Choosing more mathematics: an exploration of participation and learner identities in the Further Mathematics Network

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Abstract

In this thesis I investigate how students account for their choices of whether or not to study further mathematics within an after-school widening participation programme, the Further Mathematics Network (FMNetwork). I seek to conceptualise how patterns of participation in advanced mathematics arise not only from unequal school provision but in the 'logics' of individual students' decision-making. I draw on a qualitative research project examining a) fourteen promotional, administrative and evaluative FMNetwork documents, and b) observations, interviews and email questionnaires with twenty four students in three sites. These sites were chosen to include differences in socio-geographic and classroom contexts amid the shared feature that without the FMNetwork these students could not study further mathematics.

I use a theoretical framework based in Foucauldian ideas that sociocultural discourses construct within them practices of the self: the possibilities for being a knowing, active, choosing self in that system of knowledge and social practice. In the texts and students' accounts I analyse the discourses that shape meaning in further mathematics and look for ways they support or conflict with practices of the self in contemporary society. I argue that mathematics and (FMNetwork) further mathematics draw on different discourses, and that the discourses of further mathematics contain inherent ambiguities that students can use productively or struggle to reconcile. Mathematics students are positioned as making secure developmental progress to practical maturity and autonomous self-management. Further mathematics accelerates and/or distorts this progress. I show the students' precarious positioning as self-entrepreneurs who choose risk and face consequences, and also as children whose self-promotion may be illusory.

I argue that students' choice and participation in the FMNetwork are best understood as a project of becoming independent. Thus doing further mathematics allows students to contest their experience of some school or social exclusions, notably where experiences do not fit a dominant model that learning mathematics successfully feels fast, effortless and requires the validation of others. However, this project of doing further mathematics as becoming independent adds to the insecurities they experience about progress and responsibility, leaving them exposed to the logic that giving up is the mature response.

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Chapter 1 Introduction

There is a small but prestigious qualification for school-leavers in England and Wales that informs decisions about access to university mathematics. It is called Further Mathematics A-level, usually shortened to Further Maths (and officially capitalised[1]). It matters because it is centrally placed in overlapping discourses about rigorous mathematics and widening participation (Smith 2011). The historical practices of teaching and assessing further mathematics inform contemporary policy goals and initiatives to promote mathematics and address issues of inequity in its take-up. I have chosen it as the setting for my research because it illustrates engagements between tradition and change, policy intentions and local circumstances. It provides an opportunity to investigate how policy debates in mathematics are reconstructed within institutional practices and within student practices, and how far the resulting discourses create possibilities for students to be agentic and for patterns to change. In this research I aim to answer the questions: how do students account for their choices whether or not to study further mathematics, and how do these choices contribute to their negotiations of identity? The theoretical framework that I use is poststructural and socioconstructionist. I analyse discourse as power circulating in social practices, a "productive network" (Foucault 1980 p198) inscribing meanings and subjectivities. 'Identities' are also discursive, not fixed but multiple and shifting (Davies 1985|2004, Griffiths 1995, Walkerdine 1989). To unpick the notions of choice and identity I examine how agency is produced through the key Foucauldian notion of practices of the self (Foucault 1979, 1984, 1990) and Rose's exposition of selfhood neoliberal governmentality.

I start this introduction by describing the educational context of further mathematics and A-levels. I then introduce the theoretical perspective by which I see students' subject choices as contributing to the circulation of power and knowledge that forms discourses of further mathematics, constructing what mathematics and mathematics students are able

[1] In mathematics education research it is usual not to capitalise or shorten mathematics, whilst in schools and government documents 'Further Maths' A-level is almost universal, shortened even when 'Mathematics' is not. In this thesis I use both Further Maths and further mathematics, the first for a course title, the second for the associated practices of learning and teaching.

to be. I end the introduction with an 'autobiography' of my research questions, reflecting on how they derive from my own story of knowing.

1.1 Let mathematics take you further

1.1.1 A-levels and who takes them

A-levels are the traditional academic qualifications in England and Wales for 16-18 year olds, now taken by over 40 per cent of students. Students usually specialise in three or four subjects over two years, sitting examinations for their 'AS' qualification after one year and – if they choose to continue that subject – for the full 'A2' qualification the next. Mathematics is one A-level subject and, uniquely, students can add a second – 'further' - mathematics A-level qualification to be taken alongside it[2]. In Further Maths students use the concepts learnt in Mathematics A-level, applying them to problems in mechanics or statistics and also developing new conceptual abstractions within pure mathematics. These students are thus likely not only to know more mathematics than Mathematics-only students but to recognise the complexity of connections and technical strategies in using that knowledge. For this reason many English universities recommend Further Maths for their science, technology, engineering and mathematics (STEM) applicants, and a few of the most prestigious universities require it. Despite this declared utility and gatekeeper status, Further Maths remains a minority subject even amongst STEM students. In 2008 some 9000 students from English schools entered the AS examination, and another 9000 entered the full A2; just under 1 in 7 of the 65000 Mathematics A-level students (FMNetwork 2008)[3]. From the standpoint of university mathematics departments there is little question: it is clearly better to have relevant knowledge than to lack it. So why is the actual take-up of Further Maths not greater? One of my original and ongoing motivations in undertaking this research was a curiosity to examine the value of further mathematics to

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[2] There are two A-levels in English, English Language and English Literature, but students would not take both. Similarly for Modern, Early Modern and Ancient History.

[3] Examination statistics are complex, as I discuss in Chapter two. More students study AS-level than A-level Further Maths. However, students may enter AS and A2 in the same or different years; in addition many students do not 'certificate' their AS-level award or wait until they have taken more modules so that grades can be aggregated advantageously. For comparison, in the same year 2008, 5500 students from English schools were *awarded* Further Maths AS-level, 8500 were awarded the full A-level, just over in 1 in 7 of the 57000 A-level Mathematics awards (DCSF 2009).

students themselves by considering it not simply as a depersonalised, detemporalised binary attribute of having/lacking, but as part of a series of choices about where and how one's identity work takes place.

My second motivation balances the attention to individual choice by acknowledging the patterns in who takes further mathematics. These patterns result in differential access to higher education and cultural capital, and they raise issues of equity which trouble me. For example, we know that not all schools teach further mathematics as a timetabled subject, and this is for various reasons: they may lack qualified teachers, be unable to fund small group sizes, be wary of students over-specialising, or ending up with lower grades (Matthews and Pepper 2005; Porkess 2006). We also know that students in state schools are less likely to study further mathematics than those in independent schools (Vidal Rodeiro 2007). These differences are evident at a school level but they relate to the class and socioeconomic status of pupils. Not only do independent schools draw largely from the more affluent middle-class, but they contribute significantly to social reproduction through managing students' aspirational identities (Riddell 2009). There are also differences that appear at an individual level, when students are grouped by socioeconomic status, class, ethnicity and/or gender. For example, we know that 1% of students eligible for free school meals in maintained schools study further mathematics compared with 2.7% of non-eligible students (Hansard 30 March 2010), that Asian and Chinese students choose further mathematics more than White students (Noyes 2009; Vidal Rodeiro 2007), and that in the same schools male students are more likely to study further mathematics than female students (Mendick 2005; Searle 2008a). My research follows sociologists such as Ball (Ball, Maguire and Macrae 2000; Ball and Vincent 1998) and Skeggs (1997; 2004), and recent mathematics education theorists such as Mendick (2003; 2005; 2006; 2008; 2011; Mendick, Moreau and Epstein 2009), Solomon (2007a; 2007b; 2009b), Black (2002; 2007) and Martin (2006; 2010) in asking how it comes about that seemingly individual choices to study mathematics reproduce social patterns.

1.1.2 How do choices and changes happen?

One way to start looking at this structure- agency relationship is through *constraints*: what could be stopping a student from choosing 'freely' what subjects to take. The school the student goes to, its resources, and its power to vary the terms of its relationships with students and parents can all be seen as constraints external to the student. Another way of looking at the relationship is through *influence*: how do the cultures of the school, family and community influence students so that they choose in fairly predictable ways amongst a range of options.

Constraints and influences are familiar ways by which we explain how people make choices. They permeate our everyday discourse and I do not theorise them here (see e.g. Davies et al. 2004; Nasir 2002) but I introduce them for two reasons. The first reason is that, together, they underpinned a recent government initiative to fund a 'Further Mathematics Network' (FMNetwork) with the aim of widening participation in further mathematics. The empirical part of my research consists mainly of interviews with 24 students who participated in this initiative. One way or another, these students would not have been able to study further mathematics without the existence of the FMNetwork, and so they were well placed to give accounts of how changes in participation became possible and how they were then positioned as choosing, learning and aspiring young adults.

The FMNetwork consisted of a centrally-supported network of staff (based in schools, universities or local authority centres) who went into local schools to recruit for Further Maths, and organised tuition if schools could not teach it themselves. The pilot project was originally commissioned in 2000 by an educational charity (The Gatsby Foundation) from an independent curriculum body (Mathematics in Education and Industry). In 2005 this was extended across England, funded by the UK government. From 2009 a modified version became the Further Mathematics Support Programme. The initiative was designed to cut through staffing and viability constraints that state schools have traditionally respected (QCA 2007; Searle and Barmby 2006). The FMNetwork challenged these: it taught Further Maths as a fifth A-level subject, out of school time, using web resources for distance learning, asking students to travel to other sites for lessons and to learn on their own. In 2005 these were unusual practices, but in line with the policy move towards 'personalised learning' inside schools (Pollard and James 2004). The FMNetwork also set out to influence students from age 14 upwards to choose further mathematics, by direct influence and recruitment on school visits and by organising events that promoted mathematics as giving access to a successful life. 'Let Mathematics take you Further' is one of the FMNetwork's headline slogans. This combination of tackling constraints and influencing students resulted in a doubling of Further Maths A2 students from 2004-9. AS numbers trebled in the same time (FMNetwork 2009). Thus it introduced changes that opened the possibility of disrupting unequal social patterns in participation.

The second reason to consider the notions of constraint and influence is to critique them. These everyday explanations do not seem to me to reflect the accounts of A-level decision-making that I heard from school students. My participants are not on the whole frustrated by constraints that stop them choosing freely; instead they see this as part of reality. This is similar to the young people in Ball, Maguire and Macrae's study of London school-leavers who reiterate that they *do* have choices but also that they know "what is not possible in a world of possibilities" (2000, p39). Nor do the students feel unduly influenced by external sources; rather they recognise their identity as expressed in how they manage the expectations of others while making their own choices. Of course, there will be post-hoc rationalization operating in all such accounts of choosing. Indeed Ball, Maguire and Macrae's study shows that students who are choosing amongst A-level subjects are much more empowered in the education system than the majority with lower qualifications. They are more aware of the detailed hierarchy of careership choices, more likely to use family knowledge to distinguish themselves by those choices, and they tend to stay with their initial choices. Nevertheless, the inadequacy of these familiar explanatory concepts for interpreting students' accounts led me to seek a more nuanced theoretical approach that would consider how choosing relates to identity and how knowledge can appear as simultaneously individual and social. I introduce this theory in the next section, and develop it in Chapter 2.

Before that, I have one more related motivation for studying further mathematics. This arose from noting how the FMNetwork positioned itself within policy debates by linking further mathematics to neoliberal visions of success and equity. Mathematics has been promoted by the government as "the key for building a strong economy and highly skilled workforce" (Wright 2009), crucial for personal success and economic growth. Although much of this policy is concerned with widening participation, there is also a focus on "our very brightest young people" studying mathematics and science A-level subjects who "by doing so are ensuring that Britain has a bright future" (ibid). In such comments, policymakers blur the two different arenas of personal life-trajectory and global competition. They evoke the certainties of economic discourse to persuade individuals to choose mathematics for their own future goals (Woodrow 2003). There is a relationship between the individual and the state, and here it is being governed and shaped through the promotion of mathematics. Because I want to understand students not just as classroom participants but as classroom participants positioned within modern political and social life, I also need to examine how subjectivity itself is constructed by discourses of neoliberalism and how they bring together education and mathematics.

1.2 What is 'mathematics' and where is 'further'?

In the previous section I raised three motivations for my research:

- understanding what students say about reasons for choosing further mathematics.
- understanding how choices that are made individually can often - but not necessarily - reproduce patterns of social participation.
- understanding how choosing an educational trajectory – specifically doing Further Maths A-level – is related to ways of understanding identity and society.

Lying behind all these is a policy purpose of my research: to consider whether some practices of doing mathematics – either in school or the FMNetwork – have effects that induce more students, and more diverse students, to study more mathematics. I also have a methodological purpose: I want to test the explanatory power of a theory that takes into account the many different levels at which knowledge is produced. In this research I align myself with poststructuralist work that "understands knowledge by starting from everyday practices of knowing" (Mendick 2003, p21). I have already talked about 'discourses of mathematics' and 'discourses of policy' in the general sense of specialist languages associated with bodies of knowledge. I now want to go further theoretically and use 'discourse' as Foucault does: as "practices that systematically *form* the objects of which they speak" (Foucault 1972, p49, my italics). So the discourses of mathematics are defined by the ways in which mathematics is known and used in language, thoughts, actions, and the dispersed positions of students, teachers, mathematics educators and policy makers.

1.2.1 Theoretical approaches: discourses as regimes of truth

Poststructuralism resonates well with recent work in mathematics education that demonstrates the fallibilist nature of mathematical knowledge (Ernest 1991) and understands learning in terms of community and participation (Boaler 2000; Solomon 2007b). Fallibilist, socially-constructed mathematics does not exist separately from its discourses, and there is no pre-existing mathematical truth. This principle is helpful in explaining two features of researching further mathematics. First, outside the A-level world, 'further mathematics' has as little intrinsic meaning as 'further english' or 'further music'. My discursive approach to epistemology locates its meaning precisely in the discourse constructed by its school practices. Second, the capitalised title serves as a nominalizing front for a range of practices of teaching, learning and assessing. 'Further Maths' is primarily an A-level examination, so knowledge about it does reside partly in its curriculum and assessment practices, but students and teachers also contribute to knowing how it is learnt and chosen in schools, while universities and society contribute to knowing its symbolic role. A poststructuralist approach to research is interested in examining other knowledges apart from the official or most widely recognised one, and in examining *why* some ways of knowing get reproduced as more legitimate than others.

I have used mathematics and further mathematics as examples to introduce Foucault's principle that there are no absolute truths outside discourse. However it is not possible for *any*-one to know *any*-thing. Knowledge is regulated by the practices which simultaneously construct it, and so discourses are "regimes of truth" which authorise themselves (Foucault 1991c). One of the ways that this discursive stability happens is that discourses position individuals - knowing subjects – in certain ways, which in turn affects their power to know any differently - or to be known differently. For example, a student with a D grade at GCSE has difficulty in knowing himself or herself as 'good at mathematics'. In school mathematics discourses there is no way for his or her knowledge to be true: There are a limited number of ways to be 'good at mathematics', and doing *fairly* well in examinations is not one of them, although failing totally in mental arithmetic can be. When calculation is opposed to reasoning, echoing a body-mind dualism, then mathematics is aligned with reasoning (Burton 2004). Mendick (2005) describes such discourses as providing a range of positions within which individuals can "do" good (or bad) at mathematics and traces their intersections with ways of "doing" gender (Butler, 1990). These are performances recognised within practices of learning mathematics and which reproduce the dominant discourses. Individuals can resist the ways they are positioned but not ignore them. For example, my fictional student would 'inevitably' and 'naturally' be asked to improve or explain his D-grade if she or he applied to continue studying mathematics.

I develop this theoretical discussion in the next chapter and introduce an associated methodology in Chapter 3. For now I want to return to some implications of the poststructural approach for the process of research itself.

1.2.2 *Writing the further mathematics student differently*

I have committed myself to a way of thinking which examines how knowing produces reality rather than vice versa. This means leaving behind some of the certainty that modernist paradigms have traditionally accorded to knowledge (Walshaw 2004), and so it also includes questioning the certainty of my own knowledge. I argue that the loss of this certainty is made up for by the new possibilities brought about through the research processes. Modernist research risks being confined to critique, engaging with policy in alternately heroic and tragic modes (Luke 1995a): 'heroic' when research gloriously demonstrates a problem solved, and 'tragic' when it records and laments yet another instance of complex, failing educational practices. Poststructuralist research instead gets its hands dirty by trying to "to write the competent subject differently" (ibid, p91). My policy and theoretical purposes come together through seeing my research as trying to write the further mathematics student using different accounts than those favoured in the dominant discourse of exclusion. That is, as trying to show how the students, teachers, texts, policy and practices involved in the FMNetwork make it possible for further mathematics students to be written and write themselves differently.

My poststructuralist approach has another implication for research. Choice, trajectory, even identity are all objects of knowledge and as such they are practices that need to be examined discursively. Therefore my starting point is not an individual who is free to know, choose and act except where he or she is constrained or influenced by external discourses. Instead my starting point is discourse: discourse constructs what individuals can know, including what individuals can know about themselves, indeed what an individual is. Subjectivity itself is discursively produced in what Foucault (1990) calls "the practices of the self". This multiplies the meaningful questions about experience. As well as asking 'What knowledge do individual students construct about further mathematics when they choose to do it or drop it?', it also makes sense to ask 'What knowledge do students construct about choice when they do further mathematics?', and 'How do choice and further mathematics construct individuals?' As Davies says:

> Who one is is always an open question with a shifting answer depending on the positions made available within one's own and others' discursive practices and within those practices, the stories through which we make sense of our own and others' lives. (1989|2004, p128)

Poststructuralist research does not separate the knower from what is known, and this includes me as a researcher. The validity of poststructuralist research does not come through an objective appeal to truth, but through a critical attention to how the work claims to build knowledge - what forms of reasoning it uses, what evidence or counter-evidence looks like, what are the contexts and audiences for the claims – and how the researcher who makes that knowledge claim is constituted (Ramazanoglu and Holland 2002). The poststructural response to the criterion of validity is reflexivity in the form of critical reflection on theory and practice. In the next section I start this process of examining and explaining how research knowledge is built, by considering how my research questions are rooted in my own experiences of further mathematics.

1.3 Reflexivity: where am I coming from?

Mathematics teachers are familiar with Gattegno's maxim 'only awareness is educable'. Research involves first educating yourself - searching out new information and using theory to change how you think. Normative research aims to eliminate effects of context and personality (Cohen, Manion and Morrison 2000). Therefore returning to the personal when reflecting on educational research is a deliberate, theory-driven assertion that context and difference are important for both education and research (Davies 2005). Miller (1995) reminds us that education is largely delivered by women but theorised by men. She describes autobiography as a powerful methodological tool to critique discourses that do not recognise the centrality of women's positions in education. The tool was developed in feminism but can be used to examine and challenge the power relations in other discourses. It is particularly useful to me here because I am studying new students, structures and pedagogies in the FMNetwork but I bring to this a discourse largely constituted by what further mathematics used to be, for me and the interested communities. Critical autobiography that combines individual experiences with theory, and pays attention to political perspectives, is a basis for moving from false assumptions of universal individual experience to the situated abstractions of discursive subjectivity (Griffiths 1995).

In this section I tell two episodes from my own story of learning and teaching mathematics. Reflecting on these has helped me analyse how my engagement with further mathematics has been structured by knowledge about mathematics and mathematics education and how this has enabled me to position myself in my identity work including my relations with others. I include the episodes to illustrate where my research comes from, so that the reader can judge later how I have built the research findings from my prior knowledge and interpretation of the students' accounts.

1.3.1 Learning mathematics involves selection and anxiety

I am a competitive person – I like to do well compared to others, but I do not compete in mathematics. In secondary school our mathematics teacher told us all to close our eyes and put your hand up if you thought you would be in set 1, then set 2 … while she read out the lists. I put my hand up for set 1, but I wasn't in it. I was in the front row, eyes trustingly shut – and this whisper came from behind: "Cathy, Cathy, I saw you ..." What was worse: not making set 1, or daring to put my hand up for it? Or being stupid enough to believe in the teacher's secret poll? I worried about how I had got so vulnerable, I felt sick at having been noticed, I didn't know how to defend myself. But I wasn't worried about the mathematics set; I knew I should be in set 1.

This is a memory of anxiety that has stayed with me, but for me mathematics was/ is a place of safety. I rely on my own judgment in mathematics. Others can be quicker, more accurate, just cleverer at mathematics, but there is space for me. Of course I am aware that many people's memories of mathematics anxiety function quite differently, with mathematics itself being the cause of distress. Competition, selection, rejection and uncertainty are recurrent themes in mathematics education research, and their relationships are complex (Nardi and Steward 2003; Popkewitz 2002b; Solomon 2007a, 2007b; Valero 2004, 2007). One reason that brings me to teach mathematics and ask these questions is to explore how mathematics can also be about belonging and acceptance.

1.3.2 Teaching A-level shows what mathematics really is

When I became a teacher, A-level students were important to me. They made up the rolling mathematics group that characterised the department socially within the school. Their numbers and results affected my status, my coolness and my stress levels. As a department, we recruited keenly for Further Maths. We knew that many students would drop out but we wanted the academic status, stimulation and timetable slots. In further mathematics I enjoyed teaching mathematics close to what I had studied at university, and especially having the chance to learn it again properly.

Being a teacher in the 1980-90s made me feel threatened, caricatured as a purveyor of low standards. Teaching Further Maths was an assurance of intellectual quality, an area of personal certainty in the curriculum. Eventually becoming Head of Department gave me more power, and I changed the A-level syllabus to a modular scheme. These schemes were (and still are) criticised by many mathematics educators but they soon became the norm. Current Mathematics/ Further Maths A-levels are still taught and assessed as six modules. I sympathise with mathematicians' feelings that richness, acuity and complexity have been lost in dividing the content, but am confident that change was necessary to keep mathematics alive in school.

1.3.3 Reflection and questions

Reflecting on how I come to be asking my research questions has helped me become aware of my discursive formations, prompted me to question them and to see other possibilities. I still want to promote a mathematics of belonging but I am conscious that 'belonging' can work differently for other people, in other times and settings. I am still conscious that students' choice of further mathematics matters to teachers personally so, rather than dismiss this as irrelevant in academic research, I have chosen a theoretical approach that allows for multiple and diffuse power-relationships between individuals. My research questions about the FMNetwork are clearly rooted in a teacherly tension between an ideal relationship with mathematics and actual relationships with students. I see (my) teaching as acting out publicly a possible identity in which agency is supported by participation in mathematics, but if the students simply are not watching then the act has to change.

Reflection cannot liberate me (even if I wanted to be liberated) from the aspects that make this research personal to me, but it can acknowledge positively what is personal and local. In telling these stories I aim not to uncover my own essential subjectivity, but to remember that knowledge is produced as an interaction with other people, which will include myself and my research participants, and that it is produced in social situations with rituals of telling, fantasy and emotion (Walshaw 2010). Writing these autobiographical extracts involves deciding what aspects of me to leave out of the stories and isolates the ones I leave in. These stories are not me, they do not feel like a part of me and they are not particularly a nice part of me. I will remember this when I write others' stories for my research. Miller (1995) calls autobiography a strategy for organisation rather than therapy. Indeed by stripping out aspects of myself, the questions become less mine and more open, allowing me to think about what work they could do out there in the research community.

As a result of this ongoing process of reflection and theorizing, I have organised my research around the following questions:

1. How do students account for their choices whether or not to study further mathematics, and how do the choices contribute to their negotiations of identity?

2. What practices of learning mathematics in school and with the FMNetwork do students draw on to justify continuing (or not) with further mathematics?

3. What practices of learning mathematics in school and with the FMNetwork do students draw on to describe themselves as knowing, agentic selves?

In Chapter 2 I return to these questions and develop them theoretically. In Chapter 3 I consider methodology -what information will count as evidence for my claims - and methods - how I have collected, organised and analysed data. Chapter 4 examines official discourses of the FMNetwork through analysing a selection of promotional and evaluative texts. The remaining chapters relate my findings from student accounts, discussing different discursive relationships that were significant to choosing further mathematics: time and maturity; work and happiness; individuals and collectives; independence. In examining how these themes work together to combine and have effects on students' subjectivities and choice, I find students who 'have to' drop further mathematics to maintain coherent identities, but I also find students using FMNetwork discourses to argue for themselves as mathematicians.

Chapter 2 Theorising experiences of choosing and learning further mathematics

In the UK mathematics is compulsory up to age 16. At that age, students choose whether or not to stay in full-time education (78% of the age cohort did in 2006), whether to study A-levels or a more vocational route (45% of 16-year-olds took A-levels in 2006, and another 9% took the equivalent vocational level 3 NVQs) and whether to study mathematics among their three or four AS-levels subjects (9% of 16-year-olds did in 2006) (all DCSF 2008). After AS-level students can choose whether to continue mathematics to A2-level; and then whether to study a STEM subject at university. These post-16 choices are the main focus of research on choosing mathematics, and there is a small strand concerned with further mathematics. This includes quantitative studies into examination entries and attainment (e.g. Kitchen 1999; Newbould 1981; Searle and Barmby 2006), research into the value of further mathematics for STEM undergraduates (Hoyles, Newman and Noss 2001); and research that aims to understand the factors underlying A-level choice (Bills et al. 2006; QCA 2007). My theoretical approach, tracing practices of the self within discourses of further mathematics, is original for researching further mathematics, but it falls within a body of wider work that examines educational choices as ways of understanding and reproducing cultural identities (e.g. Ball 2001; Bowe, Gewirtz and Ball 1994; Brooks 2003; Cohen 2006; Jackson 2006a; Mendick 2005, 2008; Mendick, Moreau and Epstein 2009; Reay 2004; Reay, David and Ball 2005; Sfard and Prusak 2005; Warin and Dempster 2007). I use this literature to support my theoretical arguments and to help understand the multiple contexts in which students choose.

