilda felt it was extremely important not to let her daughter know that she wasn't a confident mathematician, whilst Clare understood that her own identity was interlinked with her father's.

The effect of adult experience on identity

The research revealed that mothers in both groups felt that they had developed a more positive relationship with mathematics due to their experience during adulthood (see Table 4).

Often, those mothers who described a change in their mathematical identity experienced a transformation of their understanding of activities through participation in different contexts for mathematics practice. A number of mother-teachers experienced transition from being an anxious mathematics learner, to becoming a confident teacher of mathematics, through participation in different contexts for mathematics learning. Clare reveals that the experience of 'revisiting' mathematics during teacher training allowed her to acquire an understanding of mathematical concepts that she felt she lacked as a child. Many mother-teachers attributed this greater understanding to current conceptually-based methods, in comparison to the algorithmic approach they had experienced themselves. Whilst participants in both groups had experienced changes in their relationship with mathematics during adulthood, there was variability between the groups in how the participants constructed their relationship to mathematics due to the differing nature of these experiences. Those in the mother group tended to associate the change in their mathematical identity with maturity, or with using mathematics in daily life. Those in the mother-teacher group, however, were more likely to associate change with the opportunity to revisit mathematics, and participate in practices which differed from those they were familiar with.

Mother group	Mother-teacher group
I think it's practical maths because once you actually leave school and you start working, you have to use maths on a day- to-day basis, and suddenly it all starts to make sense, and depending on the kind of work you do. I've always learnt by rote, managed to get through and then latterly actually as you get older, you realise why that goes with that, and it's a late discovery. Suddenly it's like, "Oh! Oh yes!" <i>Lisa,</i> <i>mother</i>	It's interesting actually as I think my own feelings about mathematics really changed when I did my teacher training. Suddenly I saw the beauty of numbers, it all fell into place and I could see how all the different parts of mathematics relate to each other. Revisiting it I had this sudden enthusiasm for maths that I'd never had before. I'm not suddenly a better mathematician because I'm doing more advanced level maths, I'm a better mathematician because I understand the basics in a different way. <i>Clare, mother-teacher</i>

Table 4. The effect of adult experience on mathematical identities.

Mothers' representations of their children's school mathematics

Whilst having clear memories of certain aspects of their own learning, many participants, particularly in the mother group, had unclear ideas of how their children were currently learning mathematics. As Table 5 shows, this lack of knowledge sometimes produced a strong emotional response. Lisa, for example, talked of feeling 'closed' to the new methods because they didn't make sense to her, whilst Karen experienced frustration, and could not view the school's methods in a positive light.

Although many felt unclear about the new methods, all participants remembered their learning as very different from the ways their children learn now, and these differences were explained as historical changes within primary education. The representations of these differences were similar in the two groups of mothers in terms of teaching methods used and different mathematical strategies for calculation. Current methods were viewed by participants in both groups as having a greater emphasis on underlying meanings and relationships, whereas a significant feature of their learning had been the repeated practice of 'rules' or 'formulae' for calculation. The groups differed, however, in their conception of whether current or old methods placed a greater focus on mental strategies. Indeed, it became clear that what was meant by 'mental strategies' was quite different to the groups. Those in the mother group tended to equate mental strategies with basic mental arithmetic, and felt strongly that there was less emphasis on this in current teaching. The participants in the mother group valued the repeated practice which had allowed their mental skills to become 'second nature'. The participants in the mother-teacher group, however, viewed current methods as having a greater emphasis on mental strategies, but saw this in terms of children having more opportunities to discuss concepts, and have a greater range of mental strategies to tackle calculation. Although mothers from both groups talked about valuing mental mathematics, how they constructed their representations and valorisations of mental mathematics was quite different.

Mothers' valorisations of different mathematical practices

Whilst participants in both groups shared the view that current school mathematics was different from their own school mathematics, the way the groups valued different

Table 5. The effect of mothers' lack of knowledge of current methods.

Mother group

I know I'm not open, I feel that I'm quite closed to these new methods because I look at them and they don't make sense to me. I get the impression that they're trying to make maths meaningful and I just think it isn't meaningful; it only becomes meaningful if you start to use it in life. And if you're one of those people that it's not obvious to, the way they're doing it, it's not making it more obvious, it's actually making it more obscure. *Lisa, mother*

Interviewer: Can you show me any ways that you think they're doing it?

