THE DIALOGICAL MATHEMATICAL 'SELF'

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Mathematical identity is a growing area of contemporary research. This paper uses dialogical self theory to support a notion of mathematical identity as being made up of multiple positions. These positions make up the mathematical 'self'. This paper focuses on a single case drawn from a wider study of parental mathematical identity. It demonstrates the application of dialogical self theory to show how mathematical experiences influences I-positions, how social and cultural factors shape social positions, and how the dialogical mathematical self can be seen to consist of multiple positions which vary both spatially and chronologically.

Key Words: mathematical identity, dialogical self

INTRODUCTION

A growing body of literature is beginning to look at how mathematical experiences are incorporated into, or reflected in, a person's mathematical identity. For instance, studies have investigated mathematical identity in US classrooms (Boaler & Greeno, 2000; Esmonde, 2009), in parents of primary school children in the UK (Abreu & Cline, 2003; McMullen & Abreu, 2011), in both parents and children in the US (Esmonde et al., 2011), and on pupil and teacher identities in the UK (Crafter & Abreu, 2010) and Spain (Gorgorió & Prat, 2011).

From a sociocultural perspective Martin (2007, p.150) defined mathematical identity as:

> …the dispositions and deeply held beliefs that individuals develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives. A mathematics identity encompasses a person's self-understandings and how they are seen by others in the context of doing mathematics

These generally incorporate notions of positioning and positionality that can be linked back to the work of Harre and van Langenhove (1991). This defines positions as a discursive mechanism through which "people locate themselves and others within an essentially moral space" (Harre & van Langenhove, 1991, p.396). In other words, in terms of mathematical identity, through dialogue people form positions for themselves regarding mathematics.

Much of the research on identity previously mentioned used notions of positioning. Advancements in psychological and educational research shown currently in dialogical self theory present an opportunity to take research involving positioning and mathematical identity further. This affords an opportunity to better comprehend parental mathematical identity. In doing so it may begin to enhance our understanding of how identity shapes parental involvement and activity, itself a key factor in mathematical attainment in UK primary school children (Duckworth, 2008).

THEORETICAL FRAMEWORK

Dialogical self theory provides a systematic approach to understanding identity through positioning of the 'self' via participation in sociocultural activity. It originated in the ideas of Hubert Hermans and builds upon the notion of 'I' and 'self' presented by the American philosopher and psychologist William James as well as the idea of polyphonic 'voices' within a personality provided by Russian literary critic Mikhail Bakhtin (Hermans, Kempen & van Loon, 1992).

When discussing his theory of the self, James distinguished between the self as object and the self as subject (Hermans et al., 1992). The self as object is characterised as 'Me' and the self as subject as 'I'. 'I' is the self as knower, a sense of personal identity, whilst 'Me' is the self as known (Hermans, 2001) and 'Mine' is our mental 'belongings' (e.g. my daughter) (Hermans & Hermans-Konopka, 2010).

Through his analysis of Dostoevsky, Bakhtin developed the notion of the polyphonic novel (O'Sullivan-Lago & Abreu, 2010). Bakhtin argued that the characters in Dostoevsky's work have separate, distinct voices. He termed this a polyphony of voices. It is through this mechanism that the novel is told, rather than a single voice of the author. Bakhtin applied this to the study of personality (Hermans et al., 1992). He suggested that dialogical processes involved the interaction of different voices (Hermans, 1996).

In dialogical self theory these two theoretical foundations are combined. The 'self' is narrative, and therefore temporal, and so evolves over time. It is evident in the stories we tell and the ways in which the past shapes the present 'I'. It is also spatial in the sense that the 'I' shifts depending on the context we find ourselves in.

As with the research outlined earlier, dialogical self theory utilises Harre and van Langenhove's (1991) concept of positionality. Indeed, positioning is central to the temporal and spatial nature of dialogical self theory (Raggatt, 2011). The self is made up of a variety of I-positions that alter as the self moves and evolves across time in different contexts. Hermans (2001) compares I-positions to characters in a story, each of which has a separate background that shapes its voice, producing a narrative, storied self. An example of an I-position might be 'I as a student' or 'I as a father'. I-positions can easily support or conflict with each other.