In the first section of this chapter I consider how prior research has asked and answered questions about who chooses to study mathematics; section 2.2 then introduces literature about choice as a social practice; and section 2.3 discusses the significance of choice in a neoliberal view of the self. My aim here is to consider how the theoretical bases used allow us to conceptualise and address differences in educational participation. Mathematics is clearly a sensible starting point for comparison, although I will go on to argue that there are differences in the practices of further mathematics. I have found that many existing studies do not (or cannot) distinguish between students who take one or two mathematics A-levels so in describing the findings I highlight when a finding specifically concerns further mathematics.

2.1 What do we know about choosing to study mathematics?

One theoretical approach taken by prior research is to treat choice as an event and look for patterns and correlations between the 'input' of student and school variables and the 'output' of chosen subject options. This body of research provides quantitative data in the form of patterns in who chooses mathematics or not. It can also aim to throw light on the mechanics of these choices by asking students to explain the factors that might influence them – such as interest, enjoyment, utility, success, career aspirations - and then comparing explanations with outcomes to see which factors "count" (Davies et al. 2004; Porter 2011). Event-based studies, even when they are not explicitly experimentally framed, conceptualise free choice and equitable participation between population groups as a null hypothesis and seek to explain variation from this imaginable or ideal outcome. The constraints and influences they identify can be interpreted in two ways: first, as forces acting *upon* the student, giving a model of structural, constrained choice, or, second, as relevant information available *to* or *within* the student, giving a model of an agent making rational choices in varying contexts (Payne 2003). Payne finds this oppositional binary between structure and agency underpinning the theoretical perspectives of most event-based choice research. The most common stance is the combination he dubs "pragmatic rationality" which recognises that both structure and agency matter but often lacks any explicit theory. In this chapter I argue for a different theoretical perspective that does explain this interaction; nevertheless event-based research and its structure/agency binary still forms part of my problematic (Brown and Dowling 1998) because its findings largely define research and policy agenda in mathematics education.

A second body of research treats choice as an outcome of an extended process of participating in mathematics. It looks at the attitudes and expectations that students have, and the practices that they engage in when they belong to communities of learning. It suggests the implications these practices have for later opting in or out, without necessarily theorising choice as a practice in itself (Daskalogianni and Simpson 2001; Grootenboer and Jorgensen (Zevenberger) 2009; Holland et al. 1993; Nasir 2002). This research is closer to my theoretical perspective because it allows participation to be considered as part of the work that students do in forming and maintaining themselves as individuals. It recognises that student identities – including the groups and social categories that they belong with - are not independent of choices about participation in mathematics but can change those choices and change with them (Cobb and Hodge 2002). Where I take a different perspective to this participation-based research is in paying more attention to choice itself as a social and individual practice. I theorise choosing and belonging as practices that take different forms in the multiplicity of communities in which individuals position themselves as 'selves' (Griffiths 1995; Mendick 2003). In addition, I place an emphasis on the diversity and specificity of ways of choosing. I want to trace the *possible* and *impossible* ways to be a further mathematics student, rather than the *usual* ways, because I want to find whether a non-traditional community such as the FMNetwork can allow some of those unusual ways to flourish.

In this section I draw on both kinds of research to describe what we know about choosing and learning mathematics. In doing so I argue that the way we pose research questions and the categories that we use contribute not only to our understanding of mathematics education but also to how differences are sustained, how they are read as equitable or not, and what possibilities for change exist. This is evident even for the fundamental policy question underpinning my and others' enquiry: what can we do to increase participation in mathematics?

2.1.1 The mathematics problem: declining numbers?

Most studies of mathematical choice in the UK (mine included) locate 'the problem' as insufficient numbers of students with the right level of mathematical knowledge, although there is little agreement on what those numbers or levels should be (Watson 2004). Commentators from university mathematics have regularly criticised successive mathematics A-level changes as 'dumbing-down' what STEM students know (Anderson 1999; Kitchen 1999; London Mathematical Society 1995; Smith 2004). This discussion of falling A-level standards within mathematics has been powerful, and I return to it in Chapter 4 with a discussion of the discursive binary 'breadth-versus-depth'. The point I make here is that the long-standing concern for standards has been overtaken by a newer concern that not enough students are even *choosing* mathematics. The clear trigger for this change was the 'Curriculum 2000' A-level reform[4] which demonstrated that a small

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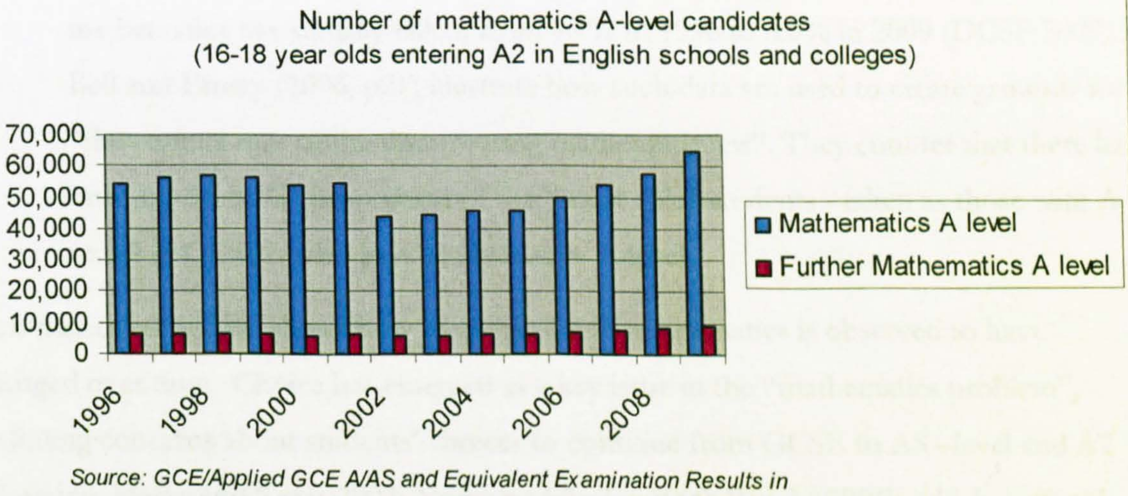
[4] Curriculum 2000 was a national reform that introduced AS-level qualifications taken after one year of study. New mathematics syllabi specified the content of AS-level modules as roughly half an A-level.

increase in syllabus difficulty could lead to a big change in optional participation. In one year, 2002, the numbers sitting A-level mathematics dropped by 10,000 students, i.e. nearly 20% (DCSF 2009). This was a striking discontinuity in what had been otherwise a steady but slow trend of decline in A-level candidates from the 1980s. The lower numbers continued until 2004, and there has been a gradual recovery thereafter (see figure 1.1). This trigger had important consequences for further mathematics. Firstly, it prompted reactive syllabus changes in 2002 and 2004 which created more AS modules at entry-level. These were significant in changing access to further mathematics because they allowed students to learn both mathematics A-levels concurrently. It was no longer the case that they had to rush through Mathematics A-level first, or be taught in separate groups (school finances permitting). Secondly, it showed the danger in calling for more challenge within Mathematics A-level, so that concerns to promote STEM refocused on safeguarding the existence of further mathematics (ACME 2010a; Porkess 2006; Smith 2004; Stripp 2004). Thirdly, students' perceptions of mathematics and how they negotiated their moments of choice became significant in research and curriculum planning.

Figure 2-1 Candidates for mathematics and further mathematics A levels 1996-2009



Source: GCE/Applied GCE A/AS and Equivalent Examination Results in England, 2008/09 (DCSF Statistical First Release, Ref. 02/2010 Revised)

We can ask if this concern over declining numbers is justified, either by the data or by its implicit assumptions about the goals of education. There are real complexities in comparing data about A-level participation collected at different times, using different

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However after only one year of familiarization before the examination, students found the mathematics AS-level content too demanding. Syllabi were revised in 2004.

methods, and within different systems (Noyes 2009; Searle 2008b; Wright 2006). My survey of the related research and statistical publications suggests that:

- There is widespread agreement that Mathematics candidate numbers fell steadily from the 1980s to 2003, with a sudden drop in 2002; then rose after 2004. Despite recent big increases, the numbers still do not match some reported pre-1990 levels (DCSF 2009; Joint Council for Qualifications 2009; Matthews and Pepper 2007; Porkess 2006; Roberts 2002; Wright 2006).
- This pattern is similar for Further Maths A-level, which fell from a historically-reported high of 15,000 candidates in the early 1980s to under 6,000 in 2002 (Porkess 2006). Since 2005 it has grown rapidly to a current level of over 10,000 (DCSF 2009; Searle 2008a, 2010). The timing of this increase corresponds to the establishment of the FMNetwork in 2004. This raises a methodological question for the next chapter: in what ways can my findings, in sites chosen for a wider participation in further mathematics, be related to the national context?
- Although more students are taking Mathematics A-level since 2004, there are also more students taking A-levels. The proportion of A-level entries which are in mathematics has actually fallen, from 9.7% in 1996 to 8.0% in 2009 (DCSF 2009). Bell and Emery (2006, p21) illustrate how such data are used to create grounds for "the curious case of the disappearing mathematicians". They counter that there has been no fall in the proportion of the "most able" students - taken as those with A or A* at GCSE - who pass Mathematics A-level.

This numerical outline shows how participation in mathematics is observed to have changed over time. Choice has emerged as a key issue in the "mathematics problem", including concerns about students' choices to continue from GCSE to AS –level and A2 (Kounine, Marks and Truss 2008; Noyes and Sealey 2009; Wright 2006), which optional modules they take (Hoyles, Newman and Noss 2001; Kitchen 1999; Ofsted 2006), how departments choose students (Roberts 2002), and the implications when universities read subject choices as indicating individuals' interest and potential (Matthews and Pepper 2007).

I want now to return to "the curious case of the disappearing mathematicians" (Bell and Emery 2006) as an example of how problems are not neutral or pre-existing starting points of research. Instead they can emerge from methodology and practice, constructed from the juxtaposition of statistics and assumptions about society – what Popkewitz calls an "alchemy of inquiry, evidence and exclusion" (2002a, p262). Popular concern over the falling *proportion* of A-level mathematics entries rests on a core belief that 'new' entrants to further education – women, working-class students, students with disabilities, students from under-represented ethnic groups – can and should participate equally in advanced mathematics. Unequal participation is identified as a problem to tackle, and this formulation is consistent with the New Labour government's contemporaneous 'widening participation' policy agenda. There are informative parallels in higher education. Archer (in Archer, Hutchings and Ross 2003) argues that wider participation is justified by the coalition of two theoretical arguments: *social justice arguments* that society benefits from educating individuals, and *utilitarian arguments* that the economy profits from locating untapped potential. However, their research shows that it is almost exclusively the utilitarian, profit-boosting argument that appears in the everyday usage of institutional texts and in the rationales offered by working-class students themselves for entering higher education. Moreover, when policy research investigates the 'problem' of encouraging new entrants, and takes a perspective that simultaneously treats participation as a universal virtue (as in the social justice argument, Macintyre 2007) and as a goal that contributes to the common good, then this can lead to a pathologisation of these same groups as deficient and worthless rather than an inquiry into the conditions and productive effects of their participation and non-participation (Archer and Leathwood 2003). So, for example, the NFER Report '*How do Young People Make Choices at 14 and 16?*' describes young people without settled career choices as lacking "necessary skills", having 'comfort-seeking', 'defeatist' mindsets, and attending unsupportive schools (Blenkinsop et al. 2006, pvii).

Returning to A-level mathematics, Bell and Emery's (2006) report provocatively hints at similar currents in the ways that the problem of recruiting 'mathematicians' has been posed: is it only high-achievers that really count as mathematicians? Are the needs of new A-level participants necessarily different from those of the "clever core" who traditionally take A-level (Matthews and Pepper 2005)? Research that treats social categories as atheoretic, contestable only in how to measure them, fails to consider the political outcomes of working and thinking with those categories. Instead a research methodology needs to acknowledge and challenge the complexities and the productive power of statements that equate 'being a mathematician' with 'being a traditional A-level student' and 'performance in mathematics exams'.

2.1.2 Patterns of choice: being "good at maths"

I have started to suggest that research must go further than identifying patterns of participation and inferring causation according to familiar distinctions. This does not mean that numerical patterns are unimportant; on the contrary, they provide powerful ways of endorsing stories about the world (Sfard 2009). In this section I consider research findings in terms of how they constitute sociocultural categories of who does or does not choose mathematics and further mathematics. Overall, the differences between particular groups clearly do not support a hypothesis of universal, unconstrained, 'free' choice. This reproduces the situation that exists in education more generally: apparent freedoms do not result in equal outcomes (Atkinson 2007a). In particular I use four large-scale analyses. The Qualification and Curriculum Authority (QCA) carried out a national evaluation of participation in A-level mathematics (Matthews and Pepper 2005, 2007) using pupil data, school surveys and case studies. The GMAP project (Noyes 2009; Noyes and Sealey 2009) used the National Pupil Database to investigate mathematics participation across the Midlands. Cambridge Assessment, the research division of a large examination board, surveyed 6500 students about A-level choice, with a focus on shortage subjects such as mathematics (Vidal Rodeiro 2007). Finally, Brown, Brown and Bibby (2008) used QCA survey data to investigate 16-year-olds intentions about choosing mathematics A-level.

The first category I look at is how differences in who chooses mathematics have been associated with students' prior attainment, and I use this as a way to develop my theoretical argument. First, I consider what kind of theory I would need not just to assert that higher-attaining students choose mathematics, but to explain why. I approach this by taking two 'common-sense explanations' and asking what assumptions underpin them: this leads me to consider the theoretical frameworks that can justify or challenge such assumptions and offer more than 'common-sense'. Secondly, I highlight the comparative sterility of research that accounts for observed inequities in participation by categorising 'able/ less able' students and not examining how ability is constructed in classrooms, workplaces and other social contexts and their practices. I examine the epistemological questions that trouble me when equity research treats such an aspect of students' identities as an independent variable, and neglects to consider how mathematics and education contribute to giving it currency. Addressing these questions leads me to adopt the poststructural perspective that identities are multiple, social and discursive, not individual or essential (Foucault 1979, Butler 1990, Griffiths 1995, Rose 1996, Walkerdine 1989). I develop this perspective to consider how participation is associated with gender, ethnicity, and socioeconomic class, the other significant categories that often constitute student categories in research on choosing mathematics.

Attainment

The students who are most likely to choose A-level mathematics are those with high prior attainment on national tests (Bills et al. 2006; Matthews and Pepper 2005, 2007). For example, high GCSE Mathematics grades are the best single predictor for attempting Mathematics A-level (Noyes 2009; Noyes and Sealey 2009). This is unusual: the proportion of students with A or A* grades continuing mathematics exceeds all the other subjects except modern languages and sciences (Bell and Emery 2006). It is not surprising that teachers and students talk about A-level students predominantly in terms of this "clever core" (Matthews and Pepper 2005, 2007). Other students who choose mathematics, usually those with B-grades, are more likely to leave after AS-level, and again this drop-out rate is more acute in mathematics. Eventually, the cumulative effect of losing the mathematics students who have not achieved so highly is that the final grades of remaining students are high. Thus at every possible stage, mathematicians are observed to be high attainers and/because lower attainers leave mathematics.

The association of choice and prior attainment in mathematics is thus well-documented. It is also not particular to England and Wales, with similar results being found in other westernised societies such as Ireland, the Netherlands and Australia (Daly and Ainley 1999; van Langen, Rekers-Mombarg and Dekkers 2008). Many schools operate cut-offs for mathematics A-level that prevent students with a GCSE grade C (or B) from entry (Matthews and Pepper 2007), but prevention is not the only cause of non-participation. Attainment also correlates with differences in attitudes to mathematics. When Vidal Rodeiro (2007) asked students which of their A2 subjects they considered to be most important, the (relatively) low attainers put Mathematics in the top four (along with English Language), while high attainers put Mathematics first and introduced Further Maths as third (compare this with English Literature/Language at $7^{th}/9^{th}$). Further mathematics is even more strongly associated with attainment, both in numbers participating and in attitudes. This extends to first-year mathematics undergraduates using 'did further mathematics' as a way to explain differences between their own and their peers' performances even when their lecturers judge it immaterial (Hoyles, Newman and Noss 2001).

Given this observed association, what theoretical interpretations meet my aims of being rigorous and accounting for students' choices in the local contexts of FMNetwork classrooms? There is a common-sense explanation for why choice depends on attainment - that one simply prefers any area in which one has been successful. However this does not explain why medium-attainers continue in English, for instance, but not in mathematics and the sciences. Another familiar interpretation might be that mathematics *is* special: that attainment stems from an innate mathematical ability inevitably associated with an inclination to study more in the subject. Again, there are critical responses: in fact, a national survey suggests high attainment correlates with lower enjoyment of mathematics for 15-year-olds, with presumably less inclination to continue (Sturman and Twist 2004). I have introduced these 'common-sense' explanations because they would be recognised in school and student talk despite their limitations. Indeed, they are so implicated in how we all think of choosing mathematics that any theoretical perspective must take them into account. Indeed, both interpretations depend implicitly on theoretical models of how individuals make choices. The first posits a natural sequence of success-pleasure-choice, while the second imagines a brain with a mathematical inclination. Neither theory addresses its critical responses. Thus when research into participation finds patterns in who enjoys mathematics, is interested in it, or does well at it, one should always examine the underlying conceptualisations of choice that structure the interpretation.

Both explanations need a particular account of how or why choosing in mathematics might be different from choosing in other contexts. However, as I argued in Chapter 1, delineating what is special to mathematics risks ignoring how choosing mathematics affects (and is affected by) other identity practices such as friendship groups, timetabling, self-image, future plans. I want to resist the mathematical tendency to simplify and make abstractions. When it carries over into education research and policy, it constructs a distorted representation of students and undermines the intentions of equity reforms:

> If I were asked to draw a "reform student" I would paint a being that looks like an outer-space visitor; with a big head, probably a little heart and a tiny chunk of body. That being would be mainly alone and mostly talking about mathematics learning, and would see the world through his school mathematics experience. That would be a "schizo-being" since she has a clearly divided self - one that has to do with mathematics and the other that has to do with unrelated things.(Valero 2004, p40)

We can see this schizo-tendency in the explanation of natural mathematical ability which separates mathematics from other aspects of life rather than connecting it. Mendick, Epstein, and Moreau (2007) have shown how the story of the obsessed, isolated mathematician pervades popular culture and student talk. School students themselves critique it as a limited stereotype, just one easy way of representing a mathematics student, but they know no others to contest it. Burton has interviewed career mathematicians to provide other stories: she found a diversity in their histories and motivations that contradicts an essentialist explanation, and so concluded that mathematicians are *not* only born; they *are* often encouraged by teachers (Burton 2004). Clearly, there are multiple and even contradictory representations of how people come to be mathematicians, each legitimate but also contestable. Mendick, Epstein and Moreau argue that, amongst these, the story of natural mathematical ability is not only more pervasive but also more useful to individuals in positioning themselves and others. It then tends to exclude other representations; that is, it functions as a dominant discourse. An inevitable result of aiming to set out the particularities of choosing mathematics will be that I reproduce dominant discourses and the exclusions that they (often) make happen. To balance this I need to ask what other discourses there are, how they function, and what effects they have on people.

To summarise my argument so far: in order to "organise my theoretical space" (Brown and Dowling 1998, p20) in relation to prior research on attainment I need a framework that critiques inadequate 'common-sense' models of how people choose, how choice is related to attainment (and other factors identified in participation research), and why this works differently in mathematics than in other subjects. I need to be alert to reproducing the ways in which dominant discourses position students, especially ones such as 'naturally good at maths' that suggest being a mathematician is separate from other ways of making life decisions. My theory must help explain why some discourses have more effects than others, and it must pay attention to the variety of ways that students understand the processes of choosing and studying further mathematics because these could provide different possibilities of participation.

I now want to consider how prior research explains a second feature of the posited relationship between mathematics and prior attainment: the associated patterns for gender, ethnicity or class. One approach is to accept the attainment-participation link, and understand inequitable patterns as the unintended consequences of school-level factors that legitimately differentiate by attainment (Ofsted 2008; Reeves 2008; Stevens et al. 2011; Wright 2006). The main culprits cited here are any (intentional or unintentional) school technologies preventing lower-attaining students starting A-level. This approach treats assessment as a legitimate and neutral practice of schools, and crucially does not critique the sociocultural patterns that exist in GCSE attainment (Noyes 2009). In any case, grade-competition itself has far from neutral effects when considered against measures of social class. Evidence from a longitudinal series of studies examining the effects of how secondary schools regulate students' subject choices (Davies, Davies et al. 2009; Davies et al. 2004, 2006) concludes that "the advantages of increasing competitive pressure again appear to accrue disproportionately to students from higher status social backgrounds whilst the disadvantages appear to be borne more by low-achieving students" (Davies, Telhaj et al. 2009, p83). This quote confirms that competition based on attainment reproduces pre-existing educational inequities, and it also illustrates how easily such findings blur the categories of attainment and socioeconomic status (where are the high-attaining students from lower status backgrounds?). The empirical evidence simply does not support an approach that separates attainment on high-stakes tests from other observed aspects of students' identities (Dowling 1998; George 2009; Mendick 2003; Mongon and Chapman 2008; Strand 2008).

Another approach to explaining inequitable patterns is to unpick the attainment-participation link to scrutinise how attainment influences attitudes towards choosing mathematics in different ways for different individuals. Collecting these individual findings together creates category judgements. Taking gender as an example, statistical analyses consistently reveal the "baffling" discrepancy (Reeves 2008, p11) that girls attain higher at AS-level mathematics yet leave in greater numbers. It is well-established empirically that *relative* GCSE performance is a stronger predictor than grades alone (Davies, Davies et al. 2009): students are less likely to choose mathematics A-level if they did similarly in other subjects. Sullivan (2009) uses this result to explain high-attaining girls' under-representation in mathematics - they are simply too good at English. She points out that her analysis leaves little opportunity for changing girls' participation except by reducing their attainment elsewhere. I suggest this is a policy dead-end that follows inevitably from seeking to understand patterns of inequity in attainment primarily as the accumulation of more detailed patterns. This approach fails to question the categories of gender, attainment and subject-specialism, or to consider how choosing mathematics is part of creating those categories

A different policy response to the relative performance phenomenon comes from the think-tank Reform, which proposes to adjust the A-level "market" by changing the value of a Mathematics A-level for universities and employers (Kounine, Marks and Truss 2008).

Their argument is neoliberal: it applies the economic model of rational choice to education and considers subject choice as the outcome of cost-benefit calculations. Low participation among medium-attainers suggests to them that a market deformation conceals the 'truth' that Mathematics is riskier but actually worth more than other A-levels. In response their recommendation would impose economic valuations of desirability and worth aiming to over-ride any differences in individuals' calculations. They do not need to question categories of gender, ethnicity and class, just render them irrelevant in choice calculations. This logic has been influential in how mathematics and further mathematics have been promoted by initiatives such as More Maths Grads (Flavin 2010) and the FMNetwork. Theoretically, however, it shares the limitations of Sullivan's (2009) event-based choice research that it can only account for variations in students' decision-making as individual anomalies to the broad model. It fails to explain why some students persist in (irrationally) choosing not to study mathematics or to acknowledge that competitive access to mathematics could have any effect other than increasing demand.

In contrast, poststructural approaches to relative attainment explain variations by teasing out the identity work involved in choosing mathematics. Mendick's analysis of school mathematics discourses (Mendick 2006) shows how attainment in mathematics is defined in opposition to femininity and also in opposition to attainment in creative subjects (and thus it is no accident that my examples echo others' by repeatedly comparing Mathematics with English). This means that girls and all-rounders do indeed experience particular tensions and advantages in sustaining positions of being "good at maths". Minor adjustments to the 'market-value' of mathematics may be enough to change some of these students' choices, but they may also create damaging effects on the prospects of students who continue not to participate. Poststructural research recognises the dominance of general trends in who studies mathematics, but sees them as resources *for* individuals' choices rather than limits *on* them. It can imagine change because it pays equal attention to the unusual ways in which students do or do not participate.

2.1.3 Epistemology, or which differences matter?

This brings me to the type of epistemological question that has driven and eventually led me to adopt my poststructural stance. How 'real' is any relationship between mathematics and an individual descriptor such as ability, gender, or ethnicity? If it is real because it is generally observed, how do we account for the variations and exceptions: the students who are *sometimes* good or interested in mathematics, who start mathematics but then choose another interest, or for the day-to-day complexities of teaching? How do we explain that the patterns of difference in participation coincide with patterns of economic and political privilege?

If on the other hand the relationship is 'only' a story or a belief that acts on individuals, how do we account for its power in structuring how students, teachers, social media and researchers talk about doing mathematics, and its resilience in spite of variation? Can such a story be stripped away or seen 'through', and is there something essential 'beneath' – a potential waiting to be uncovered or a once-blank page that has been irretrievably inscribed? If so, are those essential identities themselves characterised by difference or sameness? How could we tell?

However I approach this question of 'reality', it leads me to more questions. Each approach requires me to ignore complexities that I consider important: the open space of individual differences in the first argument, and the power of cultural representations in the second. A poststructuralist focus on discourse offers a theoretical means to reconcile the tensions between biological and cultural explanations, between equality and difference (Davies 1989|2004, Francis et al. 2009, Walkerdine 1989, 1999). The key epistemological point is to "think of an idea as 'real', not because of its power to *describe* the world, but because of its power to *produce* effects in the world" (Mendick 2006, p102, original emphasis). This means that mathematics *is* associated with innate ability, gender, ethnicity and class because students and teachers often act as if it is. There are discourses in society and in school mathematics which position people so that they know, act and feel in ways that reproduce those associations and those discourses. Dominant discourses sustain institutional technologies – processes such as GCSEs and career guidance – and structure our thinking and our choices. They also sustain practices of the self that construct how we behave as knowing, agentic subjects. From this perspective, it is clear why trend-based research so often appears to reify what it measures. Whether it challenges, reinforces or revisits existing knowledge, educational research engages with policy and continuously re-creates a reality because it has effects on people.