Oh, God, I can't. I mean, no, I can't. I must be really honest here, I don't actually understand how the mathematics is taught or why the mathematics is taught in the way it is. And the point is, I don't actually know whether there are advantages to the way they do it, I just don't know, because I don't understand it, and I don't know how they're teaching it. *Karen, mother*

practices was quite diverse. The mother-teacher group participants had a clearer idea of the purpose of the new methods. They saw the changes as predominantly enhancing children's global abilities in mathematics and as providing them with a more solid platform for later mathematical study. They spoke positively of children talking about mathematics, and developing a greater ability to reason, and a greater understanding of the concepts of mathematics. They were more likely to value conceptually-based learning, and less likely to value an algorithmic approach. Their view of current mathematics was often in comparison with how they remembered their own experiences of learning, which, whilst enabling them to perform calculation procedures well, had also meant they adopted an 'automatic approach' without understanding how numbers worked together. Their accounts of the way in which they learned may have been mediated by their greater knowledge of the aims of current methods and their current perceptual frameworks.

Most of the mother group participants, on the other hand, saw the changes predominantly in terms of confusion and complexity. They described the new methods as too numerous and more complicated, and were anxious that the focus on understanding the concepts of mathematics was at the expense of rigorous training in the acquisition of basic mental skills. They believed this would result in a gap in their children's cognitive skills, particularly if they perceived their children to have a less confident relationship with mathematics. Amongst the participants in this group, differences in methods were not described in neutral terms, and were not treated as equal alternatives. Mothers used language such as 'simple', 'straightforward' and 'logical' to describe their own form of mathematics, and 'long-winded', 'complicated' and 'obscure' when describing new ways. Mothers in this group were more likely to value an algorithmic approach, and less likely to value an emphasis on conceptual understanding. As they possessed less knowledge of the new methods, they were more likely to feel new methods inadequate or confusing, and to feel closed towards them.

How different representations and valorisations influenced interaction

The data revealed that many of the mother group participants experienced difficulties in understanding practices in which they did not have direct participation, and were often dependant on children's explanations about how they use particular procedures. As the children themselves were often unable to explain procedures clearly, this often resulted in a breakdown in communication between mother and child. Table 6 shows that Karen felt frustrated that her incomplete knowledge prevented her from helping in anything more than a checking role, whilst Susie described how lack of information made her feel there was nothing she could do, and compromised the amount of effort she was prepared to invest. Not only did those mothers who lacked knowledge of current methods feel excluded from helping their children, they couldn't judge their child's competence in comparison with their own ability at a similar stage, and felt they did not know what could be expected of their child.

As mothers talked about the way in which they interacted with their children, it became clear that many children valued the school's methods more highly than the methods their mothers showed them. This was not necessarily because the school's methods were better or clearer, but that children perceived them to be the 'right way of doing it'. Mothers in both groups talked of how their children 'revered' school more than their parents, and of their child's resistance to being shown other ways. Table 6. The effects of mothers' lack of information on interaction.

Mother group

Interviewer: Do they think they're good at maths?

Yes, I think so. The problem is it's difficult for me to know whether they're good. Obviously they seem to get their maths homework right, but I don't know what that means, are they good beyond that? Are they capable of more than that? I sort of feel like, and this is my lack really, I feel I should be more sort of involved with their mathematics... I feel I'm not involved enough, because I basically just sit and look at it and any that are wrong I'll check them, but only from a distance really. So I do find it difficult to support them as much as I could. I don't feel I can get as involved as I would if he was learning in the same way as I did. *Karen, mother*

Well, a lot of the time if I don't understand what method is to be used, I just throw up my hands. There's nothing I can do. I don't feel ... I don't feel anything really; it's a waste of energy really. There's nothing I can do, but I sometimes feel sorry for Molly, because she gets really upset and there's nothing I can do. *Susie, mother*

This often resulted in discordance between mothers and child, and led to homework becoming a source of conflict. The data also revealed that responses to mathematical practices differed according to which practices mothers valued more highly. Whilst not wanting to undermine school methods, many in the mother group displayed frustration that their own tried and tested methods were being devalued, whilst they perceived other methods as resulting in confusion for their children. Those in the mother-teacher group, on the other hand, generally had more favourable representations of current school mathematics, and were more willing to support methods which they viewed as enabling their children to achieve a positive relationship with mathematics. They reported that their teaching experience had enabled them to develop a greater understanding of current school mathematics, and this allowed them to be more confident in assessing their child's ability, and in participating in mathematics homework. However, the data also revealed that although most of the mother-teachers understood and appreciated the use of multiple methods, they adopted different positions towards these approaches if they perceived their own child was confused and this, in turn, affected how they organised mathematical practices for their children (see Table 7).