Dialogical self theory is culturally embedded (Hermans & Hermans-Konopka, 2010). I-positions require dialogue and mediation. In this way dialogical self theory can be linked to the sociocultural theories of Vygotsky, Leont'ev and Wertsch (Hermans & Kempen, 1995). In dialogical intercourse in sociocultural contexts, we reflect on the labels given to us by others. These can become incorporated into the self as social positions (Raggatt, 2011).

As suggested earlier, research into mathematical identity is growing in popularity yet very little research has utilised dialogical self theory to look at mathematical identity using the notions of I-position and social positions.

METHODOLOGY

In order to investigate dialogical constructions of the 'self', twenty-four parents (16 mothers and 8 fathers), all of whom had children attending UK primary schools, took part in a semi-structured episodic interview with the first author. This approach, established by Flick (1997), asks respondents to produce opinions and narrative episodes linked to a series of pre-selected questions. Episodic interviewing is based upon the belief that narrative is a mechanism through which people understand and make sense of their experiences (Flick, 1997). Episodic interviews have been used previously to investigate processes of identity formation in mathematics (Crafter & Abreu, 2010) and in cultural contact zones of immigration (O'Sullivan-Lago & Abreu, 2010).

Interviews were conducted in the parent's home, digitally recorded and then transcribed. The respondents produced a number of narratives and opinions that were then subjected to analysis. This analysis focused on studying narratives to ascertain the positions generated by the parents. The study of narratives to elicit positions has been widely used to study mathematical identity (e.g. Boaler & Greeno, 2000; Crafter & Abreu, 2010; Esmonde, 2009; Esmonde et al., 2010; Gorgorió & Prat, 2011).

The dialogical self analysis followed three stages by investigating I-positions, social positions and multiplicity. These were based upon the approaches taken from a number of different authors.

I-positions

O'Sullivan-Lago and Abreu (2010) studied I-positions in their work on identity in cultural contact zones. In their study, I-positions were identified through the coding of episodic interview transcripts. Using a similar approach in this study, codes were applied to segments of text where the interviewees positioned themselves whilst discussing experiences or opinions associated with mathematics and mathematical activity.

Transcripts were first open coded before being studied for patterns and commonalities. This resulted in the merging of some open codes into larger pattern or thematic codes.

In this stage of analysis coded segments for the 'self' generally, but not exclusively relied upon 'I' in the first person (I, we, me, us), for instance "*I like numbers. Alright, I like numbers, I like adding things up*" was coded as 'I as enjoying mathematics'.

Social positions

The second stage of analysis addressed the role of the sociocultural environment on mathematical identity. This studied the 'voices' or social positions that could be seen in parental narratives.

This style of analysis followed the approach of Aveling and Gillespie (2008), which focused on the relationship between I-positions and the sociocultural environment.

Their coding of interview data was designed to discover the social origin of I-positions. It focused on reported speech and what they termed 'echoes', which are "utterances that are not attributed to others, but that nonetheless seem to have a distinct social origin beyond the speaker" (Aveling & Gillespie, 2008, p.6).

Following this approach, this stage of analysis began by open coding segments of data and then combining and refining codes through a recursive cycle. Here codes reflected actual specific voices and more generalised individuals. Codes could also be often connected to I-positions. For instance 'I as good at mathematics', an I-position, could be a general voice 'I as more successful at mathematics than others', or a more specific voice 'I as more mathematically successful compared to my friends'.

Multiplicity and dialogical positioning in the mathematical 'self'

Multiplicity within the mathematical 'self' was the subject of the final stage of analysis. It was ascertained through comparing the different positioning of the 'self' within individuals. This showed not only the number of positions but also the variety of similar and different 'self' identifications. Next, the positions within each individual were studied in terms of chronology to see whether positions remain fixed or shifted over time. Finally, by looking at the context in which they occurred, positions were compared spatially.