I started this discussion with attainment because it is the most significant student variable for predicting participation in mathematics A-level. However I have argued that the theoretical frameworks of event-based and participation-based research are limited in their explanatory power and insufficiently reflexive about how the knowledge they produce sustains current inequities. For these reasons I have shifted focus from the epistemological binaries that oppose biological/cultural explanations and taken a perspective that starts with discourse. The units of my analysis will be the multiple, overlapping discourses that students use (and are used by) when constructing themselves as agentic individuals making a choice about mathematics.

In the next section I review existing research concerning gender, ethnicity and class in mathematics to develop this argument for a poststructural approach. I indicate where their theoretical approaches run the same dangers that I have identified for attainment: constructing categories out of differences, ignoring complexity, and leaving us with the policy options only of changing individual students or manipulating them without regard to differences. I contrast this with poststructural approaches to gender, ethnicity and class that provide a way to understand identity that accounts better for the individual variations and patterns that I observe in further mathematics.

2.1.4 Patterns of choice: who chooses mathematics?

Gender

Much of the theoretical critique of positivist research has arisen from feminist questioning of objective knowledge as partisan and incomplete. The search for general patterns not only fails to account for the experiences of women and other less-privileged groups, but contributes to their subordination (Lather 2004; MacInnes 2004; Oakley 1998; Ramazanoglu and Holland 2002). It is from this perspective that I made use of autobiography as a reflexive tool in Chapter 1. The questions I raised about the 'reality' of different natural abilities were inspired by feminist policy debates about how we should research and respond to gender difference in mathematics (e.g. Burton 2003; Rogers and Kaiser 1995).

In Mathematics A-level, only 40% of students are female, and gender is the second best statistical predictor for participation (Noyes 2009; Reeves 2008). Women have been even less likely to choose Further Maths (Kitchen 1999; Noyes 2009). Looking at the FMNetwork, the proportion of AS-level Further Maths students who are female starts relatively high at 40%, but decreases to 30% for A2 (Searle 2008b). These proportions have been consistent over time (2004-7) and they do not change with attainment. The number of girls studying with the FMNetwork has doubled since its start, but this still involves only a few thousand girls and the increase is in line with the increase for boys.

Thus in further mathematics, as in STEM subjects generally, the research shows little change in the participation of women. Although girls' and boys' mathematics achievements are similar at GCSE, more girls say they rule out A-level because it is 'too difficult' (Brown, Brown and Bibby 2008). Brown et al. propose raising girls' confidence in mathematics as an effective means of recruiting more mathematics students. In fact, tackling girls' under-representation appears repeatedly as a target in government reports on education and economic policy, such as *SET for Success* (Roberts 2002) and *The Science and Innovation Investment Framework 2004-14* (BIS 2008, 2009). These all make similar arguments that it "contributes directly to the skills shortage and, left unaddressed, would have a considerable negative economic effect on the UK" (HM Treasury, DfES and DTI 2004, p17), another New-Labour example of economic utility lending urgency to a social justice cause. Despite thirty years of quantitative research and policy efforts, understanding that there *is* a gender effect in mathematics has had little impact on changing it.

I see the introduction of confidence to explain girls' non-participation in mathematics as an example of a discursive strategy: "a device through which knowledge about the object is developed and the subject constituted" (Carabine 2001, p288). Confidence is ascribed to individuals but brings with it a reference to social practices (Hardy 2007). Hardy suggests that teachers and students judge others' confidence as a performance, based on observed classroom behaviours such as correct answers or rapid volunteering. However students use different criteria to describe their own confidence: often referring to characteristics that are harder to observe or replicate such as knowing how to start a problem. Thus ascribing confidence is a tactic that allows students and teachers discursive control over both the inside and outside of individuals. One productive effect of 'confidence' is to position teachers as managing seamlessly both the inside (affective-cognitive) and the outside (performative) aspects of students. The second productive effect is to describe girls and low-attainers as unconfident when they participate through non-overt practices. The tactic avoids any reference to more complex discursive relationships that produce students' classroom identity and thus has two effects on school mathematics: first it conceals the difficulties of problem-solving behind the performance of acting confidently, so that students are encouraged to focus primarily on getting answers fast. This matters because A-level students become disillusioned when they meet the slower, complex pace of advanced mathematics (Daskalogianni and Simpson 2001, 2002). Secondly, it suggests that confidence is a mathematical goal in itself, so that students who do not feel confident cannot feel mathematical. This makes participation in mathematics vulnerable to systemic differences in how confidence can be produced by individuals in their classroom contexts.

As I noted above, lack of confidence or enjoyment has been used to explain that girls can attain highly in mathematics but not choose to continue. There are some useful participation- based research studies that have tried to unpick this relationship in how girls participate in mathematics. Bartholomew (2005) focussed on high-ability 15-year-old students in top sets and found again that the behaviours that indicate confidence – working quickly and succeeding visibly – were those that students and teachers fostered and assessed in the classroom. When students talked about mathematics, many boys described their pleasure in performing these behaviours while girls reported discomfort because they conflicted with the non-competitive, hard-working and co-operative classroom practices needed to establish femininity. Thus Bartholomew suggests that gender should not be seen as a background to participation in mathematics but as "an inevitable part of what it means to do mathematics and regard oneself as mathematical" (p8). Her findings suggest again that local classroom identity practices need to be considered as relevant variables, simultaneously implicated in making choices and sustained by the choices made. (See Francis, Skelton and Read 2009 for a similar argument about mathematics and English for 13-year old boys and girls.)

Solomon (2009b) emphasises the identity work that takes place in mathematics lessons and places it as a community endeavour: identities are constructed *for* individuals but not only *by* individuals. She points out the different classroom experiences of pupils in different sets, and finds that students in top sets are offered opportunities to show interest and agency that are then read back onto them as achieved skills (Solomon 2007a). Enjoyment, interest, confidence, independence, and ability in mathematics are all constructed alongside each other by how teachers and students understand their own and others' actions and classroom goals. Her related work with mathematics undergraduates examines how gender interacts with these constructions of ability. It tests, and finds wanting, the model of undergraduate experience as an apprenticeship, where students engage peripherally in the practices characterised and valued by the mathematics community (such as seeking deeper understanding and rigorous proof). This theory acknowledges the social construction of identity but proves limited in its accounts of how undergraduates judge themselves as belonging and how they negotiate their own and others' powers to include or exclude. Solomon's analysis shows that many women mathematics students participated heavily in the community's practices, using them to describe their mathematical identities. However they felt excluded by the challenges of doing so and powerless to negotiate a closer sense of belonging. In contrast, many male undergraduates aimed for what they knew as a superficial engagement, got lower grades, but felt more successful and aligned with the community. Solomon critiques the theoretical stance that treats the practices of learning undergraduate mathematics as derived solely from expert mathematicians. Rather, she says that undergraduate mathematics cannot be separated from other discourses about education and identity: "the institutional culture of entrenched beliefs about ability and ownership of knowledge affects students' experiences of being an undergraduate and dictates the functionality of particular identities" (Solomon 2007b, p79). The disaffection of finding advanced mathematics to be frustrating and isolated is felt by all students (Rodd, 2002). However Solomon argues (with Bartholomew, Mendick, and Burton) that mathematics practices that emphasise confidence, competition and speed fit more easily with performances of masculinity. This suggests for my research that students may experience difficulties in belonging to the further mathematics community when categories which have the power to determine belonging, such as ability and confidence, are constructed by teaching practices in ways that make them more or less difficult for students to take up alongside their other identity work. In the FMNetwork, this may result if the reduced timetable, fast pace and the focus on ability strengthen the association of further mathematics with hegemonic performances of masculinity.

Ethnicity

In 2002, *SET for Success* noted that there has been "disturbingly little attention" to analysing differences in mathematics attainment between different ethnic groups, although school data suggest they exist (Roberts 2002, p16). This is in contrast to the United States, for example, which has a long tradition of research into the achievements of Black and Latino youth. Recent English studies of mathematics participation have reported a relationship with ethnicity. Noyes (2009) and Vidal Rodeiro (2007) both report that Chinese, Indian, Pakistani and Black African students are considerably more likely to choose A-level mathematics than White, Black Caribbean or Bangladeshi students (also BIS 2009; HM Treasury, DfES and DTI 2004). Vidal Rodeiro uses broader categories to report similar results for further mathematics: Non-White students are 1.5 times more likely to choose AS-level Further Maths than White students, and 1.3 times as likely to continue it to A2. Further Maths is ranked as the second most important A-level subject by students from the Non-White ethnic group, compared to ninth for the White ethnic group.

Again I want to consider what kinds of explanations are suggested for the trend that ethnic minority students are more likely to choose mathematics. Both Noyes and Vidal-Rodeiro caution, first, that there are small proportions in each ethnic group and, second, that ethnicity and socioeconomic status (SES) are usually correlated. I look at the associations of mathematics with SES below, but it is worth considering whether differences can be accounted for solely by ethnicity. Strand (2009; in press) used multi-level modelling in a longitudinal pupil study to investigate the relationships between ethnicity, SES and attainment in all subjects. His results challenge common explanations that may downplay ethnicity as related to socioeconomic deprivation, parental involvement or student attitudes to school. Using increasingly subtle statistical models to take these explanations into account, he found attainment differences accounted for only by ethnicity. This suggests the need for further research that includes other explanations such as teacher expectations, institutional racism and cultural differences (Strand in press, p19).

Further research does exist in the American context. However, researchers such as Martin (2006; 2010), investigating the mathematics attainment of African-American youth, share my concern about more and more detailed quantitative analyses of the same relation. Studies into students' attainment, attitudes and choice patterns "have helped to point out that there continue to be differences in the amount of mathematics learned among different student groups [...] These studies provide no evidence that Black students differ from their peers in their capacity to learn mathematics" (Martin 2006, p10). Martin argues that quantitative, trend-based research has a logic which means that under-achievement is primarily what is noticed and explained, while its dominance as an explanatory practice produces a discourse that normalises Whiteness and presents 'the other' as deficient. He recommends that equity research starts instead from accounts of students' experience. Hart (2003) argues similarly that mathematics education research has concentrated on ways of assessing inequities without investigating the resources - social, practical and financial - that further social justice. Martin's research analyses African-American students' accounts at individual, school, community and sociohistorical levels to investigate and explain how they achieve success. This attention to complex inter-relations fits well with a poststructuralist analysis of the various discourses that position individuals not only as exercising agency but also as belonging to sociocultural ethnic groups (Stinson 2010). Poststructuralism challenges "the essential black subject", and allows political categories such as 'black' or 'ethnicity' to breathe (Hall 1992). This instability reflects that these categories are not solely representations imposed from outside, but also 'floating signifiers' that change meaning with their contexts (Hall 1996b), and are linked with processes of identification and otherness that happen within individuals in those contexts.

These discursive practices can explicitly interweave ethnicity and mathematics, as do the 'national myths' that Indians hold about themselves: being good at technology, and being good at seizing opportunities for personal success (2005). Varma traces the prevalence of these 'myths' in the Indian diaspora, and concludes that there is no evidence that they convey essential truths or even statistical generalizations. Nevertheless many Indian students continue to achieve success by choosing mathematics and science-based routes, because that is what they set out to do. Studying mathematics provides a narrative in which second-generation ethnic minority students can collectively surmount hurdles and become successful (Devadson 2006). This is reflected in reasons to choose A-level subjects: ethnic minority students talk more about becoming successful in high-status positions, and White students talk more about individual enjoyment and vocational requirements (Hernandez-Martinez et al. 2008). As we saw above, whether it is attached to ethnicity, gender or intellect, the myth of being naturally good at mathematics is dominant in the discourse of educational achievement and it produces effects. It does not exclude other possibilities for becoming a mathematician. Earlier we met the example in Burton's (2004) work of having an inspirational teacher, and here we have the example of a culturally-legitimated trajectory of effort and opportunity. However these other stories are more marginal possibilities, and they have to interact with the determining discursive effects of individual mathematical ability.

Socioeconomic status, school type and class

Students' socioeconomic status (SES) has been defined using a range of social, economic and geographic measures such as postcodes, eligibility for free school meals, parental occupation, education and income. There are important discussions about precision in definitions of social class and poverty and about the proper measures of achievement (Mongon and Chapman 2008) but none of these obscure the clear and long-lasting trend:

> If you want to know how well a child will do at school, ask how much its parents earn. The fact remains, after more than 50 years of the welfare state and several decades of comprehensive education, that family wealth is the single biggest predictor of success in the school system. (Hatcher 2006, p203)

Focussing now on participation in A-level mathematics, Noyes's (2009) data suggest that SES has had its effect on choice even before age 16, since students' socioeconomic status accounts for most of the variation in their GCSE attainment and there is little further variation in who chooses Mathematics A-level. Vidal Rodeiro's (2007) results downplay class differences too as she finds that the proportions of students choosing Mathematics are fairly similar across measures of parental occupation. However, Hernandez-Martinez et al.'s (2008) study of A-level mathematics students suggests that this evenness represents a spread of different reasons to choose mathematics and that these "choice repertoires" differ by class. In their survey, middle-class students say they choose mathematics because they enjoy it, while working-class students choose it because it is vocationally useful or, for working-class girls, because it is an escape path from current conditions.

The situation is starker for further mathematics where there is a class-related difference even in starting the subject. Children of higher professionals are one and a half times more likely to start Further Maths AS-level than children of routine/manual workers, and more than twice as likely to continue to A2. Indeed 70% of the children of higher-professionals rank Further Maths as a 'very important' A-level. This increased participation is even more marked when groups are classified by parental education (Vidal Rodeiro 2007). In the same way as with gender and ethnicity, we can say that further mathematics is clearly associated with high socioeconomic status.

There is clearly a key determining factor that affects further mathematics, and that is its availability in schools. Further Maths was available at AS-level in only 72% of the schools surveyed by Vidal Rodeiro, and only 41% offered A2. Gorard (2009) has shown that who goes to which school and who gets what in secondary education is largely determined by socioeconomic factors. If we consider school type, Vidal Rodeiro shows that the uptake of further mathematics is three times higher in independent schools than in state comprehensive schools, and nearly twice as high in grammar schools. Students with high SES are disproportionally represented in independent and grammar schools and so have better access to further mathematics. There is a similar result from a geographic perspective: further mathematics is simply not available in many areas of social disadvantage (Ofsted 2006). As we shall see in Chapter 4, the FMNetwork mounts a response to this evident inequity (amid other factors). My study focuses on contexts where further mathematics is newly available, including areas of social disadvantage and relative geographic isolation.

What has happened since the introduction of the FMNetwork? Searle's evaluation asks where, geographically, have Further Maths entries increased? The largest increases in A2 entries are in areas of the country usually regarded as affluent. However, this is different at AS-level where the percentage increases are also big in less affluent areas such as the North-East and West Midlands. Looking at school type, 73% of the growth in A2 took place in the state sector, and more (87%) of the AS-level growth did (Searle 2010). There is much to celebrate in the better take-up at AS-level, and indeed schools report that students benefit in Mathematics from studying the one-year further mathematics course (Searle and Barmby 2006), however it is the A2 qualification that matters for elite universities. There is evidence of a familiar phenomenon here, where measures put in place to widen participation also improve participation for the middle-classes (Ball 2010; Reay 2006, 2008). The introduction of the FMNetwork has not cancelled out the inequalities in participation in further mathematics, although it has clearly provided more possibilities where students have lower SES.

The evaluation findings describe what is happening but do not in themselves explain why this pattern occurs and what its effects are. This returns to the argument I made earlier that treating student differences as pre-existing stable categories is incoherent in ignoring the circular construction of classed identity through educational practice and misses opportunities for change. Neither is it politically neutral: evaluative research measuring the categories that benefit from a policy initiative (here, which SES-defined groups benefit from the FMNetwork) cannot be used for future policy without also elaborating the proportions in which groups *should* be participating in further mathematics and a model for how introducing change affects those proportions. How do I interpret the finding, for example, that the FMNetwork has increased the take-up of further mathematics in deprived comprehensive schools but more so in affluent independent schools? A model of independent variables does not take into account the ways that schools and students have to (and may or may not be able to) respond quickly to changes in the national policy arena that affect performance indicators such as A-level grades (Ball 2001). My poststructural perspective allows, instead, a dynamic and contested production of class:

> Analysis of class should therefore aim to capture the ambiguity produced through struggle and fuzzy boundaries, rather than fix it in place in order to measure and know it. Class formation is dynamic, produced through conflict and fought out at the level of the symbolic. To ignore this is to work uncritically with the categories produced through this struggle, which always (because it is a struggle) exist in the interests of power. (Skeggs 2004, p5)

To start such an endeavour I need to consider class and further mathematics not as intersecting in certain locations with neither changing the other, but as weaving together to mobilise themselves and students within discourse. The cross-currents in these discursive practices do not produce change as progress to a new 'better' equilibrium, but as a change in local practices that unexpectedly flourishes.

I have found no research that sets out to explain individual differences in participation in A-level mathematics specifically in terms of how class is constructed. There is research for compulsory-age mathematics, much of it inspired by Bourdieu's analysis of class in terms of students' ability to wield cultural capital. Cultural capital is knowledge and practice "whose diffuse, continuous transmission within the family escapes observation and control (so that the educational system seems to award its honors solely to natural qualities)" (Bourdieu 2004, p25). Black (2002) shows how teachers in primary schools operationalise pupil ability as a form of pedagogic awareness about the balance of epistemic and social control, and how this cultural capital is validated and encouraged by the teacher in the pupils who already have it. In this way mathematical confidence and ability, that I discussed earlier in relation to gender, also inscribe class positions. Morgan (1988) also shows that aspects of middle-class cultural capital are used to signify mathematical ability in secondary school practices. Various institutional technologies in mathematics, such as the nature of tests (Dowling 1998) and ability-grouping (Wiliam and Bartholomew 2004), are structured in such a way that they have different effects given the different capitals of middle-class and working-class children. Analyses such as these suggest that the pedagogic and institutional practices of further mathematics would also have a role in constructing differences along class lines.

Bourdieu emphasises the subordinating role of middle-class cultural capital. It is imbued with pedagogic authority and functions as a naturally powerful resource to which resistance is ineffective because the structure of social practices make it so (Bourdieu and Passeron 1994). Skeggs starts instead from working-class inscriptions and examines how they *are* sustained in opposition to middle-class readings of economy and morality. Her research with working-class women finds "not an account of how individuals make themselves, but of how they cannot fail to make themselves in particular ways" (Skeggs 1997, p162). This means that people's individual experience is as 'real' as discourse: that is, it is as real as the framework of practice and knowledge that precedes and structures it, and as the truths that result from retelling it. Experience, too, is discursive. Skeggs's work on class, Mendick's work on gender, and Hall's work on the construction of 'Black' identities within/against White discourse, all draw on Foucault's assertion that knowledge is a political fiction that is brought into being through discursive practices which produce our experience and knowledge of ourselves in society (Foucault 1972, 1980). There is no testable relation between ideas, experience and reality, instead Foucault attempts to "pick out the fine stitching of many different forms of knowledge within the threads of power relations and organised systems of practices" (Dean 1994, p162).

This is a good point at which to recap the theoretical arguments I have traced through this review of mathematics education research. I started by outlining the two most prominent findings offered by trend-based research into mathematics A-level: the problem of declining numbers and the strong correlation of participation with prior attainment. I argued that these findings reproduce the dominant ways of knowing in mathematics and education and do not allow me to examine how new local practices such as the FMNetwork might allow individuals to choose differently. This led me to ask questions about the 'right' ways to understand differences when attempting education research and policy: I rejected the "stance of epistemological innocence" that underpins trend-based research (Rawolle and Lingard 2008, p728) because drawing the line between what is an appropriate difference to eliminate and what is not also demarcates what is 'really' individual and what is only 'superficially' individual. These decisions affect the individual and the social together; they are both political and epistemological, practical and theoretical (MacLure 1993). Instead I argued for discourse as the unit of analysis, allowing different positionings to be equally real whether they function as dominant representations or as subversive retellings (Stinson 2010).

I then turned to research that describes how individuals from different groups participate in mathematics. I found that interpreting these findings solely within the familiar discursive categories of gender, ethnicity and class again presents epistemological weaknesses. It ignores the complexities and possibilities in how individuals choose, and cannot account for the intersections and cross-currents in these categories. This simplification has political consequences in the ways that the differences 'add up' to hide or blame different groups of learners (Mendick 2008). I used research into the experiences of studying mathematics to argue that students are positioned - and position themselves - as legitimate participants not only by adopting the mathematical practices of the mathematics community but by making use of how mathematics produces selfhood. I have pulled together the arguments of poststructural researchers in gender, ethnicity and class to conclude that equity research into further mathematics should trace the relations between discourses inscribed in mathematical classroom practices and wider practices of the self, and examine how the continuities and discontinuities play out in terms of access and power (Cobb and Hodge 2002).

2.2 Identity as discursive practice

I now want to draw out three aspects of my poststructural approach that suggest how identities can be discursively produced. These will help explain my theoretical shift from why individuals choose further mathematics to how discourses of schools, mathematics and the FMNetwork construct further mathematics students as some kinds of people and not others. The first aspect is Foucault's explanation that knowledge does not represent truth but circulates power, and that power is productive as well as repressive. This relationship between power and knowledge is central to explaining why some ways-of-knowing are harder to challenge than others. The second concerns identity, specifically a way of understanding identity as subjectivity that is achieved by practices of the self. This argument starts with Foucault, especially in his *History of Sexuality* (1979; 1984; 1990), but has been developed by many researchers since, including Davies (1989 | 2004), Walkerdine (2003; 2007), Rose (1990; 1996; 1998; 1999) and, in mathematics education, Walkerdine (1988; 1989), Mendick (2006; 2009) and Walshaw (2004; 2010). The third aspect is how Foucault traces the interlinking of subjectivity and practices of the self – the ways of being a *knowing* self and a *moral* self – and how these are contingent on history, perspective and local context.

2.2.1 Power-knowledge

Discursive practices position people in relations of power. In a school, for example, teachers, students, researchers all have roles that frame their interactions. The shared knowledge of these roles informs what individuals can do and how their actions are interpreted by themselves and others. The power that inscribes these positions does not derive fundamentally from characteristics of the individuals, such as a natural authority of adults over children, nor from history, from the way that things have always been done. These are ways in which discourse positions knowledge as legitimate and fixed, but they do not pre-exist discourse. Instead power is perpetuated by the self-regulating processes of discourse itself, "describing and ordering things in particular ways"; hence the ellipsis 'power-knowledge' (Hardy 2004, p106). Power relations make things known, knowable and doable in certain ways by certain people:

> In short, it is not the activity of the subject of knowledge that produces a corpus of knowledge, useful or resistant to power, but power-knowledge, the processes and struggles that traverse it and of which it is made up, that determines the forms and possible domains of knowledge. (Foucault 1995, p28)

It is not power at a macro level that Foucault is explaining here, as in a Marxist view of repressive power derived from socioeconomic structures (Brown 2001; McNay 1994) or even a Bourdieuan self-perpetuating field in which power flows only from top to bottom (Jenkins 2007). Instead Foucault's power acts at the micro-level and is both local and productive. If power were only repressive or excluding, it would not be so effective in producing people in the subject positions that recreate it as knowledge. We can see this in students talking about mathematics. They can represent mathematics as hard and rational in order to position themselves as masters of an uncertain world (Walkerdine 1988), or as a bored and resistant group of students (Nardi and Steward 2003), or even as creative, flexible individuals who reject mathematics (Mendick 2008). Power circulates through all these practices, defining both what mathematics is, and who individuals are, what their goals are and what they take pleasure in. Of course, this same perspective renders other individuals powerless and excluded, unable to know anything of value in the mathematics classroom (Gerofsky 1997), and it is the possibility of this suppression that makes the earlier positions agentic in comparison. My argument is that this way of knowing about mathematics is perpetuated by the range of identities it enables, as much as by what it suppresses.

Cumulatively, then, the effects of local power relations may indeed be broad processes of prohibition or repression. They can "congeal" into apparently static categories such as gender (Butler 1990), so that doing mathematics functions as a way of "doing masculinity" for both boys and girls (Mendick 2003). They can be codified into strategies of government (Dean 1994) that result in middle-class students being more likely to study further mathematics. These broad processes have general effects but they are not enacted only *upon* individuals but also *by* individuals. As Walkerdine says, "practices are at once local and global, minute in their detail and enormous in their reach" (2007, p138) . They constitute both the social knowledge of what *is*, and the individuals who know it. Locality here does not imply a loss of generality; for all individuals are locally situated.

2.2.2 Identity and subjectivity

Contemporary social science understands 'identity' in two different and important ways: one is to describe the different categories of membership that a society provides for individuals to belong to, the other to describe the agency that creates individuality from those possibilities (MacInnes 2004). So we have 'cultural characters' in philosophy (Macintyre 2007), 'discursive representations' in sociology (Skeggs 1997) and 'subject positions" in psychology (Edley 2001), all similar in describing how individuals are constrained to produce roles and identities by what *works*, not by what *is*, and different in how they interpret the strategic use of those productions. If we attempt to separate out these two meanings of identity, so that we treat agency and structure as distinct and conflicting, then the central issue of equity research reduces to how social structures oppose an individual's power of self-definition. In my epistemological argument I chose a poststructural view because it sees discourse as producing both the social knowledge that recognises identity categories *and* the individual knowledge that recognises itself as agency. I rejected the notion of an essential self - by which I mean a knowing subject centred in an individual's biological or psychological identity, relating to an external world through constraint or influence – and argued for a discursive self. This means that the self is no longer "epistemically privileged" (Butler 2008, p16) as an author, someone who *im*poses or *op*poses structure, who "can penetrate the substance of things and give them meaning" (Foucault 1991b, p118). Instead, discourse produces an individual's power of self-definition by constructing a range of identities that 'knowing subjects' can position themselves in and with. These identities are inscribed by discursive practices in the forms of habits of thought, possibilities of action, and shared ways of knowing. The power circulated in these practices regulates which positions and movements between positions are possible. Foucault argues that these practices of the self are so intense as to suggest that any history of the present should be based as much on studying what constitutes subjectivities as what constitutes social structures and relations of power (Foucault 1990).