Table 7. Mother-teachers' valorisations of their own methods.

Mother-teacher group

Milly, I know, knows one method, and if something else is being taught, then I'm afraid I'm saying to her, ignore it, because I'm worried that she will mix it as well. I'm saying forget what Mrs Woods tells you, I keep telling her, which is very naughty, but stick to what you know, because you can do it that way. *Jane, mother-teacher*

I think we took the right decisions for Luke at the time, but I think potentially it could have been even more confusing to him, because I could explain to Luke, yes, you can do it these different ways at school, but you know if Dad's shown you this way and you're happiest with that way, then you do it that way. *Cathy, mother-teacher*

Although some mother-teachers were unwilling to devalue the school's methods, others felt they were right to encourage their children to use only one method, if their child continued to be confused. Jane talked about actively encouraging her own daughter to ignore the school's insistence on multiple methods because of her fear that she will become confused. The effect of teaching experience, then, was generally positive in terms of mothers' representations and valorisations of current school mathematics. However, although, many motherteachers recognised that multiple methods may enhance understanding by providing 'the bigger picture', they constructed different representations of new methods as too numerous and too complex if they perceived their own child to be confused by them. Even with a good knowledge and understanding of new methods, and sympathy towards the aims of the National Numeracy Strategy, their position in relation to the numeracy practices changed according to the particular role, as professional or mother, they had to adopt at any given time. It was the position mothers adopted towards these representations which affected how they interacted with their children's mathematical learning.

Conclusions

The research set out to explore how mothers' past experiences influence the way in which they construct their mathematical identities and their representations of different mathematical practices, and how these factors influence the ways they interact with their children's learning. The findings illustrate that both those with, and those without, teaching experience construct their mathematical identity in similar ways, according to their mastery of the cultural tools of mathematics and perceptions of their ability in comparison with significant others; and that this is mediated by the emotional aspects of learning mathematics. It contributes further evidence that both past and current experience has a continuing influence on the way in which parents construct identities (O'Toole and Abreu 2005), and that these identities are not fixed once formal learning of mathematics ends, but evolve through the experience of using mathematics in different contexts for mathematics learning and practice (Abreu 2002; Abreu, Bishop, and Presmeg 2002). The study further supports previous research suggesting that cultural, historical and geographical transitions contribute to the way in which parents value their children's mathematical learning, and how this influences their involvement (Abreu 2008; O'Toole and Abreu 2005). However, previous research focused on minority groups. In contrast, this study explores the experience of parents in the majority White-British cultural group, and within that group, mothers who are highly educated and with a good mathematical background. Even within this group, historical change was seen to affect the way in which mothers view themselves as 'doers' of mathematics, and the confidence with which they approach their involvement with their children's learning. More research is needed with White-British mothers with lower educational qualifications to clarify this.

The study revealed that both those with and without teaching experience perceived current school numeracy practices to be very different from those they had experienced when learning. It indicates that it is the opportunity for participation in, and mastery of, different mathematical approaches which allows mothers to construct more positive representations of varying practices, and in turn, understand how they are valued socially. The study suggests that those who experience opportunities for participation in contexts of mathematical learning different from their own tend to value these practices more highly than those without these opportunities, and are more able to embrace change more confidently. Those with teaching experience tended to attribute a higher value to current methods than those without teaching experience.

However, the study indicated that, although in many areas mothers with teaching experience held positive representations of current methods, and were able to bridge the gap between differing mathematical practices more easily, when confronted with their child's continuing confusion about mathematics, they may revert to the methods they formerly depended on. Their perception of their child's ability in relation to certain mathematical practices was, therefore, a more significant resource for mothers, and contributed more significantly to the way in which they interacted with their children than their overall representations of current methods. Successful interaction between mother and child over mathematics learning is shown to be affected by the mathematical identities of both mother and child, and the differing valorisations given by both parties to varying numeracy practices.