ANALYSIS

Because of the difficultly of presenting the wealth of data analysed in the project within this short paper, the analysis therefore focuses upon the results of a single parent within the sample. Ian was a father with two daughters, Megan in Year 4 (8-9 years old) and Louisa who attended reception (4-5 years old). Ian constructed fourteen positions related to mathematics and was broadly representative of the sample as a whole.

In first stage of analysis, focusing on I-positions related to mathematics and mathematical activity, Ian displayed twelve different I-positions as shown in Table 1. This shows Ian built a mathematical 'self' consisting of a range of I-positions associated with mathematical experiences, aptitudes and behaviours.

I-position
I as replicating my own upbringing
I as supporting a work ethic
I as a competent user of mathematics
I as confused by mathematics
I as good at mathematics
I as not good at mathematics
I as a novice and learning mathematically from my child
I as apprehensive of mathematics
I as enjoying mathematics
I as feeling supported by my parents
I as not interested in mathematics
I as regretful of mathematical activity

Table 1: Ian's mathematically-related I-positions

For instance in Excerpt 1 Ian positions himself as 'I as a competent user of mathematics'. Here the I-position is underlined and preceded by a number to specify its position in the text.

Excerpt 1: Ian - Interview	
Dialogue	I-position
Something, it keeps, (1) I wasn't brilliant at it at school but I've got a pretty good grasp of anything like that.	(1) I as a competent user of mathematics

In the second stage of analysis, which investigated the social and cultural influences on positioning, Ian constructed two distinct social positions. These are shown in Table 2. These social positions suggest that Ian saw himself as similar to his daughter Megan in terms of mathematical ability and attitude, and that his views of mathematics reflected the society in which he grew up and lived.

Social positions
I as similar to my child
I as reflecting the influences of my social environment

Table 2: Ian's mathematically-related social positions

A social position can be seen in the next example. Here I-positions are underlined and preceded by a number whilst the social position is presented in italic and preceded by a lower case roman numeral.

In Excerpt 2 Ian again constructs competent ability positions associated with mathematics and uses these when comparing himself to his daughter Megan. Here we see the links between I-positions and social positions. It also shows how Ian positions his daughter using his own experiences.

Excerpt 2: Ian - Interview		
Dialogue	I-position	Social position
I wouldn't say that it's her strongest subject really at school. (i) *She, she's very, very like I used to be at school I think. (1) <u>If I could be bothered to do it I'd do it and I'd be good at doing it.</u> (2) <u>If I couldn't be bothered to do it, I'd just wing it and get through it and be like that.</u>*	(1) <u>I as good at mathematics</u> (2) <u>I as a competent user of mathematics</u>	(i) *I as similar to my child*

Excerpt 3 shows how the environment in which Ian lived influenced his attitude towards the importance of mathematics. It shows that he saw a value to mathematics in order to be successful in society. This can be labelled as a somewhat vague social position of 'I as reflecting the influences of my social environment'.

Excerpt 3: Ian - Interview	
Dialogue	I-position
Researcher: Do you think it is important to be good at maths? Ian: Yeah definitely, (i) *You've got (pause) everyday life you use it and you are going and obviously it's a big thing in the structure of what you are going to do when you get older. It gets you certain jobs and things like that. You're always going to, you're always, it's the same as like English and things like that, you're always going to need it aren't you.* And you're better off being good at it than bad at it.	(i) *I as reflecting the influences of my social environment*

The third stage of analysis looked at multiplicity. The fourteen different mathematically-related positions exhibited by Ian hint at the multiplicity of positioning that is central in dialogical self theory. This polyphony of positions acts to construct a unique and complex mathematical 'self' for Ian. Multiplicity was a feature across the entire sample, as shown in the range of positions (6 to 26) and the mean number of positions (15).