The metaphor of a landscape (Ball and Vincent 1998; Bowe, Gewirtz and Ball 1994) helps to convey how subjects are positioned and position themselves in discourse, because a landscape both requires and provides a point of view. The discursive landscape comes into existence as individuals observe it, each having their own perspective that doubly defines what they see and where/what the see-er is. The landscape surrounds the participants, framing them in its material and social circumstances, and allowing them to mobilise to take up some outlooks but not others. The possibilities of seeing differently from other viewpoints and the possibilities of moving in the landscape all produce agency for individuals. However, any viewpoint that emerges is *part* of the landscape, in the same way that agentic self-hood is constituted within discourse and does not transcend it. This landscape metaphor describes our subjectivity - how we are discursively produced as both subjects and objects at the same time. We inscribe the landscape of what we know and are inscribed by it as situated yet autonomous persons. But how we can 'do' autonomy is not only up to us:

> People in modern institutions are conditioned to accept being an object to others and a subject to themselves. The very processes we use to inscribe our self to our self put us at the disposition of others. The task of creating rational autonomous persons falls initially to pedagogical institutions; their goal is to produce young bodies and minds that are self governing: failing that they try to make their graduates governable. (Roth 1992, p691)

Because any person engages with a variety of discourses, there are multiple identities that individuals can move between, and each discourse has rules about whether and how to negotiate such shifts. Identity work is different in different societies and in different times. Thus we are located in multiple positions of marginality and subordination, although these do not operate on each of us in exactly the same way (Hall 1992). The focus of poststructural research is to examine the micro-politics involved in "the practical negotiation of situationally-relevant identities" (Berard 2005, p70) and find what negotiations are made possible by specific contexts.

As Roth's quote makes clear, pedagogical institutions are key in inscribing the 'right' (and 'wrong') forms of being a self. One example of this negotiation is how students position themselves during educational transitions such as entry to university (Warin and Dempster 2007) or to secondary school (Warin and Muldoon 2009). Students in both these contexts have described the challenge of their identity work as trying to be a dynamic but also a coherent self, wanting to change and wanting to remain authentic. Clearly these demands are overlapping, even competing. These are goals that concern the individual self, but the way they figure in student talk is strongly aligned with contemporary pedagogic discourses in schools, universities and society. Change is configured in terms of maturity and progress, while authenticity is represented as being known and knowable by students and teachers. As a discursive strategy for managing these transitions, students take up representations that position them both as mature and as staying the same. So for example, university entrants use socialising and drinking practices to emphasise their developing yet stable gender identities (Warin and Dempster 2007; Warin and Muldoon

2009). I follow up this transition research and look at how maturity is related to further mathematics in Chapter 5.

Selfhood, then, is performed in multiple discourses and involves multiple, competing identities. Griffiths (1995) argues that we should not see this as indicating fragmented or damaged selves. Instead, she suggests, individuals are in a state of becoming as well as being. They spin a "web of identity" whose design is unique to them but inscribed by the need to belong with others:

> The individual can only exist through the communities of which she is a member and indeed is in a process of construction by those communities [...] Politics are inseparable from the construction and maintenance of the self. The experiences of acceptance and rejection, and the reaction to them cannot be understood without reference to the structures of power in the society in which the self finds itself. (Griffiths 1995,p 93)

Further mathematics students emerge as subjectivities from the weaving-together of discourses of mathematics, communities, families and classrooms. The agency of those subjectivities is not freedom *from* power but empowerment to embed and connect knowledge and construct oneself as a subject (Edwards 2008). As well as the communities that an individual can choose, discursive constructions also guide the identity work that maintains seemingly natural states of belonging. These include the categories of gender, ethnicity and class, as well as attributes that might be assigned to an individual's personality such as being a high achiever, a 'lad', or 'popular' (Currie, Kelly and Pomerantz 2006; 2007; Francis, Skelton and Read 2009; Jackson 2006a). Further mathematics students belong (or do not belong) to a range of different 'chosen' and 'natural' collectives produced by shared knowledge and institutional practices. In Chapter 7 I examine closely the discursive strategies that students use to construct themselves as belonging and how currents and tensions between different discursive practices help them to produce multiple identities alongside participation in further mathematics. These practices and institutional affordances are what Foucault calls the practices and technologies of the self.

2.2.3 Practices of the self

Practices of the individual self are the "intentional and voluntary actions by which men (sic) not only set themselves rules of conduct, but also seek to transform themselves, to change themselves in their singular being, and to make their life an *oeuvre* that carries certain aesthetic values and meets certain stylistic criteria" (Foucault 1984, p10-11, original emphasis). Although they are intentional, we should not think of them as extra-discursive agency, a remaining individual freedom to choose amongst competing subject positions. Practices of the self are strategies of discourse: they permit discourses to reproduce with stability by constructing singular knowing beings who judge their own and others' behaviour with respect to discursive norms. They are instilled in certain ways of living through what people habitually say, how they are governed, and their actions, such as – for my particular interest – choosing school subjects. In this way practices of the self are at once individual *and* institutional, habits *and* tactics (Foucault 1990).

How can we identify practices of the self and their associated technologies in different discourses? Foucault is concerned not to set limits on what can function as a practice of the self, but he suggests that they can be recognised as having three main functions: they communicate moral codes, they provide systems for judging people's behaviour, and they specify the mode of subjectification, that is "the way in which the individual establishes his relation to the rule and recognises himself as obliged to put it into practice" (Foucault 1984, p27). Where there are recurrent instances of talk and behaviour that fulfil these functions, then they are considered as practices of the self. The purpose of poststructural analysis is then to identify these regularities, and to trace their effects on what is known and done.

Foucault starts his discussion of practices of the self with moral codes because he is studying sexuality, which is widely understood in terms of prohibitions and commands. However, his first argument in *The History of Sexuality* is that the moral codes of sexuality have not changed significantly between classical antiquity and modern (western, Christian) society. What has changed instead are the systems of behaviour, and how people apply the codes to themselves. He concludes that ethics has to be understood in all three inter-related forms: codes, systems of judgement that may enact or ignore them, and views of how these relate to oneself.

Moral codes

Moral codes are recognisable when they are communicated explicitly as rules and advice about what humans should do and the reasons why. They are also communicated through what we understand to be goals and virtues in life, such as happiness, security, success, or learning. These are practical codes of action; although they are influenced by canonical philosophical theories, they rarely belong neatly to any one theory or fit into any progression. In fact, we can most easily recognise moral codes in situations where the theories are being contested and negotiated (Macintyre 2007; Sandel 2009). One example relevant to choosing further mathematics is the application process for university choices. This UCAS system requires students to consider the rules of access to competitive higher education. There are moral codes implicit in this process – students are encouraged to 'aim high' by choosing elite subjects and universities, to 'prepare oneself well' by studying appropriate A-level subjects for the next course, and to 'care for oneself' by avoiding disappointing rejections Students' talk makes these codes explicit when it describes making choices as managing their conflicts and combinations. For example, students are allowed only five course choices, so 'aiming high' is risky and conflicts with 'protecting oneself' from failure. Some courses make UCAS offers without regard to actual subjects studied. Students can then decide to maximise grades without worrying about pre-requisite knowledge, thereby achieving a successful short-term combination of 'aiming high' and 'preparing oneself well'. These UCAS considerations have effects on participation in mathematics. It is common for students to explain that it is best to drop difficult subjects (including mathematics and further mathematics) in order to secure entry to the courses they have chosen (Bell, Malacova and Shannon 2003; Matthews and Pepper 2005, 2007; Noyes and Sealey 2009; Smith 2010a). My example shows how moral codes can be identified from the complexity of actual practices and it also illustrates Foucault's argument that they are not isolated rules, but integrally bound up with systems of valuing and the negotiation of identity.

Systems of judgement

The second function of practices of the self is to produce an individual's behaviour as something that can be judged by others. This entails recognising how language, technologies and actions enable people to position each other as successful or not, as belonging or not, and as agentic or not, that is whether they are acting as proper selves. So, for example, Masters (2005) notes how the "chaotic homeless" are produced by their inability to keep appointments in their own care-plan. Here the linguistic practice of naming, the temporal technology of a diary, and the actions that ensure/prevent punctual attendance all combine to legitimate how an individual's behaviour is judged in a social care discourse. Socio-medical therapeutic interactions require individuals to make themselves known to experts, to communicate histories and futures, just as schools do for students. But the significance of appointment-keeping extends beyond care institutions or even schools. It has effects on relations in wider society because interactions of friendship and employment are understood as involving similar therapeutic practices. Foucault identifies the confessional - making one's story available to others - as one of the main ways "of identifying individuals and establishing and enforcing their location within power-knowledge networks" (Edwards 2008, p29). Both the judger and the judged are positioned by how such social relations are structured. Foucault's work on state governance (1995) shows how technologies that measure people work as a strategy to establish shared 'truth'-making practices. He calls this 'normalization', and it enables discourses of self-determination and self-governance to flourish (Rose 1990). In Chapters 4 and 5 I return to institutional discourses of time and measurement, and how they position further mathematics students.

Another way in which individuals can be compared and evaluated is through discursive analogies with systems of exchange that guide resource distribution. It is widely accepted that in contemporary western society, individuals are judged by their consumption of economic resources and/or by their control of social or symbolic capital that can be exchanged for resources. These systems are common in education, and the UCAS procedure is again an example of how some students are inscribed as more valuable than others because of their grades, knowledge and educational history. Contemporary systems of education and employment read 'individual' characteristics such as rationality, flexibility or determination as having a direct economic value (Brown, Hesketh and Williams 2003). This inscribes even more points of contact with how subjectivity is constructed and fewer possibilities that thinking otherwise can be effective (Skeggs 2004). Systems that value individual traits bring political governance and personal ethics into the same knowledge structure, so that the active subject takes on self-governance as self-hood and economic or political structures as moral codes (Hesketh 2003; Rose 1990).

Mode of subjectification

Finally, we can analyse practices of the self in the mode of subjectification. Here we ask how an individual understands moral codes and other peoples' judgements in relation to the self. Codes and systems of judgement are discursive objects, so they are powerful because, above all, discourses are what works – 'fictions functioning as fact'[5] - but they do not have to construct subjectivity as oppression. So, for example, ethical codes might function as prohibitions or aspirations, recommendations or resources, all depending on

[5] I misremembered this from Mendick (2003, p73) "fictions functioning in truth" which she in turn traces through Walkerdine (1999) and Foucault (1980)

context. Foucault's work with texts on sexuality traced the differences from the aspirational Socratic practices of *training* the self to prohibitive Christian ones of *caring for* the self by protecting it from harm (Foucault 1984). Again, this is not a free choice, as discourse constitutes subjectivities in certain ways. A recent example of work that has addressed this relationship and influenced political rhetoric is Beck's (2000; 2007) theory of individualisation. He claims that contemporary socioeconomic mobility obliges individuals to understand themselves as no longer *guided* by traditional rules of class membership but as responsible for *navigating* their own risky journeys. I see his argument as concerning the mode of subjectification as well as critiquing the continued structural influence of class cultures. Beck is criticised as failing to recognise that continuing stability of social patterns remain as effective as ever, veiled by a new justification that rewards spring naturally from the "individual choices and personal solutions" of the middle-classes (Atkinson 2007b, p710). Again, Atkinson's argument invokes a mode of subjectification, that of the autonomous individual who makes choices among competing codes. Their debate illustrates how metaphorical talk about journeys, change and risk, rewards and difference, caring and disciplining, builds competing knowledges of what it is to be a self.

When we discuss morality in studies of contemporary subjectivity, the question of the mode of subjectification is often turned on its head. Instead of asking how discursive practices of the self construct individuals, we understand individuals as *using* ethical knowledge. This reflects the mode of agency that we ascribe to contemporary subjects. Macintyre's *After Virtue* summarises this contemporary mode: "we simultaneously and inconsistently treat moral argument as an exercise of our rational powers and as mere expressive assertion" (Macintyre 2007, p11). I understand this as indicating that people's moral actions predominantly take the form of *calculating* what they should do, weighing up ends and means; and also *deploying* the process of deciding what they should do in order to express something about who they are. This chimes with du Gay's analysis of ideal workers as 'entrepreneurs of the self' (du Gay 1996) acting upon themselves as resources in the quasi-economic projects of their identity. Giddens agrees that the significant contemporary relationship between morality and the self is expressive. For him, effective identity lies in the "capacity to keep a particular narrative going" (1991, p54). Choosing which stories to tell about oneself in order to present an explicable, coherent biographical narrative are thus practices of the self; and these stories then combine to structure social knowledge of reality. Again there is disagreement about whether everyone has the resources to be able to sustain any narrative that they choose (Archer, Hollingworth and

Mendick 2010; Ball, Maguire and Macrae 2000; Hall 1996a; Solomon 2009b). This is a timely reminder that the dominant discourses – here those of rationality and self-expression – are not universal truths about how people *are*, but contested practices contingent on local contexts.

The literature on choosing further mathematics provides examples of these rational and expressive modalities that are relevant to my study. Some students choose mathematics because they reason it gives the best access to lucrative careers, and others because they want to show themselves as an able student. Explanations such as these are frequently recorded in research into reasons for choosing mathematics (Bills et al. 2006; Hernandez-Martinez et al. 2008; Mendick, Moreau and Epstein 2009; Noyes and Sealey in press; Roberts 2002; Rodd 2002). The student who wants to be known as able fits Macintyre's suggestion that these two modes of morality are combined. Who one is (or wants to be known as) can become a 'rational' factor that influences what one *should* do. We will see this when students explain that they chose mathematics because they are good at it, otherwise it would be a waste. By taking this approach, students put themselves in a mode of obligation where they must choose to exploit their talents.

There are also students who argue that they choose whether to continue with mathematics in terms of enjoyment (Bills et al. 2006; Brown, Brown and Bibby 2008; Putwain 2009; Roberts 2002) I see these students as positioning themselves broadly in a relation of self-care, reasoning that they can (or even should) feel happy. Putwain (2009) warns that 'feeling comfortable' needs further investigation because it can equally serve to balance such differing practices as worry or indifference. Ahmed (2008b; 2010) shows that happiness is constructed as a promise and a duty: to oneself, other people and the future. I investigate the goal of happiness in Chapter 6. Another example originates from research into female STEM participants but applies more widely: some students explain they choose mathematics because they want to be unusual and show agency (Davis 2009a; Mendick 2003). This again suggests choice-making as a form of "rational individualism" whereby students are not so much resisting dominant knowledge about who can do mathematics but rather making use of it as a way to express authenticity (Currie, Kelly and Pomerantz 2006).

These three areas of communicating moral codes, systems of judgements by/of others, and the individual's relation to the rule give a framework for identifying practices of the self. From the examples I have given of how these areas can be constituted it is clear that practices of the self are multiple, interacting and contested. None is holistically truer than another, though some turn out to be more effective. It is their relations and the effects they produce for specific individuals working within specific discursive contexts that are of interest. I want to make two points that follow from this. The first point concerns my use of the survey literature comparing students' reasons for choosing mathematics. Surveys are useful in identifying a whole range of justifications for choice permitted by dominant discourses. It is widely reported that students do explain their choices by talking about confidence, enjoyment, interest and attainment, wanting a challenge from mathematics, desiring its content or its status, appreciating the flexibility in its modules and being attracted by school departments and teachers (Bills et al. 2006; Cooke 2009; Ofsted 2008; Roberts 2002; Vidal Rodeiro 2007; Wright 2006). All these reasons feature in discourses of mathematics and education as legitimate knowledge that affects choice, and I expect to find them in accounts of choosing further mathematics. However surveys abstract the way that students use these reasons from their discursive contexts and attribute them to individuals. The relations between different justifications disappear and they cannot be traced directly to classroom practices. Wright's wide-scale literature review (2006) confirms that these reasons appear similarly in many recent surveys, and moreover that they appear similarly for other subjects, so they tell us little that explains different participation in mathematics. Rather than attempt to weigh up these reasons for choice, I am interested to know how students juxtapose them with specific mathematics classroom practices and then to trace which ones have effects over time. This approach follows from recent richer accounts of choosing STEM subjects that consider how students work on aspects of identity in mathematics (Black, Mendick and Solomon 2009; Boaler and Staples 2008; Davis 2009a; Hernandez-Martinez et al. 2008).

The second point is to signal that the practices of the self that are seen to characterise contemporary society are constructed around self-governance. Confession and normalization continue as important strategies for discursive regulation but they are retouched as self-expression and rational self-determination. Choice recurs in my examples as a discursive proxy for agency since individuals govern themselves by choosing amongst what is available to them. I therefore end this chapter by introducing recent sociological literature arguing that choice is central to practices of the self in neoliberal society and I use this to reframe my research questions.

2.3 The neoliberal self: choosing as autonomy and belonging

I have now reached a first turning point in my thesis. My critique of the existing research has pointed me towards a poststructural framework in which studying individual choice not only requires examining how an individual makes choices but also how choice makes individuals. One of the threads running through the literature has been the binary of structure and agency. I now see this as a discursive relationship put into place by practices of the self. Moreover, in contemporary society, this relationship takes a particular form produced by the neoliberal policies of recent English and western governments (Chandler 2011; George 1999; Mendick, Moreau and Epstein 2009; Rawolle and Lingard 2008). By neoliberalism I mean a particular way of understanding the working of society and politics that constructs the process of governing as one of guiding and regulating free individuals in a quest for mutual – although not equal – economic success (Rose 1996, 1999). In neoliberalism the relationship between the state and the individual self is productive rather than punitive, so that individuals are encouraged, indeed obliged, to be autonomous. Political, social and institutional discourses combine to construct neoliberal practices of the self: a whole range of technologies of government and communication create the knowledge that we only become a self through exercising the freedom to govern ourselves:

> The problem of freedom comes to be understood in terms of the capacity of an autonomous individual to establish an identity through shaping a meaningful everyday life. Freedom is seen as autonomy, the capacity to realize one's own desires in one's secular life, to fulfil one's potential through one's own endeavours, to determine the course of own existence through acts of choice (Rose 1999, p84).

Choosing combines freedom and responsibility and is thus the key way of demonstrating autonomy in neoliberal discourse (I discuss this further in Chapter 8 where I examine how discourses of further mathematics articulate participation as independence). Rose argues that autonomy is the central moral value in contemporary liberal thought and he provides evidence using Foucault's concepts of practice of the self to analyse a range of practices of work, morality and governance. In all of these he finds that autonomy is expressed through notions of choice as identity work and self-discovery:

> Contemporary practices of subjectivity [...] put into play a being that must be attached to a project of identity, and to a secular project of 'lifestyle', in which life and its contingencies become meaningful to the extent that they can be construed as the product of personal choice. (Rose 1996, p 244)

Although these projects, identities and lifestyles are produced by discourse as individually determined, they circulate power only in so far as they are recognised. The neoliberal empowerment vocabulary establishes autonomous choice as the mode of subjectification, but it also inscribes subjectivity as a successful project of belonging to the social and economic state. Exclusion from social institutions codifies as "lack of self-esteem, self-worth and the skills of self-management necessary to steer oneself as an active individual in the empire of choice" (Rose 1999, p 268). We could expect neoliberal discourse to emphasise inclusion because shared systems of judgement are what allow the self-supporting strategy of normalization to come into play. It is untenable for a neoliberal individual to work on identity without having his or her behaviour judged by self and others. Autonomy needs to be observed, and so intelligible choices must be made.

However Rose does suggest that neoliberalism encourages individuals to seek out new ways of judging how we belong with others. Community membership is understood not just as fact or constraint but also as coming about through choice and self-identification. We have already seen this in the arguments of Beck and Giddens, both influential commentators on contemporary liberalism, that identity is now only weakly and electively tied to traditional social groupings of class, family and religion (Beck 2007; Giddens 1991, 1998). The new freedoms of time, space and abstract economics allow society to change reflexively in the light of new knowledge, so that collectives are formed around knowledge or shared technologies (Anderson 1991; Bauman 2001). This means that social structures are as much inscribed by subjectivities – by who we know ourselves to be or want to – as they are crystallised from naturally- or socially-occurring phenomena. Belonging also becomes an expressive choice, sustained by the ways that the self guides itself, uses its freedoms and makes new allegiances to maximise its success (see Chapter 7 where I examine belonging in further mathematics).

As I argued above, education is particularly significant for the functioning of neoliberal government. Social institutions - schools, workplaces, shops, hospitals, media producers – all maintain technologies that frame identity work as consumption and entrepreneurism, comprising research and decisions to maximise one's own powers, productivity and success (du Gay 1996; Edwards 2008; Rose 1998). These institutional framings are both directly and indirectly encouraged by the state, which reserves for itself the abstract role of defining the ideal relationship between itself and free, responsible individuals (Ball 2001; Beckmann and Cooper 2005; Steer et al. 2007). In education, processes such as target-setting, assessment and monitoring, and of course choosing A-levels, produce individuals that know themselves and are expected to make choices based on that knowledge (Besley 2005). The regular choices that students make in their experience of further mathematics - to start it, to take AS-level, to resit modules, to complete A2 - are practices that responsibilise students. In choosing they identify whether or not they aim to belong in the discourse of that subject and they (re-)produce subjectivity as entrepreneurism.

> In this way, subjects are brought forth who are (self-)fashioned and positioned as active learners *and* as self-regulating subjects, where the subjectivity stimulated is one that regards the maximization of capacities and dispositions appropriate to maximising their own productivity as both necessary and desirable. Subjects with an enterprising relationship to the *self* are framed in certain discourses of learning, a self that exhibits qualities of autonomy, self-management and personal responsibility, and reflectiveness. (Edwards 2008, p28)

As part of the dominance of these systems, teachers are valued not only for their authoritative subject knowledge but for knowing and passing on therapeutic and management techniques. They become experts in the logic of educational choice and they disseminate these as "procedures for understanding oneself and acting on oneself to overcome dissatisfactions, realize one's potential, gain happiness and achieve autonomy" (Rose 1999, p 90).

I have described neoliberalism because it is the knowledge framework that is dominant in contemporary discourses of society and education. The practices of the self permitted by further mathematics have to work alongside the neoliberal understanding that choice has the functions of exercising autonomy, expressing belonging and maximising productivity. The work done by students to combine and reconcile them is what can give rise to possibilities for new discourses to emerge. Although, as I have shown, my theoretical journey has been slightly different, I still address the same concerns over agency, identity, relationships and equity that have guided recent research on identity in mathematics education (Black, Mendick and Solomon 2009; Lerman 2000).

I ended the last chapter with a set of three research questions that were framed in terms of problems in mathematics education. With their emphasis on knowing, agency and accounts, they fall within the narrative of rational individualism that has currency in classrooms and in policies about student choice:

R1. How do students account for their choices whether or not to study further mathematics, and how do the choices contribute to their negotiations of identity?

R2. What practices of learning mathematics in school and with the FMNetwork do students draw on to describe themselves as knowing, agentic selves?

R3. What practices of learning mathematics in school and with the FMNetwork do students draw on to justify continuing (or not) with further mathematics?

These questions placed students, their accounts and experience as the focus of my enquiry. I have since argued that I should start with discourse, that is with knowledge and the power that it circulates. I can now develop them into the following series of theoretical research questions that determine my methods and the form of the research findings. The questions overlap, so they are not intended to be addressed singly but used to tease apart the different negotiations of power that include or exclude students.

The first questions concern discourse:

- Q1a What are the discourses about choosing, about schooling, and about further mathematics?
- Q1b How do these interrelate and which take precedence in making choices about further mathematics?

Mathematics education research, policy documents and sociological analyses of neoliberalism all contribute to discourses of mathematics and/or education so I have already started to answer these questions during the course of this literature review. When I selected the material to include and explained its relevance to further mathematics I started the process of recontextualisation that takes theoretical knowledge into the empirical classroom context (Lerman 2008). In the data chapters I consider other sources that can help me answer these questions, namely the institutional texts of the FMNetwork and the accounts of students themselves.

The next questions focus on the relationships between these discourses and how they are produced as meaningful by classroom practices and by the subject positions available to students (including discursive representations of ability, ethnicity, class and gender). They examine how power circulates to construct the FMNetwork and its students:

- Q2a What are the power relations in these discourses in the FMNetwork, and the classroom practices that support them?
- Q2b What are the discursive strategies that subjects use, and are used by, to position themselves as able to choose to be a further mathematics student, or not, or as lacking that choice?
- Q2c Which positions are strong, precarious, surprising or untenable?

By answering these questions I aim to find out how knowledge about participating in further mathematics is produced as true, how it positions those who use it, and how it is challenged. They return me to the discursive construction of agency: discourse positions students as active in their own construction, self-knowledge and governance. In this chapter I have reviewed the argument that neoliberal society articulates agency as choice and positions subjects as managing themselves in a moral project of autonomy, belonging and success. My final set of questions examines how subjectivity is inscribed by multiple, competing practices of the self

- Q3a What articulations of subjectivity are drawn on in discourses of choosing and learning further mathematics?
- Q3b What practices of the self are used by individuals to be intelligible in these discursive positions? Can they resist or adjust them?

This focus is necessary in order to examine how characteristics such as gender, class, ethnicity and ability can simultaneously be socially constructed and understood as essentially individual, and it allows me to explore how group patterns of inclusion/exclusion operate at local, individual levels. It also allows me to compare further mathematics students' practices with the practices of the self inscribed in policy discourse, such as rational calculation, entrepreneurism, and self-expression. Where there are new or different possibilities to participate, I consider whether these are enabled by neoliberal discourse or otherwise.

This completes the theoretical framing of my research questions. In the next chapter, I consider the methodological implications of my poststructural approach. My epistemological position emphasises the historicity and the contingency of mine and other peoples' knowledge about mathematics and about participation, and insists on examining the effects of seeking and producing knowledge. I now need to consider what forms of new knowledge and empirical data can be answers to these questions.