What is perhaps most novel about this study is the evidence to indicate that representations and valorisations can change according to the role that mothers have to adopt at any given time. The mothers' perception of the needs of their children play a significant part in their negotiation of how to value subjective knowledge, and these needs override the representations and valorisation mothers may otherwise hold in a different role, for example, as a teacher. The study makes clear, then, that there are many factors which affect the way in which mothers value different mathematical practices, and that this valorisation strongly influences the way in which they engage in their children's educational development.

Mothers' contributions to their children's mathematical learning are clearly a significant resource for improving the mathematical performance of their children. More research is needed into how schools communicate the way they approach mathematics, and about the opportunities they offer parents to learn about these practices, thus raising their confidence about becoming involved. Other lines of research that are useful to extend the findings of the current study include research with fathers who are involved in helping their children with school mathematical homework (although they may not be the ones who usually attend school meetings (Peters et al. 2008) or volunteer to be participants in investigations). In addition, research examining the interaction between parent and child (i.e. mother-child) when they complete school mathematical work at home, will contribute to extending the understanding of the data collected from interviews such as those in the current study.

Notes

- 1. Information about the NVivo software used to support the analysis of the data can be found at http://www.qsrinternational.com/products_previous-products_nvivo2.aspx.
- 2. All names have been replaced with pseudonyms.

References

- Abreu, G. de. 1995. Understanding how children experience the relationship between home and school mathematics. *Mind, Culture and Activity: An International Journal* 2, no. 2: 119–42.
- Abreu, G. de. 2002. Towards a cultural psychology perspective on transitions between contexts of mathematical practices. In *Transitions between contexts of mathematical practices*, ed. G. de Abreu, A. Bishop, and N. Presmeg, 173–92. Dordrecht: Kluwer Academic Publishers.
- Abreu, G. de. 2008. From mathematics learning out-of-school to multicultural classrooms: A cultural psychology perspective. In *Handbook of international research in mathematics education*, ed. L. English, 352–83, 2nd ed. New York and London: Taylor and Francis.
- Abreu, G. de., A. Bishop, and N. Presmeg, eds. 2002. *Transitions between contexts of mathematical practices*. Dordrecht: Kluwer Academic Publishers.
- Abreu, G. de., and T. Cline. 2003. Schooled mathematics and cultural knowledge. Pedagogy. *Culture and Society* 11, no. 1: 11–30.
- Abreu, G. de., and T. Cline. 2005. Parents' representations of their children's mathematics learning in multiethnic primary schools. *British Educational Research Journal* 31, no. 6: 697–722.
- Abreu, G. de., T. Cline, and T. Shamsi. 2002. Exploring ways parents participate in their children's school mathematical learning: Case studies in a multi-ethnic primary schools. In *Transitions between contexts of mathematical practices*, ed. G. de Abreu, A. Bishop, and N. Presmeg, 123–47. Dordrecht: Kluwer Academic Publishers.
- Allexsaht-Snider, M. 2006. Editorial: Urban parents' perspectives on children's mathematics learning and issues of equity in mathematics education. *Mathematical Thinking and Learning* 8, no. 3: 187–95.
- Anderson, D.D., and E. Gold. 2006. Home to school: Numeracy practices and mathematical identities. *Mathematical Thinking and Learning* 8, no. 3: 261–86.
- Baker, D., B. Street, and A. Tomlin. 2001. Understanding home school relations in numeracy. *Proceedings of the British Society for Research into Learning Mathematics* 21, no. 2: 41–8.
- Bibby, T. 2002. Shame: An emotional response to doing mathematics as an adult and a teacher. *British Educational Research Journal* 28, no. 5: 705–21.
- Braun, V., and V. Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3: 77–101.
- Civil, M., and R. Andrade. 2002. Transitions between home and school mathematics: Rays of hope amidst the passing clouds. In *Transitions between contexts of mathematical practices*, ed. G. de Abreu, A. Bishop, and N. Presmeg, 149–70. Dordrecht: Kluwer Academic Publishers.
- Cobb, P., and L.L. Hodge. 2002. A relational perspective on issues of cultural diversity and equity as they play out in the mathematics classroom. *Mathematical Thinking and Learning* 4, no. 2/3: 249–84.
- Cole, M. 1995. Culture and cognitive development: From cross-cultural research to creating systems of cultural mediation. *Culture and Psychology* 1: 25–54.
- Crafter, S., and G. de Abreu. 2010. Constructing identities in multicultural learning contexts. Mind. *Culture and Activity* 17, no. 2: 102–18.
- DCSF. 2007. Parental involvement in children's education. Nottingham: DCSF Publications.
- DfES. 2007. *Keeping up Pupils who fall behind in Key Stage 2*. Nottingham: Department for Education and Skills. http://publications.education.gov.uk/eOrderingDownload/ Keeping%20Up%20-%20Pupils%20who%20fall%20behind%20in%20Key%20Stage%202.pdf
- Esmonde, I. 2009. Ideas and identities: Supporting equity in cooperative mathematics learning. *Review of Educational Research* 79, no. 2: 1008–43.
- Feiler, A., P. Greenhough, J. Winter, L. Salway, and M. Scanlan. 2006. Getting engaged: Possibilities and problems for home-school knowledge exchange. *Educational Review* 58, no. 4: 451–69.
- Flick, U. 2000. Episodic interviewing. In *Qualitative researching with text, image and sound*, ed. W. Bauer and G. Gaskell, 75–92. London: Sage.