The parents within the sample showed varying amounts of spatial and temporal shifts in positioning. It was noticeable that some parents presented a greater degree of stability over time and across contexts than others. Stability tended to increase in parents that were mathematically confident or who saw themselves as 'good at maths'.

When studying Ian's I-positions it is evident that many appear contradictory. For instance Ian positioned himself as 'I as a competent user of mathematics', 'I as confused by mathematics', 'I as good at mathematics' and 'I as not good at mathematics'. As we see when comparing Excerpt 1 and Excerpt 4, Ian's mathematical position changed depending on context and across time. In Excerpt 1, when discussing helping his daughter Megan with her homework, he positioned himself as a competent user of mathematics, even though he acknowledged that he "wasn't brilliant at it at school". When asked directly what he thought of mathematics, shown in Excerpt 4, Ian saw mathematics as a school activity that he was not good at and which filled him with apprehension and dread.

Excerpt 4: Ian – Interview	
Dialogue	I-position
Researcher: What do you associate with the word mathematics? Ian: Probably Numbers, that's probably the first thing that comes into your brain, numbers. (1) I don't know because I was rubbish at maths at school (laugh). (2) You probably think, "Oh god not maths again". Numbers, dread, homework really.	(1) I as not good at mathematics (2) I as apprehensive of mathematics

In a different context, shown in Excerpt 5, this time playing darts with his own father, Ian positioned himself as 'I as good at mathematics'. This stems from an ability to quickly perform mental multiplication. A change in context and activity produced a

re-positioning towards mathematics. Again, he uses this to compare himself to his daughter.

Excerpt 5: Ian - Interview		
Dialogue	I-position	Social position
And I always say the same thing to her, because growing up when I was 9, 10, 11, 12 me and my dad used to play darts all the time. (1) And I learnt all my numbers from playing darts, growing up with my dad. So anything that's multiplied into 16, treble this, treble that, double that, I got it straightaway. (i) *And she's like that.*	(1) I as good at mathematics	(i) *I as similar to my child*

Excerpt 6 shows a change in positioning over time. Ian positioned himself first as enjoying mathematics at secondary school. This is opposite to the position he reconstructed of his primary-level education. Again uses this to support an identification of himself and his daughter.

Excerpt 6: Ian - Interview		
Dialogue	I-position	Social position
Err yeah, well (pause) (1) probably more from secondary school really because I probably started getting it at secondary school whereas sort of (i) *when I was sort of Megan's age I was probably exactly like she is.* (2) As can't be bothered, don't matter.	(1) I as enjoying mathematics (2) I as not interested in mathematics	(i) *I as similar to my child*

In the case of Ian, as with the whole sample of parents, it is possible to see chronological instability over time as remembered events and experiences lead to the creation of different mathematical I-positions. Similarly there is spatial instability as different activities result in different I-positions.

DISCUSSION AND CONCLUSION

The case presented in this paper is typical of the findings of this research project. It shows a highly complex mathematical 'self' that is made up of a series of different, and often contrasting, I-positions. These positions can also often be seen to reflect social positions emanating from the surrounding social and cultural environment. The

mathematical ‘self’ can also be seen to shift and alter depending on the mathematical context and also change across a lifetime.

The analysis also shows the potential for using dialogical self theory to better understand mathematical identity, linking a context-specific activity (mathematics) to a context-specific theory of identity (dialogical self theory). A limitation of this research is that it only focuses upon the identity of the parent and does not address the identity of the child. Through involving children in further research it should be possible to use dialogical self theory to better understand the mathematical ‘self’ of both parents and child. In turn this should allow greater understanding of the ways in which experiences shape identity, and identity shapes mathematical activity. This could reveal the extent to which the ‘self’ is shaped by the ‘other’. It could also study the degree to which a child’s mathematical identity reflects the identity a parent holds or constructs for their child. Understanding these kinds of elements is crucial if we are to support parental involvement in children’s mathematical development, a major contribution to mathematical attainment in the UK.

NOTES

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