Chapter 3 Methodology

In Chapter 1, I described my research aims in pragmatic terms: I wanted to investigate further mathematics participation with an approach that could allow new possibilities for engagement and that recognised choosing mathematics as part of students' wider relationships with schools, society and selfhood. In Chapter 2, I considered how these pragmatic aims relate to knowledge about who can learn mathematics, and developed a theoretical approach that understands discourses as practices of the self. In this chapter I set out the decisions and processes I undertook in collecting and interpreting data. Section 3.1 outlines the implications of adopting a poststructural methodology for operationalising my theoretical framework in the field. Section 3.2 describes how I used purposive case selection (Yin 1994) and a longitudinal dimension to provide discursive data and ensure sufficient diversity to be able to trace discourse in less usual narratives. Finally, section 3.3 considers the challenges of analysing the data in terms of practices of the self.

3.1 What is a poststructuralist methodology?

Poststructuralist criticism "investigates the effects of history and power on what we claim to know and how we organise our discourse practices" (Cherryholmes 1988, p7). It is not a research method as such, but a philosophical commitment that influences the choice of methods. Jankowski and van Selm (2005) suggest that methodological decisions and innovations take place at three levels: the *macro* level concerning epistemological issues, the *mezzo* level concerning research design and strategy (for example, decisions to combine multiple methods, and the length of projects), and the *micro* level of particular techniques of data collection. In these terms, poststructuralism operates at the macro level but addresses the mezzo and micro levels because it insists that local practice matters in constructing truths.

I have already described how poststructuralism challenges foundationalist epistemologies of scientific structuralism, and this means that its methodology is often defined in terms of what it is not: it is *not* positivist and empiricist (Peters and Burbules 2004). This challenge extends to questioning dominant institutions and modes of thought, so poststructuralism can seem to sit hard with education research and policy where currency and impact are often taken as intrinsic goods (Rosenau 1992). Although taking a poststructural approach is unlikely to provide me with simple 'solutions' within existing institutions, it is useful to unpick the rules and structures of what we take for granted (Burman and Parker 1993). Its iconoclastic view alerts us to new constructions that arise from changing or locally specific practices (Wain 1996). This makes it particularly relevant for examining settings that appear to have got 'stuck in their ways' despite attempts at reform, such as participation in mathematics.

Foucault himself is notable for using data from a non-standard range of sources - historical texts, technical documents, descriptions of practice – and bringing them together around unfamiliar objects of scrutiny (bodies, madhouses, confessions) in a way that shows their relevance to current ways of thinking (Marshall 1990). Drawing on this 'genealogical' approach means undertaking "multifaceted interpretations of structure and intent of modern social arrangements" (Roth 1992, p688). The aim is to persuade others that similarities in organization underpin the ways that subjectivities are constructed in specific institutional settings. As a poststructural researcher, there are no set rules for where and how I source my data, but I must argue the case from it. Poststructural arguments involve the recognition of competing stances, a profound vigilance to how language does its work and attention to how the micro-circulation of power positions what is known and those who know (Burman and Parker 1993; Peters and Burbules 2004; Ramazanoglu and Holland 2002):

> Foucauldian researchers scrutinize their data, looking for related assumptions, categories, logics and claims – the constitutive elements of discourses. They also analyse how different (even competing) discourses are present in social settings, how related social settings may involve different discourses, the political positions of setting members within different discourses, and the discursive practices used by setting members to articulate and apply discourses to concrete issues, persons and events. (Miller and Fox 1997, p44)

To show how I have implemented these features of my poststructural approach, I describe what I took as my unit of analysis (Ruane 2005), the aspect of social life about which I select and organise information to make it usable as data. Although this is a methodological term usually considered in empirically-oriented research, I found the analogy helpful in thinking critically about how I collected and made records, how I decided what to see, where I was going to locate significance, and how to present my argument (Mason 2002).

3.1.1 Discourse as unit of analysis

Brown and Dowling (1998) insist that a research project must articulate the "concept-indicator" links between its theoretical framework and its empirical component. The idea is to reduce the 'discursive gap' - to develop the theory so as to describe the data adequately, to organise and categorise empirical information to respond to the problem pertinently - so that the researcher and readers can recognise how answers are reached from the data presented. As we have seen above, my poststructural approach means that these knowledge-practice links will be multiple, complex and perhaps unexpected. Nevertheless, one way to articulate them is to consider the unit of analysis (Lerman 2001; Ruane 2005). This is the aspect of the social world that will be interpreted and used in theoretical arguments, but which can also be explicated in terms of empirical observation. Deciding on the unit of analysis should clarify what data is required and the logic of the research design.

Poststructural studies do vary in their units of analysis. For example, discourse analysts may work with individual statements, categorising and grouping them thematically (Watkins et al. 2007). Others treat empirical data as text, and analyse it for discursive structures and the exchange of meanings (Edley 2001; Luke 1995b). Because of my focus on discursive practices of the self, I take my units of analysis to be the discourses available to FMNetwork students.

Working with discourse means that I do not make a qualitative distinction between what is data and what is context or background information (Taylor 2001b). This aligns my work with ethnographic enquiry in that everything that I observed can be data. (I certainly had to make pragmatic decisions about what was most useful to attend to, and I describe these below, but nothing empirical was *a priori* irrelevant.) Ethnographic enquiry treats experience and identity as practices embedded in their local contexts, culturally and historically mediated (Holland et al. 1993; Miller and Fox 1997). Poststructural ethnography offers educational research this "more complicated version of how life is lived" (Britzman 2000, p30) while acknowledging that the version of 'truth' thus constructed is not a gathering of reality but an effect of discourse. What poststructuralism adds to ethnography is seeing that individual agency is also contingent and structural (Cotton and Hardy 2004). Ethnographic research identifies the "vast inventory of possibilities or potentialities regarding situated action [in which] individuals have to deal with situational constraints; but they always have the possibilities of dealing with them by redefining the situation" (Baszanger and Dodier 1997, p25). Poststructuralism examines not only this inventory, but also how/why some discursive subject positions are produced with a power of redefining possibilities, and not others. This enlarges the notion of students' context beyond the classroom and the mathematics community of practice to their socio-political contexts (Valero 2004).

This is not the same as making individual students my unit of analysis. I see that as theoretically inconsistent because an individual may draw on several subject positions at different times, or in different contexts, and as a function of how they are positioned in overlapping discourses. Poststructural analysis moves away from studying people/things to the systems of ideas that individuals see, feel and act on. So for example Lesko describes her poststructural analysis of adolescence as focusing on 'childhood' and 'adolescence', not 'children' (Lesko 2001). Lerman argues that "people become part of practices as practices become part of them" (2001, p88) and so recommends a unit of analysis for discursive psychology as 'person-in–practice-in person'. I want to borrow his phrase but turn it inside-out, and consider discourses as 'practice–in-person-in-practice'. This reminds me that discourses and people are mutually constitutive

I should also explain why I have not opted for more easily delineated empirical units such as statements or interactive episodes. I do this because individual statements are connected in discourse. Considering statements as units neglects this important intertextuality. Discourses are recognised through how statements are used, how they relate to forms of practice, and how they "connect with each other and refer to each other, sometimes systematically and sometimes unsystematically, sometimes through authorial choice and deliberation and sometimes through coincidence" (Luke 1995b, p15). I would add to this description of intertextuality that acts of "authorial choice and deliberation" are themselves discursive constructions presenting students as agentic, able to vary their positions in some ways but not others, and so they are part of the data.

Another way of looking at this decision is to note that prior research has already traced how familiar classroom mathematics statements construct mathematics discourses. This approach has been helpful in characterising the distinctiveness of mathematical talk (Gerofsky 1997; Morgan 1988; Walkerdine 1988), and I use these findings for further mathematics. It has been less helpful when aiming to investigate how students experience mathematics or where mathematics relates to other discourses such as gender or enjoyment. In these cases authors have recommended a broader research focus on discursive identity and relationships (Bibby 2009; Mendick 2006; Solomon 2009b; Walkerdine 2007).

This choice of discourse as unit of analysis has implications for the form of my textual data, and I have pre-figured this by referring to students' 'accounts'. "To *account-for* something is to offer interpretations, explanation, value-judgement, justification, or criticism" (Mason 2002, p41). In the previous chapter I described how neoliberal discourses associate choice with responsibility and self-expression. Giving an account of one's choices is a practice of the self current in educational institutions, acting like Foucault's confessional to position and govern the self (Butler, 1990). I read the textual information I collect as accounts, that is as attempts to communicate the claims, assumptions, categories and rules that individuals make use of when choosing further mathematics. They are not just narratives, or stories, but ones with a purpose of explaining or evaluating one's actions and experiences to a researcher (Cameron 2001). This matches how I characterised practices of the self in Chapter 2 as communicating moral codes, judging behaviour, and positioning oneself in relation to those codes. I will go on to discuss how I have collected these accounts, but to do so I need to introduce another methodological consideration: diversity.

3.1.2 Selecting data for diversity and complexity

Heterogeneity, multiplicity and difference are central values in poststructuralism (Ramazanoglu and Holland 2002). I have already discussed two important reasons for this. Firstly discourses are constructed 'bottom-up' in local practices, so that contexts matter in establishing 'truths'. I want to stay with the complexity of multiple, contingent knowledges rather than pursuing a modernist goal of synthesis and unity. Of course, any finite commentary on discourse has to be selective: "we really have no option but to transgress by the very act of inquiry" (Rosenau 1992, p19). Still, in making a selection of what to collect, analyse and report I aim to keep centre-stage the local links between discourse and context rather than downplay differences.

Secondly, discourses are always contested and constitute an unstable reality, so that investigating differences and oppositions is an integral part of understanding them. I want to trace the contested frames of reference to persuade us of the patterns in this diversity (Roth 1992). We can see this in *Discipline and Punish* where Foucault investigates multiple facets of madness, which then allows him to comment on how it constructs normality as its 'other'. Even dominant productions such as binary gender and natural ability are continually contested by other ways of knowing. Currie, Kelly, and Pomerantz, in their research on girls' school identities explain the implications this has for analysing empirical data:

> Rather than smooth-over inconsistencies, contradictions or gaps in girls' stories in order to tell a coherent story, moments of rupture are read as symptoms of hidden process. In this paper they are read as symptoms of unspoken but ever present meanings of girlhood. We thus read moments of instability and disjuncture as signalling the contradictory nature of discourses addressing girls. (2007, p27)

The case for "unspoken but ever present" discourses has to be argued in context rather than taken as general. Some identity discourses are personally important but not freely talked about publicly (Clegg 2008). Others may be talked about freely by participants but not traditionally be deemed relevant to the issue under investigation, such as the role of 'hedonistic youthfulness' in the career-choices of young people (Ball, Maguire and Macrae 2000). This means that my poststructuralist approach needs not only to accept the possibility of rarely-articulated knowledges with nevertheless traceable effects on what is said or done, but should seek them out. This is an important criterion in the practical selection of what accounts to collect and what to observe.

Herbert (1989) argues that the best way to seek out this diversity while keeping the richness of ethnographic study in a small number of sites is to have multiple forms of data collection. Planning varied interactions with participants increases the possibilities for saying things that are not usually said. This is different from a methodological concern with 'triangulation', whose metaphor suggests that a closer approximation to 'truth' is possible through the intersection of different sources of data. Rather, it expects that many truths will result from different collection modes (Jankowski and van Selm 2005). Clearly such accounts cannot be considered as typical or representative data but – despite their specificity – they may indicate how discourses work together and have effects. It is the job of the poststructural researcher to argue their significance in context. As Ball et al. (2000, p19) say about having to order and juxtapose accounts of young peoples' lives: "there is no obviousness".

This finishes my elaboration of poststructural methodological principles, which I have done through discussing my unit of analysis and my reasons for seeking diversity in data. Now I explain how I put those principles into practice in choosing what to collect and record.

3.2 Collecting data on choosing further mathematics

A researcher can manipulate two main areas in deciding how to collect information: the context in which it is collected, and the stage at which structure is imposed (Brown and Dowling 1998). Of course these two considerations affect each other, with some contexts allowing structure to be imposed earlier or later in the research process. Following my arguments above, the guiding principle of my empirical design at the strategic *mezzo* level was to collect accounts of choosing further mathematics from a diverse range of socioeconomic, institutional and interactional contexts, and honouring their specificity. I pre-structured some of this diversity in choosing the sites and occasions in which I collected data; but I also incorporated instruments (such as email questionnaires) that allowed me to defer when I imposed structure. By doing so I aimed to keep open other possible interpretations of the data so that multiple connections can be made and 'truths' examined (Burman and Parker 1993). Overall I used a longitudinal research design that took place over a two year period and my data consisted of:

- document analysis of 14 selected texts
- 31 audiotaped and transcribed interviews with 24 students
- 18 email questionnaires/conversations
- field notes from 43 hours of classroom observation

I describe my choice of sites, students and timings first (§ 3.2.1), and then return to the data collection methods (§ 3.2.2).

3.2.1 Choosing sites, students and times

When it came to implementing this design, my case selection was purposive (Yin 1994), both in choosing the schools in which to collect data and choosing students in school. Although I focussed on the FMNetwork, this was not a single site and did not have one standard way of relating to schools. The regional FMCentres were self-funding administrative units, based in schools, universities or local education authorities, and liaising with local schools to recruit and teach further mathematics. Schools became involved in two main ways. If they could recruit sufficient students but lacked teaching expertise, the FMNetwork supplied a visiting further mathematics tutor. In this case schools negotiated with the centre on details such as the tutor's timetable (usually once a week after school), duties (e.g. report writing), and access to resources. The financial relationship was standard: schools paid FMCentres the per-capita subject funding they received from government. If instead a school had only a few interested students, the FMNetwork liaised with other schools to create a sizeable group taught at a central location. Schools would then negotiate with parents and the FMCentre about timings, transport and off-site responsibilities. The FMNetwork also taught a few individual students by distance learning but I did not include any in my sample.

There were thus different practices operating within the FMNetwork. On top of that was the variation expected in any education project: the differences in schools' geographical settings, socioeconomic contexts, their mode of governance, and in the communities they serve. Mathematics departments also have different histories in relation to further mathematics teaching. I needed multisite data collection to follow "the threads of a project of social ordering across the linked contexts that are implicated in it" (Hamilton 2009, p223). Taking a pragmatic approach, I identified three sites that between them exemplified the main ways in which schools used the FMNetwork and provided diversity in their settings. All three sites were in south-east England, for ease of access. Two sites, Moorden and Grants[6], belonged to the same FMCentre, allowing me to hear different perspectives on shared events such as revision days. They were two of its three teaching groups with eight or more further mathematics students. This restriction on numbers ensured a reasonable number of participants for a voluntary longitudinal study. In planning for data collection I considered my responsibility to active and passive participants, and followed the FMCentre's advice not to involve the third group in which several newly-arrived international students spoke limited English. Throughout the study I was guided by the British Educational Research Association's ethical guidelines (Gardner, Lewis and Pring 2004) and the responsibility to ensure that my research had a purpose worth the efforts of all concerned (Adler and Lerman 2003). Here we felt that the outcomes of the research, and the possible benefits for some students from participating in reflective interviews/emails, did not outweigh the disadvantages of losing time or making selections within the group. In all sites I sought consent from the FMCentre, schools and students (aged 17-18 years), with specific consent for email contact (not always given), and provided information for parents. All students in a group were invited to participate.

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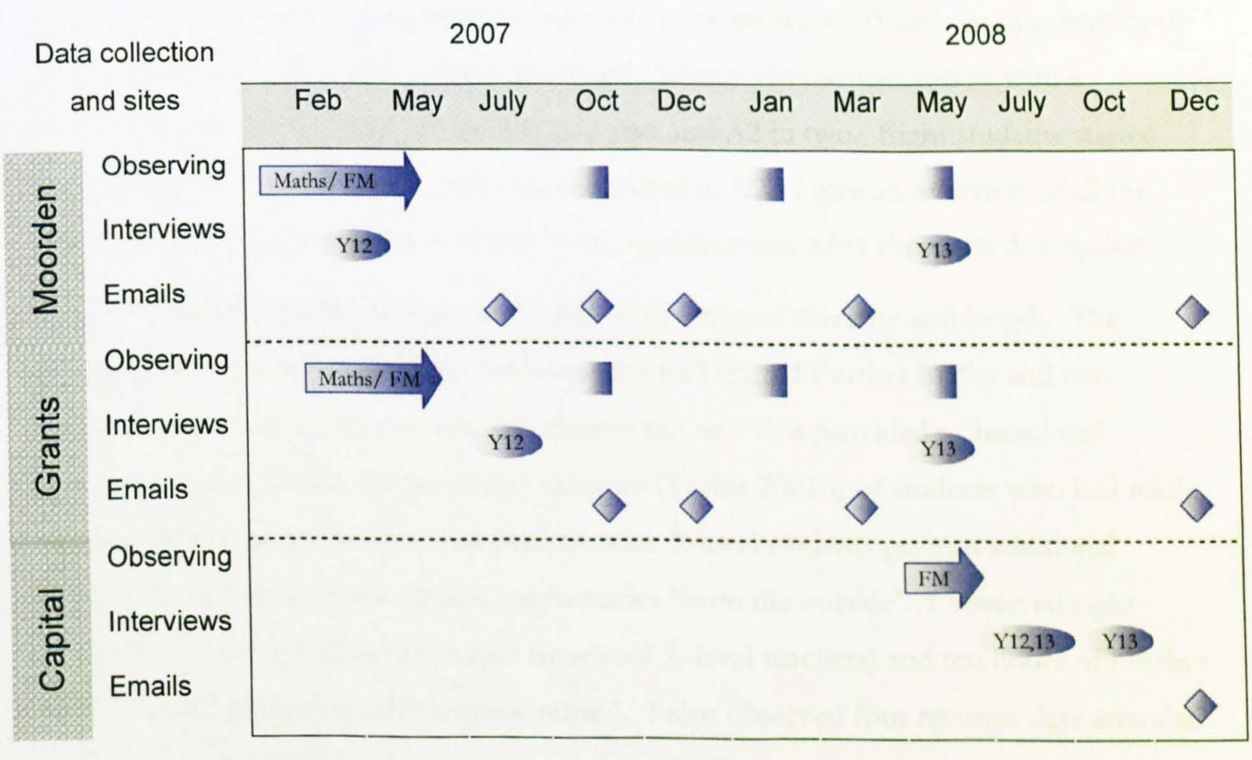
[6] Pseudonyms are used for schools, FMCentres, teachers and students throughout.

The Moorden and Grants groups were taught on their own school premises, with the main liaison happening through the mathematics departments. I then chose the third site, Capital, to include some of the other features seen in the wider FMNetwork. It was situated in London, with tuition at a central location bringing students from several schools together, and had more involvement from the local authority. It also differed in how further mathematics fitted into the historical relationship between schools and communities. Moorden and Grants started as comprehensive schools in established, socially-mixed communities, looking to reintroduce or strengthen a traditional subject. Their mathematics teachers spoke as if there was a parallel between renewing further mathematics and updating the 1970s-built school. The Capital site served an area of predominantly working-class and minority-ethnic communities and it engaged more with individual students than departmental plans.

Figure 3-1 Schedule of data collection



Each of the sites was different in its particular circumstances and this led to my taking different decisions about the scope of data collection. Figure 3.1 gives an overview over the two year data collection period, and then I describe each of the three sites below. I should note that these site descriptions are themselves discursive constructions assembled to present the rationale of their inclusion, and to orient readers to the student accounts that follow. To make them I drew on observations, documents, discussions with teachers and students, and my research notes from the time, but I omit for now any dissenting voices or alternative interpretations that arose in students' accounts. Nor does my research remit extend to critiquing the effectiveness or intent of the institutions themselves.

Moorden school

Moorden is a large 11 -18 school serving a market town and surrounding villages. Ofsted and local authority reports describe it as a predominantly White school with below the average number of pupils on free school meals. At the time it was seen as the 'better' of the town's two schools, although each year several Year 11 pupils left to do A-levels elsewhere. This meant that developing the sixth form curriculum was a school target. The mathematics department at Moorden had not taught Further Maths A-level for some years and was keen to build up student demand and teacher expertise. The school had two Mathematics A-level teaching groups per year, both studying the same modules in core mathematics, mechanics and statistics. All these students were offered the opportunity to take Further Maths as a fifth subject in a weekly 2-hour after-school lesson with a FMNetwork tutor, finishing AS-level in one year and A2 in two. Eight students started Further Maths in the first year, and four continued to A2. I give an overview of all the participants and their different Further Maths qualifications after these site descriptions.

The data collection at Moorden was the fullest in terms of diversity and length. The participants consisted of the eight students who had started Further Maths and two Mathematics A-level students who had chosen not to. This provided a "broad and inclusive" sample within the particular category (Taylor 2001b) of students who had made choices about Further Maths. The Mathematics A-level students gave an additional perspective in talking about further mathematics 'from the outside'. I observed eight hours of Mathematics lessons (taught by school A-level teachers) and ten hours of Further Maths lessons (taught by FMNetwork tutors). I also observed four revision days attended by Moorden and Grants students at the regional FMCentre, and had informal discussions with teachers that provided contextual information about students and courses. I interviewed Moorden students once in Year 12 and again in Year 13. Between and after the interviews I used five email questionnaires to pick up on themes at key periods. I identified these themes as:

- reflecting on choices (after the exams in Y12 and near the end of Y13)

- choosing subjects for A2 or university (beginning and end of first term in Y13)
- comparing school and university learning (term after leaving school)

Clearly participation in my eighteen-month study had to be voluntary and I not only solicited the students' informed consent but agreed to avoid examination times and to provide opportunities for non-responses and leaving the study. Fortunately all eight further mathematics students did participate, as well as two volunteers from a Mathematics A-level class. Nine of these initial ten agreed to a second interview and I received thirty responses to forty-eight email questionnaires. One of the purposes of using mixed online–offline methods was to provide interesting and convenient ways of engaging for the participants (Orgad 2005). This design appeared to have been relatively successful in retaining participants, and I discuss this more fully below. Although they complicate this description, I mention the non-responses and variations in procedure because I want to include the contingencies and limitations in this process of creating research knowledge. This acknowledges my own active participation as the researcher, trying to create a fruitful path by combining the ideal map of my research design and the individual journeys of the participating students and schools. It also allows others to evaluate the process by which I construct my argument from the empirical field (Taylor 2001b).

Grants school

Grants is one of many schools in a large industrial city and is considered socially and ethnically diverse in the eastern region. Although most people in the catchment have a White ethnic background, around a tenth have Pakistani or Indian ethnic backgrounds. There are also many families of east-European workers. The proportion of students eligible for free school meals is above average. When I started my study, Grants had two sizeable teaching groups for Mathematics A-level: students who also studied Physics took mechanics modules, and a second group took statistics. On top of this, Grants had planned to reintroduce Further Maths A-level teaching as a timetabled subject and had recruited a small cohort of prospective students. Sudden teacher illness early in year 12 led them to fall back on FMNetwork tuition. Students who had expected timetabled lessons for their fourth AS-level moved instead to a weekly 2-hour after-school session with a visiting FMNetwork tutor. Such details show again the contingencies of schools' planning and FMNetwork involvement; no site feels 'typical'.

Eight students started Further Maths AS-level (only one taking statistics), of whom four continued to A2, and one left the school. All seven remaining students agreed to take part.

In the middle of the data collection period Grants merged with nearby secondary schools to form a very large academy with a distinctive building, timetable, leadership and administrative structure. The Mathematics A-level groups were rearranged and a new teacher employed to teach Further Maths A-level. From Year 13 onwards, the students used the FMNetwork only for online resources and revision days. No students from other schools joined the seven cohort students, and they were put into one teaching group and given 90 minutes extra teaching time weekly to be used flexibly for Further Maths at the teacher's discretion. The four A2 Further Maths students in this group attended this extra time throughout, and two students opted in just for an extra mechanics module that boosted their Mathematics grades. This schedule meant that further mathematics had an unusually high profile in the whole group's mathematics experience compared to the other two sites. It has been suggested that students benefit across both subjects when schools teach Mathematics and Further Maths as an integrated course (Hoyles, Newman and Noss 2001). My longitudinal design meant that I could use email and Y13 interviews to ask the Grants students who had given up Further Maths but who remained in a further mathematics dominated class about the effects of the arrangement.

Data collection at Grants was similar to Moorden but on a more concentrated scale. I observed eleven hours of Mathematics and Further Maths lessons, carried out two sets of interviews, and attended a number of other mathematics lessons, events and revision days. When I interviewed the seven students at the end of Year 12 (during an unexpected off-timetable week) I had to group them in threes and a one. In Year 13 interviews, two pairs asked to be interviewed jointly again. I sent the first email questionnaires at the beginning of Year 13, and the last in the term after leaving school, receiving 17 out of 28 responses. I used the same themes as for Moorden, adapting the questions to the local setting. One student attended both interviews but responded to emails only after leaving school; another did not attend a second interview.

Capital Further Maths Centre

The Capital site is a FMCentre in a socioeconomically disadvantaged London borough. Most students in this area are from non-White ethnic backgrounds. There is a large established Bangladeshi community, a relatively high proportion of Chinese students, and students come from a wide variety of other ethnic groups including Irish and non-British

White. The borough has been involved in a series of initiatives to promote mathematics, and it recruited actively for the FMCentre in nearby schools. Students met for a weekly twilight session taught by a FMNetwork tutor. This was usually based in a school, although it moved once during building work, and again at the end of the first year. An important difference in the Capital students' learning is that they worked towards AS-level over two years, sitting just one module at the end of the first year (Further Pure 1). This schedule was a planned consequence of Capital's broad recruitment policy, the subsequent delayed start, and the expected disruptions caused by student absences for school priorities such as parents' evenings and trips.

I collected data at Capital in order to include accounts from this teaching structure and from these students who would not otherwise have had access to further mathematics. This widened the opportunities for tracing connections between less-dominant discourses of further mathematics and of being a choosing individual. When I made contact, Capital had four Year 13 students completing AS-level, and seven Year 12s half-way through, and I observed 2 hours in each class. These students came from five different schools, making it impractical to observe lessons in school. Seven students agreed to be interviewed: two from the older cohort just as they completed AS-level in year 13, and five from the younger cohort as they started year 13 (two of these had stopped Further Maths). Only one of the Capital schools allowed me to ask students to participate by email, and these two students responded after their final exams.