- Green, C.L., J.M.T. Walker, K.V. Hoover-Dempsey, and H.M. Sandler. 2007. Parents' motivations for involvement in children's education: An empirical test of a theoretical model of parental involvement. *Journal of Educational Psychology* 99, no. 3: 532–44.
- Hughes, M., P. Greenhough, W.C. Yee, J. Andrews, J. Winter, and L. Salway. 2007. Linking children's home and school mathematics. *Educational and Child Psychology* 24, no. 2: 137–45.
- Hyde, J.S., N.M. Else-Quest, M.W. Alibali, E. Knuth, and T. Romberg. 2006. Mathematics in the home: Homework practices and mother-child interactions doing mathematics. *Journal of Mathematical Behavior* 25, no. 2: 136–52.
- Jackson, K., and J.T. Remillard. 2005. Rethinking parent involvement: African American mothers construct their roles in the mathematics education of their children. *School Community Journal* 15, no. 1: 51.
- O'Toole, S., and G. de. Abreu. 2005. Parents' past experiences as a mediational tool for understanding their child's current mathematical learning. *European Journal of Psychology of Education* 20, no. 1: 75–89.
- Patall, E.A., H. Cooper, and J.C. Robinson. 2008. Parent involvement in homework: A research synthesis. *Review of Educational Research* 78, no. 4: 1039–101.
- Peters, M., K. Seeds, A. Goldstein, and N. Coleman. 2008. Parental Involvement in Children's Education Survey 2007. BMRB Social Research. Research Report DCSF-RR034. Nottingham: Department for Children, Schools and Families. http://publications. education.gov.uk/eOrderingDownload/DCSF-RR034.pdf
- Quintos, B., J. Bratton, and M. Civil. 2005. Engaging with parents on a critical dialogue about mathematics education. In *Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education*, ed. M. Bosch, 1182–92. Sant Feliu de Guíxols, Spain: FUNDEMI IQS, Universitat Ramon Llul. Compact disk.
- Remillard, J.T., and K. Jackson. 2006. Old math, new math: Parents' experiences with standards-based reform. *Mathematical Thinking and Learning* 8, no. 3: 231–59.
- Rose, J. 2008. *The independent review of the primary curriculum: Interim report*. Nottingham: DCSF Publications.
- Sato, T., Y. Yasuda, A. Kido, A. Arakawa, H. Mizoguchi, and J. Valsiner. 2007. Sampling reconsidered: Idiographic science and the analyses of personal life trajectories. In *The Cambridge handbook of socio-cultural psychology*, ed. J. Valsiner and A. Rosa, 82–106. Cambridge: Cambridge University Press.
- Valsiner, J. 2009. Cultural psychology today: Innovations and oversights. *Culture and Psychology* 15, no. 1: 5–39.
- Williams, P. 2008. Independent review of mathematics teaching in early years settings and primary schools. Department for Children, Schools and Families, UK.

Copyright of Research in Mathematics Education is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.