The twenty-four students participated in Mathematics and Further Maths to different levels, depending on individual choices and what the institution offered. The variations are subtle so I list them below, and then summarise in Figure 3.2. I asked the students to provide their own pseudonyms, and these give a good indication of gender[7].

- 2 students studied Mathematics for two years up to A-level and chose not to study Further Maths at all.
- 2 students started Mathematics and Further Maths but did not continue either in year 13. Both completed Mathematics AS-level, Steve completed Further Maths AS-level while Esther stopped after one term.

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[7] I was intrigued that students chose pseudonyms to match their gender but not necessarily their ethnicity or class. Students often signalled some humour as they chose old-fashioned, 'posh' or boring names, characters from films and computer games, and names they had always liked, but I was not always let in on the joke.

- 9 students completed Mathematics A-level and Further Maths AS-level. For five Capital students this meant continuing Further Maths over two years, four others stopped after year 12.

- 2 (Capital) students completed A-level Mathematics but stopped Further Maths after year 12 part-way through AS-level.

- 1 student completed Mathematics A-level and Further Maths AS, continued with both in year 13 but left Further Maths early with one more module.

- 8 students completed A-level Mathematics and Further Maths over two years.

There is a full list of participants, sites and subjects in Appendix 1.

Figure 3-2 Participants by pseudonym and their qualifications in Mathematics and Further Maths A-level

Subjects taken	**No Further Maths**	**AS Further Maths**	**A2 Further Maths**	**Total**
MATHS AS	-	Steve ←Esther	-	2
MATHS A2	Ellie Hayley	Bob Sukina 007 ←Joe John Li Mai ←Michael Clive AgentX Ricky Tom	Charlotte Charly Jodie ←Steffi Paul Randall Mario Helen Simon	22
TOTAL	2 (2 female)	13 (3 female, 10 male)	9 (5 female, 4 male)	24

Key: ← left the course after one module Moorden Grants Capital

This completes my account of the ways in which I selected sites and participants. I had imposed a structure that ensured diversity along four dimensions: socio-environmental setting; time; teaching context in Mathematics/Further Maths; and student level of participation. These dimensions were not analytic categories intended to pre-determine ways of grouping accounts to which one could associate further differences. Instead I intended them to create spaces in which the different discourses could interact.

After the site-selection, volunteering and consent process I checked that there was diversity in the gender, ethnicity and class of the individual participants. I collected this information in a variety of ways: lesson observations and discussion with teachers; asking biographical questions in interviews; and asking direct questions in email questionnaires. It was relatively straight-forward to adopt students' own descriptions of their gender and ethnicity after interviews, but I found that students did not talk about themselves in terms of class (Savage, Bagnall and Longhurst 2001). I therefore made a multi-faceted judgement for each student, drawing on the information they gave about parents' occupations, family levels of education, aspirations and knowledge of careers, receipt of government educational allowance. I also looked for similarities between individual students' discourses in further mathematics and how class has been articulated in discourses of higher education and employment (Archer, Hollingworth and Mendick 2010; Ball 2010; Reay, David and Ball 2005; Walkerdine 2003, developed in Chapters 7 and 8).

I now move on to the *micro* level of design and discuss the particular techniques of data collection that I used to identify discourses of further mathematics.

3.2.2 Implementing the empirical design

Document analysis

This part of my research focused on a selection of public texts that promoted, organised or evaluated the FMNetwork. Organisational documents produce the work and function of an institution by recording a collective memory of its practices. Together with promotional and evaluative documents, they are "employed to create versions of reality and self presentation" (Atkinson and Coffey 1997, p57). Thus I see them as accounts that produce the public discourses around social 'problems'. These accounts use institutional technologies (such as forms, checklists and personalisation) to translate the experience of individuals into administrable categories (Hamilton 2009). Therefore such documents are significant in producing knowledge about further mathematics for schools and individuals, and they have a role in legitimating certain discourses of mathematics. When they refer to education policy, they set out key narratives relating the goals of further mathematics education to the wider practices of schools (Robson and Bailey 2009).

The purpose of this analysis was to examine discourses apparent in some 'official' accounts of further mathematics, both for their own coherence and to trace similarities and effects in the practices of selfhood described in students' accounts of choosing. I selected fourteen documents (listed in Appendix 2) published near the time of the FMNetwork's inception (2004-7). These fell into four groups. First were three FMNetwork-authored leaflets/media-releases explaining why students should study further mathematics and publicizing the FMNetwork as a new solution to a 'mathematics problem'. Second, there were articles written for undergraduate STEM educators by FMNetwork staff, analysing the 'problem' and informing them of the initiative and implications for universities. Third are documents from the FMNetwork's independent evaluators that set out criteria for judging its success and position it against 'other' ways of defining itself and the mathematics problem. Fourth are key policy reports/leaflets that address concerns with mathematics participation but with a wider remit than the FMNetwork. Together these documents gave a sample that illustrated how the FMNetwork accounted for its own existence, and how these accounts fitted into contemporaneous policy discussion.

The bulk of this documentary analysis was completed while collecting student data. In this way I could use its findings about available knowledge structures and power relations in refining email questionnaires and in interpreting accounts.

Observations

I carried out observations of mathematics and further mathematics lessons in all three sites. The purpose of these was to provide contextual information about teaching and learning experiences and to enable some shared experiences as a basis for interview questions and interpretation of email responses. In doing so I was attempting to keep a sense of discourses as material practices and not solely as linguistic ones (Jivaji 2011). My role in the classroom was that of a semi-participant observer, positioned as able to ask and answer questions about progress and mathematics (Cohen et al, 2000). I used field notes (see Appendix 3) to make a brief narrative of the structure of the lessons, pupils' actions and groups. I also recorded data in two specific areas: teachers' or students' classroom comments that concerned actual or desirable identities in mathematics classrooms, and use of oppositions or metaphors that compared mathematics to other practices. I later used these notes and my reflections on them to suggest further questions (or phrasing of questions) in the interviews and emails. For example, observing two teachers in the same school, one using metaphors of 'saying' and the other of 'doing', inspired me to offer 'talkative' as a possible description of mathematics. I also cross-checked them against students' descriptions of classroom practice and asked more when there were differences and repetitions.

Interviews

The substantial part of my data comes from interviews with the 24 students concerning their experiences of choosing and learning mathematics at school and with the FMNetwork, and their expectations of continuing in mathematics. This setting fitted my styling of the data as accounts of choices and experience, articulating institutional practices in personal trajectories. Blenkinsop et al. (2006) have reported variability in 14- and 16-year-olds' accounts of educational decision-making collected over even a short time. Because I am analysing discourses and not individual students, this is not theoretically problematic for me. I would expect discourses to be used differently as students took part in different conversations and as they changed their engagement with further mathematics. Therefore I interviewed Moorden and Grants students once in year 12 and again in 13, aiming to encounter a diversity of relationships with further mathematics (such as continuing, enjoying, succeeding or not) and with choice (such as looking forward or back).

All the interviews took place on school premises during students' free lessons, lasting from 40-80 minutes. Where possible I interviewed students individually, but their preferences and timings sometimes prevented this. The data consists of 31 audiotaped interviews: 7 with individual Capital students, 11 with the seventeen Moorden and Grants students during year 12 (two 3s, two pairs and seven individuals), and 13 with the fifteen students still participating during year 13 (two pairs, eleven individuals).

This choice of how to be interviewed was an area in which I had agreed to respect students' preferences for ethical reasons. In individual interviews I found that I had more time to discuss students' views, and more freedom to follow up interesting responses without having to be aware of the group dynamic. In pair/group interviews, students were clearly conscious of others' right to speak and hear. They talked among themselves as well as directly to me, and there were some disagreements and negotiation of responses. My impression was that individual interviews were useful for seeing how a student wove different discourse together, and that group interviews showed up the power relations between discourses.

In the interviews and observations I aimed to position myself as I was introduced by teachers: a visitor whose credentials and relevant knowledge were warranted through professional links with the school teachers, the Further Mathematics Centre and its host university. Researchers are positioned by discourses just as participants are (Hardy 2004). I decided to accept and reflect on the defining effects of that initial position, but also consider that my positionings would be multiple and mutually constituted by the practices and participants in the research and the FMNetwork (Valero 2004). The space of each interview has determining effects: a story is "told within the space that both of us share in interview, and hence cannot escape the effects of the participant's own desire to relate a coherent and compelling account that allows me, the listener, to attempt to understand" (Walshaw 2010, np). I was aware of some repositioning at Grants and Moorden, where my observations in Mathematics and Further Maths lessons had an unforeseen effect. During the early interviews, the students and I became aware that I was the only person other than themselves to have attended both their school and FMNetwork lessons. This highlighted the novelty of their learning experience, and the value of 'capturing' it. By the later interviews I felt that students intended me to feed back comments to their schools and the FMCentre: they were the experts moving on, and I was staying behind with the further mathematics practices. This was different at Capital where I visited schools only for the interview, and students represented their school experience to me as an outsider with no relationship to the schools.

The interviews were semi-structured, with a schedule outlining the core questions/tasks and optional extensions, allowing flexible "topic steering" (Flick 1998, p106). In the Year 12 interviews I asked students: how and why they chose A-level subjects; to describe their experiences of learning mathematics and further mathematics; to comment on themselves as mathematicians and what is good practice in learning mathematics. In Year 13 interviews I asked about their decisions to drop subjects, their future plans and how these related to their school experiences; to reflect on themselves as learners; and how further mathematics had contributed to their education. I give four interview schedules in full in appendices 4.1-4.4 (for year 12s, year 13s who dropped/continued A2 Further Maths, and AS-only students).

I was mindful that this kind of interaction privileges a form of identity construction that resolves multiple, historical and momentary selves into one "rich, differentiated story of self" (Warin and Muldoon 2009, p293). Moreover, the practices of 'telling' such an identity are associated with middle-class cultural capital (Reay 2004; Skeggs 2004) and its discourses of self-awareness. I therefore designed two Year 12 interview tasks, 'Adjectives' and 'Photographs', that relied less on coherent narratives, aiming for variety in how students could describe themselves and mathematics.

In the 'Adjectives' task I provided twelve adjectives written on cards and asked students to choose three words that they thought applied to mathematics and three that did not, and to talk through their choices. They then repeated the choices for further mathematics and/or a favourite A-level subject. As the task was designed to provoke discussion, I chose adjectives to offer ambiguous and surprising ways to describe mathematics, while avoiding obvious binaries and content-based vocabulary. They were:

warm	*green*	*repelling*	*painful*	*new*	*fluid*
straight	*talkative*	*safe*	*stale*	*cloudy*	*hopeful*

I aimed to reference several themes through my choice of words. (See Appendix 4.5 for a detailed rationale). I picked up on metaphors that position mathematics as being directed, cold, or cloudy (Early 1992; Gerofsky 1997; Solomon 2005), learning as a journey or insight (Cameron 2003), and choosing as finding direction and comfort (Blenkinsop et al. 2006; QCA 2007; SHM 2006). I drew on observations and research in participation in mathematics to suggest words (*stale, painful, repelling, warm, hopeful, talkative*) that described emotions associated with studying mathematics and belonging to a community (Daskalogianni and Simpson 2002; Nardi and Steward 2003; Rodd 2002; Solomon 2007b). The interweaving of all these themes was intended to stimulate a discussion that could both develop and question what was offered in the classroom, using the unfamiliarity of the words to allow adjustment or resistance to dominant discourses (Skeggs 1997).

The 'Photographs' task was designed as a replacement to the direct question, "What do you see yourself doing in five years time". I had included this in informal piloted interviews with 17-year olds but those participants appeared uncomfortable or did not offer either fantasies or any of the expected rehearsed responses. Instead, I assembled a set of images that represented employment, working, or studying situations and asked if any of the images appealed in terms of their future in 3-5 years' time.

I was inspired to take this pictorial approach partly to provide entertaining, rich methods of data collection and partly as a result of the early analysis of FMNetwork documents. Eye-catching images featured prominently in the FMNetwork and More Maths Grads promotional texts. So the design element of this task was to introduce some of these visual discursive practices of further mathematics into conversations where students described their own choice-making. I have provided the full set of images in Appendix 4.6. Johnson and Weller describe both visual stimulation (as in my photographs task) and taxonomic pile-sorting (as in the adjectives task) as methods to elicit "tacit subjective understandings in some cultural domain" (2002, p492).

For the Year 13 interviews I used the 'twelve adjectives' template again and provided students with a bank of words to describe themselves as learners. This had the same rationale for opening up ways of talking about oneself but I selected adjectives to support or challenge discourses of educational identity heard in schools (see Appendix 4.2). I also asked students to talk through part of a mathematics A-level question concerning graphs, differentiation and integration, a topic with connections to both mathematics and further mathematics. This task was used as a stimulus for talking about differences and similarities between the two subjects and the expectations of different teachers.

Email questionnaires

This method complemented interviews in two key ways. First, since choosing is a practice that positions people as agentic users of discourses of autonomy and self-expression, then students will give different accounts of themselves in further mathematics before and after making choices. Thus being able to compare data collected over time was important for investigating these diverse relationships between choosing, mathematics and practices of the self. Second, by collecting accounts soon after specific practices such as examinations or UCAS entries, I could examine the roles of specific school technologies or discourses such as parents' evenings or examinations.

Email correspondence gave me greater control of timing and access to participants than face-to-face interviews (Mann and Stewart 2000). This raises a question of how email data is compatible with interview data: is email an "impoverished medium", or a "potent but troubling" (Hine 2005, p6) cultural artefact that offers new possibilities for meaning-making in social practice and in research? Discussions of computer-mediated methods tend to balance advantages with disadvantages. Email efficiently provides data in written form, yet/and its lack of visual clues and feedback can inhibit interpretations for researcher and participants (Kivits 2005). Email's asynchronicity and diffuseness allows participants time to reflect and refine their responses (James 2007), but/and participants have freedom to decide whether, and when to engage, and for how long (Joinson 2005; Mann and Stewart 2000). This distance from the researcher also offers advantages of seeming privacy, raising issues of ethics and validity in generalising from online to offline selves (Orgad 2005).

Drawing on these discussions, I planned a series of email questionnaires to complement the Grants and Moorden interviews. I sent these as word documents combining short, factual questions concerning recent decisions with open questions asking students to explain reasons, feelings or thoughts about their mathematics experiences (see Appendix 5 for an example). Structurally, email's interactivity let me refine my questioning in response to my growing knowledge of the school context, the preferred communication styles of individual participants, and my ongoing analyses. I sent questions that were increasingly differentiated by site and level of participation. Moreover, I followed up interesting or unclear responses, and tried out some initial conjectures through later questions. So although I have called them 'questionnaires', the regular interactions over time created an instrument that combined aspects of diary-keeping and interviewing (Mann and Stewart 2000). Sixteen students agreed to receive occasional email questionnaires (over four or five terms) and they answered an average of three each.

James (2007) considers that ongoing social interactions are significant aspects of email interviews because the iterative personalization and refinement of questions and answers become confessional practices of self. The knowing subjects of emails are constructed as 'telling' their authentic identity stories by seeking to express ideals and values, and explain their growth and change. This is particularly relevant for educational contexts which provide diverse technologies for participants "to question and construct their identities, and consider how these constructions changed over time as they engaged socially in their world" (2007, p966). My intention therefore was to use email to gather rich accounts of the self.

I also considered the power relations implicit in using email, and how email and interview data relate. These are linked because they concern the relationships between 'online' and 'offline' identities in relation to responsibility to participants and research integrity. Ess (2002) considers email to be the internet research method most similar to traditional social research interactions and their ethical concerns. The Association of Internet Researchers

(Bruckman 2002) goes further, arguing that any online research has an offline context and so must address traditional disciplinary codes. I had already considered this in designing my research in schools according to BERA's ethical guidance (Gardner, Lewis and Pring 2004). Mann and Stewart (2000) explore specific issues of identifiability, confidentiality, privacy and vulnerability in online settings, and I followed their recommendations, guided also by Heath et al.'s (2007) analysis of the power relations in negotiating consent in youth-oriented settings. To give some key examples: I sought gatekeeper and participant consent specifically for emails, used an academic address and sent no bulk emails; I stored my electronic data separately from how I collected it, and agreed with students and schools to send at most one reminder and one follow-up email per questionnaire.

I struggled continually with the level of formality and tone of emails. Some researchers suggest that the intrusiveness of email inevitably breaks its initial formal, protective barriers. Its social conventions require personal disclosure from both parties to establish the necessary relations of trust for continuing in a disembodied textual setting (Joinson 2005; Kivits 2005). Others argue that extended interactions over time can foster this mutual trust without intimacy (Mann and Stewart 2000), although this may rely on participants having a personal investment in the field (Kivits 2005). Getting this right was important as email participants have a relatively high degree of control over whether and how they reply. I phrased questions formally, disclosing some of my research progress, and using my knowledge of the school and of participants. I focused on students' personal experience more than institutional evaluation but, as with interviews, the richer, later email responses featured students taking a role as expert commentators.

By starting and ending with interviews I avoided the most extreme issues of establishing a virtual researcher identity. I monitored online interactions so that they felt compatible with my offline role as a school visitor. Similarly, students had online/offline identities. Although it is clear that the medium matters, there is no simple characterisation of how participants use discourses differently in email and face-to-face accounts of the self, not least because computer use has changed so rapidly[8]. Following Orgad (2005), although computer-mediated methods do produce different forms of articulacy and power relations, the resulting discourses are close enough for researching an offline context. Moreover,

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[8] When I collected the data, most participants used email regularly, some rarely. Social networks were still confined to instant messaging or posting public statuses, not daily asynchronous interaction.

participants manage their authenticity across different media just as they do within observations and interviews. I saw authenticity across media not as a problem of validity, but as another practice of the self that would interact with accounts of choice.

3.3 Analysing data and writing this thesis

Earlier, I described the choice of discourse as unit of analysis, and this underpins my analysis of the separate strands of observations, documents, interviews and emails. This took place in three phases: an early phase where I analysed documents and reviewed lesson observations while transcribing Y12 interviews and planning emails, a middle phase where I analysed and coded Y12 interviews while planning and transcribing later interviews, and finally an extended phase where I developed my thinking from the Y13 interviews and emails, and then applied the final coding systematically to all the student data.

In this process I found that I made little detailed use of my lesson observation notes. In part this was because lesson practices fore-grounded discourses of doing mathematics rather than student choice. Student practices were similar over repeated lessons and tended to be defined by teachers, so the observation data was not as rich as students' descriptions of typical lessons. Reviewing the notes did have two benefits: they provided contextual information and appropriate vocabulary for interview tasks and they suggested teacher metaphors and narratives that I could investigate in the student accounts. My later analysis of happiness, work, belonging and independence all had roots in these observations. In the rest of this thesis I use the observation data only if it adds notably to other findings.

3.3.1 Discourses in documents

The aim of analysing these documents was to identify discourses used by the FMNetwork and others to present it/themselves publicly, and to consider how these aligned with wider discourses of mathematics/education policy. This analysis was interpretive, not evaluative. Where I noticed omissions, additions or differences between the documents, I took these as reflecting how discourses are inscribed in different ways for different purposes, not as authorial errors.

I followed the analytic framework suggested by Atkinson and Coffey (1997). I started with features of individual documents: how they presented themselves in structure, style, layout, and ordering, the language they used, how they moved from general to specific statements, how the authors were positioned, who they addressed directly and who were the implied audiences. From this base I looked for relationships of uniformity, intertextuality or contrast between the documents. Uniformity has the effect of creating predictability out of complex social practices, reconstructing "persons and courses of action [...] in terms of the categories and rules of the organisation itself" (ibid, p60). Intertextuality, identifying where documents drew meaning from each other, shows how organisations produce and reproduce their reality through documents. This includes how documents construct themselves as the outcomes of rational sequences of policy decisions and consequences. Contrasts indicate competing discourses or audiences. They may suggest a process of coming-to-know: for example, further mathematics' role in providing differentiated learning changes from being "perhaps [...] helpful" to "not properly geared" between QCA's interim and final reports (Matthews and Pepper 2005, p7; 2007, p22). The explanatory statements that accompany a change of tone can show how the texts positioning themselves using multiple relevant discourses.

From this analysis I identified three tensions that appeared within the documents and across them: further mathematics as *inside/outside* the system; further mathematics as *breadth-plus-depth*; and further mathematics as a past-/future-oriented *gold-standard*. In Chapter 4 I describe these tensions, how they are lined up with inclusion and exclusion, and how the FMNetwork manages them. They reappear within students' accounts in other chapters, and I have written elsewhere of how they can be traced within one student's struggle to stay with further mathematics (Smith 2010b, 2011).

3.3.2 Discourses in student accounts

The major analytic work in this study was working with the data from interviews and emails. For interviews I considered the primary data as the audiofiles, and my first level of analysis took place during the interviews, informing my responses and the subsequent conversation. I acknowledged this process during the conversation by paraphrasing in an open way and asking further questions so students could correct and revise the knowledge that I presented as shared. The audiofiles were transcribed by myself and others, and finally edited by me, aiming to record the interviews as a co-constructed conversation. The written transcripts did not have the detailed tonalities and hesitations of speech but showing turn-taking, words and phrasing using standard layout and punctuation (Cameron 2001), and with bracketed comments for non-verbal responses. I considered this less-detailed "denatured" transcription appropriate for exploring embodied discourses rather than mechanics of speech (Oliver, Serovich and Mason 2005). I listened three or four times to each audiofile. Occasionally I heard the students' words differently to how I recalled them or had responded to them during the interview. This made me aware that even the clearest recording is a re-working of the interview-as-event. I did not privilege one hearing or another, but instead noted the multiple possibilities.

The email data was already in typescript, although in different forms. I gathered the text of each student's emails into one long question-and-answer conversation (and subsequently created a second spell-checked version to allow easy searching). I then treated it in the same way as the interview transcripts, using Nvivo to store, organise and search all this textual data together. This allowed me to move quickly between ways of looking at the data along the dimensions I had identified (e.g. student, site, time) and to experiment with coding.

I did not take one standardised approach to coding and writing about the data. Rather, as I became familiar with it through collecting, transcribing, responding and reviewing, I looked for key narratives (Robson and Bailey 2009) in the students' accounts: systems of knowledge that either recurred frequently or were presented as particularly significant in accounts of choosing further mathematics. Some of these discourses I expected because they occurred in previous research findings as reasons for choosing mathematics. For example, I specifically introduced questions about family, teachers, and memories of maths. Others, such as maturity, work and self-knowledge, emerged from the data because they were recurrent and significant strategies used to explain choices and experiences in the classroom. This gave me a basic set of codes which I developed in response to my further reading and thinking. Table 3.1 shows these codes and how they support my thesis chapters. I give two examples (one long, one short) that show different levels of this process.

- Happiness and Work: developing codes into a chapter

I initially chose to code 'happiness' because it featured in both the literature and students' accounts as a reason for choosing mathematics. I coded sections of speech that related to happiness either because of the vocabulary used (such as enjoyment, liking, hating) or because of tone of voice. Quite separately, I coded 'work' because it featured prominently in teachers' observed speech and in student accounts. I identified speech sections with broadly relevant vocabulary (work, homework, questions, reading, effort, hard, easy) and descriptions of practices that seemed like mathematics work. It was immediately clear that the same text often had both codes. In one way, this was not surprising, as my reading of

Rose (1990) suggested that both work and happiness are targets of neoliberal self-entrepreneurism. After further reading I sub-coded to show three different theoretical relationships between work and happiness: naturally opposed, managed alignment, and resources for self-expression. Again the coded text often overlapped since students made use of all three discursive strategies at times, introducing opposition/alignment in order to make claims about themselves as mathematicians. At this point, I felt rather overwhelmed by the complexity, and was wary of the temptation to focus on students rather than discourse. I had to make decisions about how to write about the relationships in a concise way that did not impose unjustified categories on the data. I reviewed the coded text to make three kinds of summaries: for individual students, for the different contexts or experiences (e.g. in lessons, at home, with friends) in which the students 'set' their accounts of happiness or work, and for Maths/Further Maths. Making the student summaries confirmed to me that the patterns in the talk about work and happiness established different positions that students could take about choosing further mathematics. Combining the summaries for settings and Maths/Further Maths allowed me to restructure my thinking. First I reorganised my three theoretical coded relationships into four imperatives that recurred throughout the accounts: you have to work, you have to not work, you have to be happy, you have to work at being happy. Different combinations of these still allowed me to capture opposition, alignment, and self-expression. Then I looked at the 'real-life' settings that students brought into these arguments in order to satisfy these imperatives, and identified the similarities/differences between them. Finally I examined where the accounts suggested explicit differences between further mathematics and mathematics (or other subjects) in how students related work and happiness. The imperatives, their settings and the effects on further mathematics gave me the outline for Chapter 6. During this process, I had developed my coding to unpick the detail and complexity of choosing further mathematics, and then experimented with ways of writing that did justice to the data. Other chapters were the result of similar processes, although for each I made different decisions about how to write (see Table 3.1).

Table 3-1 **Mapping codes to findings/chapters**

Initial codes	Developing coding	Chapters	Organised by ...
Time schedule	→	5 Time and maturity	Discourses: mathematics as safe, straight; further mathematics as doing extra, getting ahead, precocity and illusion
Does FM matter?	→		
Work	4 imperatives: you have to →	6 Work and Happiness	Discourses: work and happiness as opposed, aligned or work on the self. Dependability and working together as happy objects
Happiness	→		
Individual self	Individuality →	7 Individual and Collectives	Practices of successful belonging: going it alone, family, friends,
Friends			
Family	Collective →		
Teachers	Individual within group →		
Mathematics		8 Struggling with Independence	Practices of independence that can exclude: responsibility, resistance, learning for oneself, speaking for oneself.
Universities	Knowledge about ... →		
Technologies of learning: text books, website	Backed up by ... →		

- Teachers and family: developing codes across chapters

I decided to include *teachers* and *family* amongst my basic codes because I was interested in whether students ascribed different reasons for choosing further mathematics to different groups of people they belonged or wished to belong to. I wondered whether there were 'home' and 'lesson' discourses that students had different access to, and had to negotiate, and how these related to FMNetwork discourses and practices. Coding in this way was helpful in finding similarities in how students talked about teachers' and other people's influences or where they were positioned by conflicting identity practices. This led into Chapters 7 and 8, where I examine how particular students used discourses available in further mathematics to manage their identities at the intersection of collectives, including those associated with family, ethnicity, class and neoliberalism. 'Going-it-alone' emerged as a theme of successful students who continued to participate in further mathematics, either supported by school practices or as a resistance to how schools had positioned them. In Chapter 7, I examine the discourses that make it possible to belong in a further mathematics collective and simultaneously to be identifying with a neoliberal project of independence. In Chapter 8 I turn to some of the 'casualties' of further mathematics and examine how these interactions and practices of becoming independent also acted to exclude students.

3.3.3 Broad analytic sets

My unit of analysis is discourse, and discourses are both local and general. In identifying the discourses of further mathematics I have worked from the large mass of student talk, tracing how meanings and practices fit together and recur across students, sites, times and choices. Writing the thesis imposes a need to encapsulate my findings, to communicate concisely and to explain the local context. One way of doing this is to use "analytic sets" to represent the data. By addressing each theme through a few students at a time, I can "blend fairly detailed narratives with a degree of conceptual focus" (Ball, Maguire and Macrae 2000, p17). Throughout the thesis I have been guided by this approach, but also been wary of the way that it places individuals at the centre of the analysis. The language of individual choice/accounts makes it easy to suggest that power circulates through individual narratives/trajectories rather than discourses, but I want to stress the theoretical point that the individuals described in each chapter are not chosen to represent types or possibilities. Rather they illustrate how discourses of further mathematics, choosing and wider society come together in particular ways to produce effects and meanings through which students are positioned and position themselves, and that 'selfhoods' are among those effects/meanings (Butler 1990, 2008; Edwards 2008; Foucault 1979; Walkerdine 2007; Walshaw 2004). By focussing on a smaller number of students, it is possible to trace how "narratives of [...] subjectivity" *produce* individuals as knowing, choosing and changing themselves, over time and with purpose, that is as 'doing' an agentic, enterprising subject (Walkerdine 2003, p244). I can aim to show the complexities and fluidities of these multiple, shifting practices (Davies 1989 | 2004; Griffiths 1995) at the intersection of many discourses.

Broadly then, Chapter 4 introduces the institutional discourses of the FMNetwork that delineate the value of further mathematics and 'ideal' students experiences. Chapters 5 and 6 correspond to different discourses that featured significantly or surprisingly in the student data. I have drawn on larger sets of students to include the different ways these discourses were used. Taken together, these chapters address my first set of questions concerning the discourses that structure knowledge about choosing further mathematics. Within each chapter, I report my analysis of the coded text to examine the subsequent questions concerning the power relations and interwoven effects of practices of schooling, choosing and of the self.

In Chapters 7 and 8 I use smaller sets to consider in detail how these discourses work together and have effects on the choices that 'can' be made. The constraint here is that of intelligibility: what 'can' be chosen or recounted by students is what is intelligible in contemporary educational, political and psychological discourses (Foucault, 1991; Rose, 1999). I use my theoretical work on discourses of neoliberalism to consider how discursive strategies in further mathematics relate to wider dominant discourses of the self and how they contribute to constituting agentic subjectivity as independence, autonomy and responsibility. For these chapters I have chosen examples from students who used the discourses in dominant ways and those who used it in more unusual ways, and I establish how this has effects for their continued participation.

Chapter 4 Constructing Further Mathematics

In this chapter I examine the 'official' discourses of further mathematics: those that are given a status of permanence and abstracted generality by appearing as published documents or websites as well as through teachers' and pupils' classroom practices (Morgan 1988). I start by showing my analysis for a short but significant document: the first student page on the FMNetwork website. This page tackles the core question 'Why Study Further Mathematics?' and has remained essentially unchanged for five years, so seems appropriate for a stand-alone example. I use it to introduce the discourses I identified from analysing all fourteen selected texts (see §3.2.2, §3.3.1 and Appendix 2). I then examine how the FMNetwork has reproduced and adapted historical discourses of further mathematics to re-position itself in terms of future directions for equity, quality and individual practices of the self such as aspiring and belonging. In later chapters we will see that these same FMNetwork-inspired discourses are used in students' accounts of choosing mathematics, alongside other discourses of the self and mathematics, and so they underpin the rest of the thesis.

4.1 Why study further mathematics?

Figure 4.1 shows a screenshot of the webpage (FMNetwork n.d.), now promoting the Further Mathematics Support Program (FMSP) but otherwise unchanged. The red banner at the top of the screen and the grey menu on the left are common to all pages, and this is the first page of the 'Student area'. On the right is a column displaying 'action' photographs of mathematics careers and lessons, and quotes from students, universities and teachers. The FMNetwork also distributed a leaflet with the same title and much of the same central text, photographs and quotes, so I take this combination as an established whole.

The 'people' involved in this document appear prominently in the banner and title-question. The document constructs its author as an institution, the FMSP itself. This institutional presence appears in the prominent red branding in the header, the map of regional offices and the highly-structured menu options such as "about us", "teacher area", "online resources". A human author "CS" (Charlie Stripp, the FMSP leader) appears at the very bottom of the page logging the 2009 update, but his actions are depersonalised by using initials as for internal bureaucratic record-keeping. The scope of the language is also wide: it claims to report what students, teachers and universities "find", "say" and "achieve" in a detemporalised present tense, and to predict outcomes for a comprehensive range of student scenarios. This all suggests more than one person's experience is being represented in the central text, and indeed this is distinguished from the individual quotes which are placed to the right, named, set in italics and change every time the page is refreshed. This impression that the central text presents institutional "cold knowledge" (Ball and Vincent 1998) - a formal abstraction and restructuring of lived experiences - is reinforced through the layout with its bulleted lists and professional-looking video links.

Figure 4-1 The FMSP webpage 'Why study further mathematics?'


Further Mathematics Support
Let Maths take you Further...

Browse | Welcome to furthermaths.org.uk

Home
News/Media releases
About us
Getting involved
Teacher area
CPD
Student area
Tuition
Revision events
Enrichment
Useful links
Contact us
Site Map
Online Resources
Log In and Information
FMSP Regional Contacts
Please select a region
FMSP Staff Area
Log In

Why study Further Mathematics?

What is Further Mathematics?

- Further Mathematics is an AS/A level qualification which both broadens and deepens the mathematics covered in AS/A level Mathematics.
- AS level Further Mathematics is designed to be learnt alongside AS level Mathematics in year 12, or taken up as a new AS subject alongside A2 Mathematics in year 13.

Why study Further Mathematics?

Please also see 'Is AS/A level Further Maths for me?'

There are many good reasons to take Further Mathematics:

- Students taking Further Mathematics overwhelmingly find it to be an enjoyable, rewarding, stimulating and empowering experience.
- For someone who enjoys mathematics, it provides a challenge and a chance to explore new and/or more sophisticated mathematical concepts.
- It enables students to distinguish themselves as able mathematicians in the university and employment market .
- It makes the transition to a mathematics-rich university course easier.
- Some prestigious university courses will only accept students with Further Mathematics qualifications.

By studying Further Mathematics through the FMSP, students also:

- taste a more independent style of learning, which is good preparation for university or a career;
- have the chance to work with like-minded students from other schools and colleges;
- in many cases, have regular input through a local university.

Any student planning to take a mathematics-rich degree (this covers a very wide range of academic areas - Engineering, Sciences, Computing, Finance/Economics, etc., as well as Mathematics itself) will benefit enormously from taking Further Mathematics, at least to AS level.

Students who are not planning to study for mathematics-rich degrees but who are keen on mathematics will find Further Mathematics a very enjoyable course and having a Further Mathematics qualification identifies students as having excellent analytical skills, whatever area they plan to study or work within.

AS Further Mathematics introduces new topics such as matrices and complex numbers that are vital in many mathematics-rich degrees. Students who have studied Further Mathematics find the transition to such degrees far more straightforward. Studying Further Mathematics also boosts students' performance in AS/A-level Mathematics.

Any student capable of passing an AS/A level in Mathematics should also be able to pass AS Further Mathematics. Studying Further Mathematics also consolidates and reinforces students' standard A level Mathematics work, helping them to achieve their best possible grades.

Students planning to study for a mathematics-rich degree who did not begin AS Further Mathematics in year 12 can choose to study it alongside A level Mathematics in year 13.

Students who are especially keen on Mathematics will really enjoy the full A level in Further Mathematics. It is a challenging qualification, which both extends and deepens students' knowledge and understanding beyond the standard A level Mathematics. Students who do it often say it is their favourite subject.

Further Mathematics qualifications are highly regarded and are strongly welcomed by universities. Students who take Further Mathematics are really demonstrating a strong commitment to their studies, as well as learning mathematics that is very useful for any maths-rich degree. See: What the Universities say about Further Mathematics

Updated by CS 01/08/09

Maths Careers Video

Case Studies - Jobs

Further Maths Video

Quotes

"Studying Further Maths with the Further Maths Centre has enabled me to expand my mathematical horizon."

Helen Long

More quotes from students.

"Thanks to the Further Maths Network, we have finally managed to get Further Maths back onto the timetable."

Jean Helsby: Lymm High School

More quotes from teachers, universities, and professional bodies.

I now want to highlight some of the ways the webpage constructs further mathematics and the language used to do this. These are discourses that I will return to later so I have brought in significant connections with the other documents I analysed.

A first look at the webpage shows it setting out definitions and reasons to choose further mathematics. Further mathematics is introduced as an AS or A2 level qualification that measures progress in year 12 and 13; later, "overwhelming" findings show it results in "more independent" work, "more sophisticated mathematical concepts", "the best possible results" and the chance to "distinguish" oneself or be accepted by "prestigious" universities. Most of the nouns in the text are qualified, often with comparisons of scale, which suggests a discourse of *measurement.* Its major structural feature is using paragraphs to categorise students by their future degree choices, again qualified as "mathematics-rich" or not, and mapped to their level of participation (AS/A2-level). The final paragraph presents further mathematics as "highly regarded and strongly welcomed", and its students as "especially keen", "really demonstrating a strong commitment", and learning "very useful" mathematics. All of these are common-place qualifiers but together they present "further" mathematics as something that is a special case: extreme but still measurable. Sfard describes numberese, "our present tendency for speaking in numbers about absolutely anything, whatever the nature of the things that are talked about" (2009, p9) and its reifying power in education discourses. In this text the measures are not numerically quantified but they are produced as significant by emphasis and repetition, and they construct claims to rigour, objectivity and generality. I see this as a softened version of numberese. It feels like a knowing omission: a reader aware of the potential geekiness of mathematics can see the text avoiding numbers, a reader sceptical of calculations can see it reasoning with qualities not quantities (aligning it with pure mathematics to those already familiar with a calculation/reasoning binary). This combination seems particular to the FMNetwork recruiting document. Other promotional FMNetwork documents use similar measurement adjectives when they argue for further mathematics but they also present quantitative data presenting evidence of its "dramatic decline" (Barmby and Coe 2004, p1). The mathematics promotion scheme (more_maths_grads 2007) makes repeated references to declining/increasing student *numbers* but it applies far fewer qualifiers to students or learning than occur here for further mathematics.

This brings in a second associated discourse, *mathematics for all/mathematics for some,* which (see §2.1.1) constructs the problems of mathematics education in terms of a play-off between participation and standards. I see this FMNetwork webpage as setting out a case for 'further mathematics for all' when it addresses "any student" or generic "students". However it articulates "mathematics for some" when it matches different kinds of students (e.g. "those who are not planning to study for mathematics-rich degrees") onto different modes of engagement. Thus it translates the *mathematics for all/for some* binary onto further mathematics. However by structuring it in an argument that exhaustively categorises specific cases, it attempts a reconciliation. By representing enough of the possible "some", further mathematics can be also be for all (where 'all' is presented as those who enjoy and are "capable of passing an AS/A level in Mathematics"). Again, it is characteristic of the FMNetwork to distinguish the special case of further mathematics, and suggest ways to re-examine old problems.

The measurement discourse is also supported by a third mathematical metaphor characteristic of further mathematics: *breadth/depth*. In this short example, further mathematics "broadens and deepens", then "extends and deepens", and (less measurably) "consolidates and reinforces" mathematical knowledge. In practical terms, Further Maths has six more modules than Mathematics, so broadening means studying a wider range of entry-level applied mathematics modules (e.g. statistics, mechanics, discrete mathematics, numerical methods), and deepening means studying longer sequences of hierarchically-dependent modules (e.g. mechanics 1 and 2). This link to examination technologies gives *breadth/depth* a seemingly objective basis. I will use the other texts to argue that the metaphor carries much more than this syllabus-based meaning. Here the linked pair[9] *breadth/depth* is presented as foundational, natural since it provides structure to the argument. Breadth is offered by bullet points giving a comprehensive list of reasons for students choosing further mathematics or situations in which they should choose it; depth by projecting into what universities and employers require. Breadth and depth are always paired, so that, for example, adjacent paragraphs juxtapose "Any student" planning for "a wide range" of mathematics- rich degree subjects who will benefit from AS-level, with "keen" students who will be identified as having "excellent" analytic skills from either qualification. Even in this single document we can start to see how the *breadth/depth* discourse lines up with others, such as *mathematics for all/for some* and also a fourth discourse, *equity/quality*. We can see that further mathematics is clearly aligned with quality throughout, via the discourse of *measurement* and the use of "good", "rewarding", "distinguish", "prestigious". Equity is addressed implicitly, and primarily in the form of overcoming 'constraints', via the repeated references to "any student" and the quotes from

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[9] I am drawing heavily here on Mendick's (2003) methods for studying mathematics through its gendered binaries such as hard/soft or theory/experience. Breadth and depth (or equity and quality) are not primarily treated as opposites although they usually appear together, so I have called them pairs rather than binaries.

agentic individuals who are "enabled" and "have managed". The notion of influences is more indirectly addressed by stressing the "enjoyable" and motivating nature of further mathematics for "any" student. I return below to the prominence of *equity/quality* in the other FMNetwork policy/ research documents

A fifth discourse that is prominent in this webpage relates to *time*. There is a general sense of "transition", "planning", and "preparation" for the future. Of the 25 sentences answering "Why study Further mathematics?", 14 include "universities" or "degree", three focus on future grades, and just five describe present-day "enjoyment" or "challenge". This document is unlike all the others in not also presenting the FMNetwork as a project that is itself moving forward and improving in time. This omission makes sense since an impression of impermanence could threaten the constructed institutional authorship. The other documents include an analysis of further mathematics past-and-present and have notable similarities in their shared language of "decline" (e.g. Searle 2008b, p6), "vicious circle" (e.g.Stripp 2004), "decline and downward spiral" (Matthews and Pepper 2005, p4) that is changing to an "upward spiral" (QCA 2007, p6), "the survival of an academic discipline" (more_maths_grads 2007) and "a bright future" (Wright 2009).

Finally, the webpage positions further mathematics as both *inside* and *outside* the practices of school mathematics. At the beginning, it is defined as a qualification and linked by vocabulary to the technologies of school years and examinations, and thus *inside* school mathematics. However, the focus is clearly not on a student's own school and its teachers. The only other mention of school is FMNetwork students having "the chance to work with like-minded students from other schools and colleges". The sense of belonging here is not the school-community but with the FMNetwork's imagined community[10] (Anderson 1991) of other students who are similarly interested in mathematics and aspiring to mathematics-rich careers. As we saw above, the text positions itself as speaking for universities and employers, so this community is *outside* of school, with its own knowledge and concerns that the reader is invited to share.

So far, then, I have introduced the discourses of:

- Measurement (through qualitative distinctions)

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[10] Anderson uses this term to explain the socially constructed nature of nationhood. Although members of an imagined community may never meet, they come to see themselves as belonging together because they share language and practices.

- Mathematics for all/mathematics for some
- Breadth/depth
- Equity/quality
- Time
- Inside /outside

In the next section I describe how these discourses are used together and how they position further mathematics. As I noted above, most of the documents are structured by time: they use a historical perspective to explain the situation of further mathematics today. This allows them to draw contrasts and to align or distance themselves from the past. To follow these moves, I need to give a brief history of further mathematics, for which I draw on the 14 documents and several key historical sources (Bell and Emery 2006; Hoyles, Newman and Noss 2001; Kitchen 1999; Newbould 1981). I organise this analysis of discourses working together around what emerged as a central argument of the FMNetwork: to show how it could improve both quality and equity. I show how the dominant discourses of *measurement* and *time* together construct a *gold-standard* metaphor for quality, while its inequities are constructed as *school deficits*. I then return to the forward-looking, progressive arguments of the FMNetwork documents and examine how they use the discourses of *inside/outside*, *breadth/depth* and *mathematics for all/for some* to introduce new constructions of quality as *conformity* and equity as *systematised access*. Finally I examine *breadth-plus-depth* as a unifying discourse that attempts to reconcile quality and equity by delineating spaces for each. I consider the relationships between these different discourses of further mathematics and what this may mean for students' choices.

4.2 Historical constructions of further mathematics

4.2.1 Looking back: 'pure mathematics for all' and the open market

In the 1970s some 45000 students passed mathematics A-level, and a third of these also took the equivalent of further mathematics and thereby became eligible for mathematically-demanding degrees (Hoyles, Newman and Noss 2001). Schools were free to choose among several syllabuses but these all had a similar structure, with two parallel A-levels called 'pure' and 'applied' mathematics. This content-driven division represented the implicit educational hierarchy of the time. Pure mathematics was seen as fundamental in its own right, the necessary preparation for science and engineering degrees and the significant grade for assessing everyone. Applied mathematics was the 'optional extra' giving practice in the pure techniques and adding breadth, but not considered as going 'further' or deeper. This hierarchy configured applied mathematics as deviations from the standard middle-class route towards higher-education. Its pure/applied split echoes familiar abstract/concrete and theory/practice binaries which present themselves as neutral while lining up with classed and gendered identity practices (Mendick 2006). In his historical study of further mathematics, Newbould (1981) found that many students achieved relatively low grades in both pure and applied mathematics, but that these casualties were largely invisible with, for example, no records of how many students dropped out or failed examinations. Instead, it was taken for granted that further mathematics students got good grades and continued to university mathematics (Porkess 2006).

The 1980s saw a gradual evolution of A-level syllabuses under private examination boards. Increasingly configured as businesses, the boards diversified and competed to attract schools and students: the market and choice were entering educational discourse. These new A-level syllabuses introduced the current division into mathematics and further mathematics. 'Mathematics' combined the lower levels of the old pure and applied content. 'Further mathematics' contained three kinds of topic: some relatively isolated from the core mathematics content (e.g. complex numbers); some developing it (e.g. differential equations); some applying it in different contexts (e.g. mechanics/ statistics). This new format proved increasingly popular with schools, in part because students tended to get at least one good grade, and the old pure/applied format disappeared in 1997 when examination boards were regulated by government (QCA 2007). During this time national policies had also encouraged more 16-year-olds to stay in a broadly academic programme, normalising the A-level/university trajectory as an indicator of educational success and culminating in New Labour's target for 50% of the age cohort to attend university. Simultaneously the primacy of pure mathematics was cast as unwelcome specialisation. Applied mathematics was extended to include discrete mathematics and re-valued as relevant and necessary to "drive the economy and generate knowledge and innovation" (FMNetwork 2006b). So it was not surprising that schools and students increasingly chose the single mathematics A-level, whose syllabus covered both pure and applied content and gave better grades (Kitchen 1999). Further mathematics became described as a subject that "lost out in a market-place competition with easier alternatives [developed for] non-traditional students" (Porkess 2006, p2). Note here how widening/broadening A-level participation is posed as threatening 'hard' mathematics.

It is useful to say a little here about how further mathematics is positioned in relation to the school system. The historical perspective of these documents clearly suggests it has moved *outside* the mainstream curriculum although remaining an A-level. Porkess finds that further mathematics "lost out" and that "universities are reluctant to mention it in their prospectuses for fear of frightening off potential applicants" (2006, p5). QCA (2007) describe it as "a minority subject, [. . .] lost for some schools and colleges" (p3) and "often seen as an 'extra' to a student's A level package" (p9). Despite remaining an A-level and so *inside* the national system, preserving further mathematics is not a national political concern in the same way as mathematics is (Smith 2004). Foucault (1980) reminds us to look for productive power in such positionings. I suggest that being outside mainstream educational concerns makes it possible to construct roles for further mathematics that would not be appropriate for A-levels with broader candidate bases. One such role is to solve the "serious problem" of "differentiating between the very best students" who get A grades in mathematics (FMNetwork 2007). No other A-level is routinely cross-referenced with the grades of another in this way. This differentiation is positioned as meeting the needs of universities and these able students themselves:

> The boys and girls who would take up this course are usually the best in the school, and they know they've always been the best in the year. But [...] they see people who are even better than them in mathematics and it takes them onto another level. (teacher quoted in Barmby and Coe 2004, p6)

The presumption that only able students will do further mathematics means that it can be encouraged and acknowledged to include more demanding examination questions than other A-levels (Bell and Emery 2006), to allow teachers to teach in more challenging ways (Matthews and Pepper 2005) and to induce more sophisticated habits of mind (Hoyles, Newman and Noss 2001). A second role is to maintain a presence and an influence for pre-university mathematics in a small part of the school curriculum. Further mathematics teaching and examinations retain skills and practices for future re-inclusion in mathematics but they are only able to sustain them precisely because they are peripheral, both inside and outside. The importance of the *measurement* and *inside/outside* discourses are to maintain this extreme-yet-included position.

4.2.2 *Quality in further mathematics: a gold-standard*

I now want to argue that the historical genesis of further mathematics associates it with a nostalgic concept of quality in mathematics education, which is strengthened by the dominant discourses of *measurement* and *time*. First, the title and the very existence of further mathematics suggest that the content of A-level is structured hierarchically. The split syllabus designated particular mathematics topics - and the experiences of learning them – as 'further', creating a measure by which they are deemed more difficult, less accessible and therefore higher quality than others. Whether measuring content or students' mathematical thinking, further mathematics is awarded a symbolic role that emphasises individual difference. It constructs quality as a property of standing out from the norm in or beyond some measure. Thus the first meaning for quality constructed as 'given' within further mathematics is that quality in education is measurable and there is a way to "distinguish between stronger and weaker mathematics" (Porkess 2006, p9). It is worth recalling that Mathematics and Further Maths A-levels are taught concurrently to the same students (since 2004) so this ranking cannot be solely determined by prior requisite knowledge: 'further' is not simply 'later' but 'better'.

Secondly, these documents construct quality as the past embedded in the present/future. Why do such forward-looking documents emphasise the past? Bauman (2001) suggests that modern western society is particularly alert to managing change. It positions individuals as responsible for negotiating risks and culpable for any failure. Searching for stability then becomes a modern practice of the self. In this way individuals choose to perpetuate situations that could otherwise – without that element of choice - be seen as traditional constraints. This means that an appeal to the past does fit within promotional documents seeking to influence choice, as do the forward-looking "genuine grounds for optimism" (Stripp 2004, p15) and "a new era for the country in which more and more people continue to engage with and to enjoy our subject" (FMNetwork 2006b). Further mathematics certainly offers an ongoing link with the education of thirty years ago. I want to be careful here - recalling familiar reassurance is not the same as asserting quality. Quality also requires observation and evaluation of the past, which these documents achieve through measurement and retrospective. Bauman argues that when the world around us changes, the normative response of modern individuals is to make sense of what is happening to us, to rationalise and compare old and new practices; it is within this change-inspired evaluation that a discursive notion of quality is produced. Because the history of further mathematics positions it as relatively stable in a fast-changing educational environment, it evokes narratives of sense-making such as "vicious circle" and "decline" that heighten its visibility and position it as a context for evaluation. I call this a 'gold-standard' construction of quality. The gold-standard only has meaning because we no longer pay in gold. However, by evoking the rationale of calculating back, it continually reinvents itself. So in further mathematics we have stories of a mythical past golden age in which students were well-prepared in science subjects and all competed to enter mathematics degrees. These stories have currency in today's policy documents, even as we accept that practices have changed. They relate to wider neoconservative discourses in contemporary political thought that say we can no longer make "a presumption of progress" (Brown 2001, p6) that harks back to a golden age while making plans for the future.

4.2.3 Visible inequities

I have given examples to show that further mathematics is often constructed as *outside* the school system, but it is also presented as *inside*. At its lowest, several thousand candidates still continued to study the A-level (from a minority of disproportionately private schools and colleges in England, Wales and abroad) and a few elite universities (such as Cambridge, Oxford, Warwick) continued to request it. In a culture of choice, why did it matter that some (elite) schools and students continued to choose further mathematics? For example, independent schools use examinations such as International GCSEs and Advanced Extension Awards without comparable attention. I suggest that further mathematics features in neoliberal discourses as a problem that needs addressing firstly as part of a search for quality education and economic "bright futures", and secondly because it was an A-level that was publicly configured as inequitable. The documents describe this problem as an "incompatible" tension "between quantity and quality" (Porkess 2006, p5) or the "contradicting aims" (Matthews and Pepper 2007) of mathematics for all and mathematics for some. In the next section I will consider what this positioning does for the FMNetwork, but first I want to point out how school technologies feature in this discourse and make the tension visible.

Further mathematics is defined as an A-level, and the students' grades matter to them and their schools. The numeric 'rules' of the A-level curriculum are that subjects should be roughly equal in value, for example A-levels share a common teaching time and 'points scale' for university entrance (UCAS). This background parity positions A-level grades as a meaningful discriminator of an individual's "reality of mathematics achievement"

(Matthews and Pepper 2007, p10). But alongside this official knowledge, teachers and the media practise an 'expert' knowledge that certain subjects have greater exchange value for university entrance. Further mathematics is one of these; it can have value even with a lower grade. For example, the FMNetwork press release (2006a) reveals that a university "rewards applicants offering a Further Mathematics qualification with double UCAS points". Research shows that students from White, middle-class backgrounds tend to seek more expert advice and choose these high-status subject combinations (Ball, Maguire and Macrae 2000). Information about further mathematics is thus differentiated by class and ethnicity. At the same time as government policy was promoting mathematics "to ethnic and social groups who haven't traditionally been involved in this subject" (more_maths_grads 2007), the FMNetwork was exposing that "Currently, only a fifth of A-level students attend independent schools, but over a third of Further Mathematics entries are from students in this sector" (FMNetwork 2007). These differences in school provision challenged the three liberal notions of equity (Hart 2003): students did not have equal opportunity, treatment or outcomes in their mathematics education. As we saw in §2.1.4, these classic notions are used as performance indicators in education research. Taken together these texts construct Further mathematics as problematic because it is inside a school system that aims for equity and yet it not only perpetuates but gains value from its excluding practices. These practices are made visible as structural differences between schools, and therefore posing a problem to neoliberal policy makers who cannot explain the outcomes as resulting from individual choices or accountabilities. Indeed the government's advisory body has distanced itself from its own qualification: until there is "universal and equal access to Further Mathematics", it is not "appropriate for higher education tutors to use [it] as a legitimate discriminator" (Matthews and Pepper 2007, p14).

The role of further mathematics in quality and equity is part of a wider narrative that society tells itself about itself: we understand the decline of class distinctions as central to modernity (Atkinson 2007a). In this narrative quality and equity are linked, but they function as opposites. Society needs more workers able to use mathematics, so mathematics applications were included in the single A-level and the 'higher' pure topics went into further mathematics. Students from all schools should have equal access to university mathematics courses so universities had to modify their curricula. The opposition seems natural because other factors are taken as unchangeable, such as the comparability of A-levels, the amount of teaching a student or undergraduate should have, and mathematics itself, all crystallised in the practices of teaching and examining that make up education.

This framing is not simply a zero-sum game but one that is oriented in time, echoing a modernist model of progress towards liberal justice (Brown 2001). Quality is constructed as the rules of the past; equity as including more students in the future. For example, Porkess describes new A-levels as righting an "injustice": traditional questions were "mathematically satisfying " but "poor assessment instruments" (2006, p8). Matthews and Pepper quote teachers as explaining that "in previous years" they excluded weaker students who might "depress standards" but now take "students with a wider range of ability" (2007, p54).

This introduces my next focus: how the documents describe the FMNetwork and the 2004 changes to further mathematics A-level, and thereby produce new concepts of quality and equity. I do not aim to criticise the choices made in the documents, but to understand more about how they sustain these positions, and how they relate to traditional conceptions and practices of the self.

4.3 Changing further mathematics

4.3.1 Bringing quality up to date: conformity

The constructions of quality discussed above were rooted in the past or in mathematics content that appears timeless, but the FMNetwork supports a new construction that is rooted in present-day technologies and in change. It does so by emphasising that further mathematics "has been made into a genuine AS Level (Porkess 2006, p13) just like any other. It encourages students to choose further mathematics by stressing the techniques that integrate it with A-level Mathematics, such as the 'least-best rule'[11] for exchanging modules.

Thus one way that the FMNetwork constructs quality is as a property of conforming to the institutional demands of the education system and thus - we infer - to its policy aims. *Quality-as-conformity* offers a discursive promise of equity in the form of universal access to

[11] Further Mathematics and Mathematics A-levels share some optional AS and A2 modules. When there were several ways to combine modules, examination boards applied the 'least best rule' to give each candidate the best A-level Mathematics grade possible, using the lowest scoring modules that achieved this. The remaining modules determined his/her Further Mathematics.grade.

further mathematics, and the improved life-chances that follow. For example, the FMNetwork tells universities that "the new QCA rule changes [...] will make it far easier for ordinary schools to offer Further Mathematics" (Stripp 2004, p15) positioning 'ordinary schools' as the appropriate focus of university concern (with perhaps a reminder that it is easy to focus on 'good' schools or individual students) . Here *quality-as-conformity* downplays individual and school agency and positions the structure of A-levels as powerful in itself: the main actors here are 'rule changes'. Stripp adds that schools can "increase the supply" of mathematics students, but "it's up to the universities to ensure this happens by creating the demand" (p16). Analysing the rules and demands for further mathematics is taken to be enough to change what schools will offer and students choose, and thereby achieve policy aims. This claim suggests a neoliberal framing of modern society as a complex 'swarm' of individual trajectories, all choosing according to economic forces but choosing alike (Bauman 2001). The FMNetwork positions itself with universities and policy makers who understand how power works within the swarm and can use that knowledge for change. *Quality-as-conformity* is a discourse that recognises the "policy levers" used by the state to shape modernisation and educational improvement, their links with funding and an institution's ability to construct itself as successful (Steer et al. 2007). The effects of this discourse are cited by teachers in the QCA survey:

> I think we may be in an upward spiral now. A few years ago many of the universities didn't seem interested [in whether our students had further mathematics or not] so fewer did it and so universities seemed even less interested. Now our students are getting really positive responses so more are taking up the subject and the universities begin to expect it more.
>
> (2007, p6)

I have now traced two constructions of quality. The historical perspectives on further mathematics construct quality through historical continuity and extremes-of-measurement. I suggested those discourses were reconciled in a neoliberal economic metaphor by treating further mathematics as a *gold-standard*. Because this view of quality was located in the present but looked to the past, the inequities associated with it could be understood as outdated White middle-class male privileges that lingered to produce school deficits. The second construction was *quality as conformity*; this time quality is enacted as progress in an ever-improving education system and promising a more equitable future by systematising access and widening choice. Clearly these co-existing constructions introduce potential tensions: Is quality judged in the past or present? Does it concern conforming or standing out? Are inequities over or still being ironed out? I have identified one more construction in the FMNetwork texts that functions to resolve these potential conflicts: quality/equity as achieving *breadth-plus-depth*. The duality in this metaphor manages tensions through flexibility and ambiguity: Further mathematics is valuable and equitable because it is broad or deep or both as required. As we will see, both breadth and depth are used to symbolise quality in mathematics education. Breadth also symbolises equity; this means that finding ways to produce depth as complementary and not oppositional challenges the binaries of *breadth/depth* and *mathematics for all/mathematics for some*. It suggests that wider access can be reconciled with the historic status of further mathematics; and it opens the way to do this by countering outdated class privileges with the powers of individual choices in a market whose 'freedom' is regulated by the state. This new metaphor was enabled by one specific national rule-change that changed the discursive tools available. In 2000 the first half of an A-level course was given its own name – AS-level – allowing separate identities for each year of further mathematics.

4.3.2 Breadth plus depth

How does this breadth-plus-depth construction work? Firstly, the FMNetwork follows many government texts (e.g.QCA 2007; Smith 2004) in associating the AS course with "broadening a sixth form student's curriculum" (Searle 2008b, p6). Breadth provides a metaphor for widening access and inclusion. It also becomes a symbol for quality when education is seen as aiming to provide universal, flexible skills suitable for an unpredictable working life (Rose 1999). When Porkess describes AS students encountering "exciting new ideas, like complex numbers, as the building blocks at the start of Further Mathematics" (2006, p13) he uses "building blocks" to evoke utility, flexibility and progress– all seen as important for future careers. "Building blocks" is an accessible metaphor, evoking children and practical work/play. I find it an unexpectedly concrete metaphor for complex numbers. Compare it, for example, with a description of them (by a participant, Charly) as uncomfortably abstract: *something that doesn't even exist. Just, it makes me feel sick, the thought of it.* I suggest that the difference illustrates the imperative for the FMNetwork to construct the AS syllabus as broad, practical and accessible to all.

The second half of the metaphor, depth, follows from the historical re-organisation of syllabuses. These associated further mathematics with 'higher-level' topics (Kitchen 1999) but the FMNetwork texts rephrase the historical positioning in terms of depth:

> The new AS will be more a 'broadening' than a 'deepening' option. This means that AS-Level Further Mathematics is no longer an 'elite' qualification, suitable only for A-level Mathematics high-fliers. (Stripp 2004)

Here breadth is inscribed as a modern contender to depth, but there is still ample reassurance, just in their name, that 'high-fliers' should be taking further mathematics. Depth is separated from particular mathematical content, and rather defined as being what the 'elite' study, and so inherently bound up with exclusion. It is still firmly attached to quality through the continuation of familiar standards: "The stretch and challenge for the elite is still provided by going on to the full A-level in Further Mathematics [...] which is just as demanding as ever" (Stripp 2007).

In summary, the FMNetwork justifies itself as an agent for change by arguing for a new construction of quality as broader relevance and participation. However, since breadth departs from the traditional exclusions, the change is only enabled by a successful defence against itself, that is by simultaneously arguing for depth. Breadth and depth are thus held together as two forms of quality existing on either side of the AS-level but pulling in opposite directions, one including and one excluding. What holds them together is students' responsibility for choosing: inclusion is systematised by ensuring universal access to AS-level, exclusion is thus individualised. In later chapters we will see how students' are inscribed with this responsibility.

4.3.3 What is equity for the FMNetwork?

In my discussion above I suggested that constructing quality in certain ways might entail corresponding constructions of equity. We have seen how the texts implicitly align *mathematics-for-all* with breadth, and *mathematics-for-some* with depth. A particular feature of the four evaluation texts is setting out a formal structure for discussing equity. They exemplify how these constructions of quality and equity function together by what they include as worth evaluating, and how they relate to the promotional and wider policy texts.

I showed earlier that the FMNetwork program coincided with a revival in candidate numbers for further mathematics, with the 'one-year' AS-level numbers more than tripling and 'two-year' A-level numbers nearly doubling. Searle's (2008a) evaluation emphasises that over three-quarters of this growth was in state schools and concludes that access according to school sector was becoming more equal. It thus prioritises the historical perspective that class-based differences in provision between schools were the primary problem of inequity. This increase strengthens the network's claim to achieving *quality-as-conformity* alongside equity as *systematised access* to choice.

Searle then examines equity in more detail by relating school region to socioeconomic status. More affluent areas of England accounted for much of the growth in the two–year A-level, but the 'one-year' AS-level grew very significantly in deprived areas. Presenting this data makes a weaker claim for progress towards ironing out class differences, but it does strengthen the suggestion that the AS-level is broad in its appeal to previously-excluded students. Hence the FMNetwork is positioned as partially successful in its aim to achieve quality constructed as *breadth-plus-depth*, with AS-level providing the breadth. But there are some unstated tensions between this *breadth-plus-depth* construction and equity as universal opportunity. How can we account for the social differences in who engages with the 'deeper' material and who stops at AS-level? What individual and social factors might be at play? My research includes students who after one year chose to stop mathematics – which can be construed as an exercise of individual agency – but also some who were being taught only the AS-level content over 2 years, a structural school-level constraint. A discussion of equity would be further informed by analysis that linked individuals' outcomes to course opportunity. The fact that this type of data is not within the remit of the official data-collection illustrates how neoliberalism averts its gaze from issues of how individual and social factors interact (Atkinson 2007a).

As well as socioeconomic status and school type, the other factor reported in detail in Searle's evaluation is gender, perhaps owing to its ease of classification and the longstanding concerns over girls' participation in mathematics. The 30-40% proportion of further mathematics students who are female has not changed in the period. This is left without comment: it is not clear whether any change was desired or feared. Other individual background factors are not reported. We know that students who are Black African, Chinese, Indian, Pakistani and from mixed heritage backgrounds choose mathematics/science subjects proportionally more than White students (see §2.1.4) , but not how they have engaged with further mathematics over time. Nor can we find out whether students from different socioeconomic backgrounds, but in the same school, choose differently organised lessons and obtain different outcomes. Through the selections made in these texts, no doubt for necessary reasons, equity is constructed as the absence of those differences that relate to institutions. What affects individual choice is left out of the enquiry. Here the explicit treatment of equity in the evaluations fits with the implicit treatment in all the texts: recruiting individuals into further mathematics is the primary, unproblematised goal.

In summary, the FMNetwork makes use of an educational technology – the decoupling of AS from A-level - to sustain roles for both breadth and depth, and find a compromise where each has a different function but each conforms to institutional requirements. Quality as depth is described in terms of the past and an elite, and thus linked to *quality as gold-standard.* There is a new understanding of quality as breadth with everyone doing more mathematics, and this links to *quality as conformity.* Equity is constructed as the opportunity for an individual to start further mathematics no matter what type of school, how teaching is organised, or what was previously learnt. The AS-level year promotes this goal of universality and recruits for the full course, but it also legitimates selection in the second year. This selection is no longer understood as a means by which schools reproduce privilege because, for the purposes of further mathematics, schools are instead positioned as operating with an agency that is informed by economic truths and the open, objective demands of universities. Change is guaranteed by calling on practices aligned with neoliberalism and individuals have the responsibility for choosing further mathematics for themselves.

4.4 Practices of the self

By carrying out this analysis of the competing discourses within significant FMNetwork documents I have begun to build up answers to my questions about the discourses of further mathematics, their relationships and how they construct choosing as a practice of the self. Here I have focussed on the 'official' knowledge of the FMNetwork about the role of further mathematics and why one should study it. I found that the overlaps, recurrences and inter-relations in the texts did not construct one simple discourse of further mathematics. This is not surprising: discourses are traversed by "processes and struggles" (Foucault 1995). Instead they established as a consensus that there are two competing knowledge structures which line up to construct quality and equity as oppositonal, and a third, *breadth-plus-depth*, that resists and adapts them. I have identified the discursive strategies that allow the FMNetwork to position itself as able to see both perspectives and also to reconcile them, able to speak for further mathematics and to change it. These institutional discourses and strategies are available to students as a resource: a way of making sense of themselves in further mathematics classrooms. The tensions and the power relations constructed in them have effects in students' practices.

Moreover, they construct further mathematics students as certain types of individual engaged in certain practices of the self (McNay 2003).

When the FMNetwork addresses students as part of a wider audience interested in future employment and economic growth, it invites self-reflection and entrepreneurship. When it constructs quality as gold-standard and conformity, it represents students as aspiring to acquire timeless knowledge with a recognised, "fungible"[12] (Matthews and Pepper 2007, p16) quality. As we will see in later chapters, when it describes the like-minded students who would enjoy further mathematics, and the traditional barriers that have stopped them doing so, it sets up ways of belonging to further mathematics or other choice-based collectives. It also codifies strategies for inclusion and exclusion that operate not only at an institutional level but in how individuals understand themselves. In Smith (2011) I traced how the different constructions of quality and equity appear in one student's descriptions of choosing AS-level further mathematics, then A2-level, and then higher education, all in terms of finding and demonstrating an authentic self. Here they permeate the following chapters in which I examine students' talk and practices of the self. In particular, there are parallels with Chapter 5 where I consider how students constructed their participation in further mathematics in terms of time and maturity.

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[12] A fungible good is one where any unit of the good can be exchanged for any other without losing value. Matthews and Pepper are referring to the status of Mathematics A-level whatever six modules are chosen.

Chapter 5 Time and Maturity

In this chapter I turn to the ways that students use discourses of time within their accounts of choosing and further mathematics. In the last chapter I showed how official policy documents positioned the FMNetwork as transformative, echoing the neoliberal understanding that non-governmental bodies working with the private sector have a vitality that stimulates individuals towards an educational improvement that is read as national improvement. I also described the *gold-standard* discourse that shows further mathematics as progressing towards a 'bright future' inextricably framed in terms of past decades when a higher proportion of A-level students studied further mathematics. This is how history plays a role in politics and policies: past generations and events not only establish the conditions in which the present comes about, they also "haunt, plague and inspirit our imaginations and visions for the future" (Brown 2001, p150).

Time features in any discourse as one of the organising principles that establish truth and subjectivity (Foucault 1984; Foucault 1995). It is implicit in the ways we structure arguments, meanings and narratives, for example as coming to know something new, or recognising something old. Even in formal mathematical discourse, time matters by its absence: mathematical knowledge should be timeless and separate from its knower (Ernest 1991; Morgan 1988). How we talk about time organises how we think about ourselves as a society and as individuals (Ahmed 2008b; Butler 2008; Gurvitch 1964; Harvey 1989; Nowotny 1994; Parkins and Craig 2006). It is not surprising then that time featured significantly among the discourses that students used to explain their participation in mathematics and further mathematics. It appeared in accounts of school practices, of how students come to know, how identities are formed, and of how choices are lived. The scope of these interrelations is enormous, but here I focus on the ways in which two particular discourses of time entered into accounts of mathematics and further mathematics and I examine their effects in supporting participation or bringing tensions. I name these two discourses *moving/improving* and *getting ahead* and I explore how they align, or not, with the temporal practices demanded of the neoliberal self. Analysing the student accounts shows that these struggles around representing time in further mathematics are closely associated with discourses of adolescence and maturity. Thus, before I move to the data, I want to examine this relationship between time and adolescence to understand how it is constructed in relation to contemporary education, and how it contributes to making 'natural' categories of gender, race and class. As I will argue, the power relations operating within adolescence are at work in the same way in choosing further mathematics – and with similar effects of inclusion/exclusion.

5.1 Adolescence and maturity: becoming and being

One of the reasons that time is such a dominant discourse in accounts of choosing further mathematics is the way that time structures adolescence. We cannot really examine accounts of young adults without recognising that adolescence has a special role in first-world western culture as a site for conscious self-discovery, where young people "form symbolic moulds through which they understand themselves and their possibilities for the rest of their lives" (Willis 1990, p7). The practices that make up categories of adolescence are almost universal in that they run through so many western discourses, touching on family, workplaces, transgression, consumption and self-expression (Besley 2002; Furlong and Cartmel 2007; Peters and Besley 2007; Peters and Burbules 2004; Rose 1990, 1998). There are theoretical approaches to adolescence from psychological, sociological, philosophical and biological traditions which have all contributed to constructing "childhood" and "youth" and thus positioning young people in educational discourses. Amongst these, the dominant modernist construction of adolescence is in developmental terms, as a process of working towards maturity, or coming-of-age. This falls readily into psychological/biological theorising, but the sociological conceptualisations of youth as relationally defined have "still often idealised and institutionalised [youth] as a deficit state of 'becoming' that exists and has meaning in relation to the 'adult' it will 'arrive' to be" (Besley 2002, p3).

The classic work on deconstructing adolescence as coming-of-age is Lesko (2001). She examines the discourses of progress embedded in early 20th-century pedagogic reforms and their later reverberations in the discourses of therapeutic self-discovery (or "psy-discourses" as Rose (1996) calls them) of late 20th-century schooling. Lesko highlights the work of the influential pedagogue G. Stanley Hall whose ideas guided early 20th-century concerns that civilisation risked degeneracy. She traces the analogies between the developmental view of adolescence - with its attention to emotional development, health as a personal resource, the state as carer, securing childhood apart from adult life - and the parallel interest in progress toward new constructions of human civilisation and nationhood. When adolescence is viewed as development it has two reference points; it connects and harnesses the perceived strength of the 'savage' and the control of the 'civilised man'. By doing so, it inherits all the signifiers of raced, gendered, classed differences that inhabit this dualism (Edwards 2006; Hall 1992, 1996b; Mendick 2003, 2006, 2008; Skeggs 1997, 2004; Stinson 2010; Walkerdine 1988). Lesko argues that adolescents have to take up positions in "border zones between the imagined end points of adult, and child, male and female, sexual and asexual, rational and emotional, civilised and savage, and productive and unproductive" (p50). Their 'becoming' is characterised by the struggles within these dichotomies, and one of the reasons that adolescence matters is because it is a site for contesting these wider social battles. In the developmental temporalities of adolescence the present must draw its meaning from the endpoints of past and future. Education matters because it is a symbol of progress in a modern nation state and because its technologies construct and normalise the 'moving and improving' of adolescence as being trained in privileged forms of rationality, sensibilities, values and subjectivities (Edwards 2006). That is why adolescent hedonism is so socially threatening (Ball, Maguire and Macrae 2000; Peters and Besley 2007): it exalts the present, so removes the time-dependent vectors that help to separate and structure differences into social categories.

These historical links between growing up and racialised and gendered progress mean that adolescence functions as a technology of Whiteness and masculinity that perpetuates colonial power relations (Fraser and Gordon 1994; Halberstam 2005; Lesko 2001). This discourse persists because we take the technologies that reproduce it as fact rather than cultural formulations. So for example we see it as natural to educate children in classrooms, decoupled from their surroundings, and to organise their curriculum by age (and, recurrently, gender (Shaw 1995) and social class (Jivaji 2011)). We shall see that it also persists because it reinforces the modernist episteme of progress and privileges knowledge that controls change in the present and future. Lesko identifies the specific temporalities that mark out adolescents: *panopticon* time where adolescents are continually being watched and measured normatively by age (for example through technologies such as health visits, or sitting A-level modules every six months); *expectant* time which holds them in waiting, unable to act until given social permission (by rituals such as school qualifications, marriage); and *abstract adventure time* in which adolescents do act but in context-reduced simulations of life (teen TV shows, or the biographical case studies on the FMNetwork website). These constructions of time keep adolescents in the present but always needing to balance their future and past. This puts pressures on them – to perform, to resist, to be motivated, to act out, to be fulfilled into adulthood - that are strategically taken as psychological not social: evidence of 'becoming' not 'being'. Lesko argues that "the discourse on adolescents, like colonial discourse, omits material conditions of existence and focuses solely on the psychological state of youth to position the psychological traits as the logical source of the social structural inequities, or the reasons adolescents have to be controlled" (Lesko 2001, p127). Conversely, this 'psychological' danger prompts schools to adopt technologies that identify the safest path as slow, careful development-in-time.

Contemporary adolescence is thus one of the grounds in which young people are constructed as progressing and purposeful, agentic but not yet fixed (Lesko 2001; McNay 2003). The practices by which they claim their own direction and also to be recognised as adults are individualised versions of the contests that characterise feminist and post-colonial identity politics (Butler 1990; Halberstam 2005; McNay 1994; Ramazanoglu and Holland 2002). However these 'internal' struggles for meaning are read as evidence for an understanding that healthy adolescence is a slow development, in which precocity (such as underage pregnancy or very early attendance at university) is dangerous. Correspondingly, authenticity is understood as a moral code that steadies and normalises the struggle for becoming oneself (Warin and Muldoon 2009). Sociologists have also pointed out that the transition to adulthood, compressed and standardised during the first half of the century, has since become "stretched out and individualized" by the diffusion of adult rituals such as leaving education, finding employment and marriage (Hayford and Furstenberg 2008, p484). (See also Brooks and Everett 2009; Furlong and Cartmel 2007). Lesko argues that this diffusion values youth as distinctive even as it is being adopted by adult culture. Moreover in this contemporary thinking, some of the temporalities associated with adolescence, such as the "slow time" of living in the present (Parkins and Craig 2006), the casual employment practices within leisure industries (Ball, Maguire and Macrae 2000), or the "ironic impassivity" of 'cool' (Pountain and Robins 2000, p19) are all associated with achieving authenticity. The authenticity constructed by these time-based disruptions provides a new way of valuing oneself through how one subjectively experiences time (Nowotny 1994), and challenges expectations that one will take up the existing socially-recognised categories on offer. I can thus ask how the discourses of further mathematics contribute to the discourses of adolescence, and how they resist them, whether their effects construct the same, or different, patterns of inclusion and exclusion.

This provides a framework in which to consider how students' talk about time fits with contemporary discourses of adolescence and identity. I am now going to move on to describing the two discourses of time that recurred in students' talk. In doing so I will show how one of them, *moving/improving*, supported the dominant developmental view of adolescence, while the second, *getting ahead*, adapted it to position individuals as distinctive, projecting them towards an endpoint of enhanced self-control and rationality. I argue that choosing further mathematics is a practice of the self that can be productive in resisting and adapting the discourse of slow, staged, deficit 'becoming', but in the end it fails to position students as adults. In particular they cannot escape the prescriptive power of examinations, a theme which recurs throughout my analysis. Students who struggle to maintain their participation in further mathematics mount a defence against it that emphasises their practically-demonstrated maturity in contrast to its illusory promise.

5.2 Moving/improving

> Modernity is not only premised on the notion of emergence *from* darker times and places, it is also structured *within* by a notion of continual progress. (Brown 2001, p6, original emphasis)

The first sense of time that I want to examine is time as continual movement and improvement. Time does move on, and we can hardly discern it otherwise, but modernity produces a heightened discourse of progress in economics, social justice and in subjectivity. This obscures the effects and the subtleties of other time discourses, that are reproduced but simultaneously challenged. In our economic lives, time-moving-on is the "naturalised" background against which we measure both the steady journeys of 'Fordist' modernity with its schedules for work and consumption, and also the accelerated, time- and space-compressing volatility of contemporary global capitalism (Harvey 1989). Similarly, a sense of stable progress from past to future underlies the familiar temporalities of Western bourgeois reproduction associated with family, longevity, inheritance and risk/safety (Halberstam 2005). Even the choices of the individual are understood to rely upon an account of increasing freedoms associated with a hegemonic culture of neoliberal modernity:

> When policy makers discuss modernity or secularism they are indexing a particular link between temporal progress and a conception of freedom - a link that has been developed in time and involves some coercive practices in its formation. (Butler 2008, p6)

All these authors note the coercive practices produced by this sense of time. As with adolescence, the developmental discourse of Western liberalism and modernity constructs dissenting voices as backward, natural, constrained and unprivileged. So, for example, Halberstram's (2005) examines the academic and media responses to the life and murder of the transsexual man, Brandon Teena, and shows how they not only produce an identity for Teena as a disruptor of normative gender and adolescent temporalities but also one for small-town America as naturally intolerant and unchangeable.

Injunctions to choose freely are ways in which discourses of progress become practices of the self, as are the subsequent normative technologies that 'name' the outcomes of these choices as what one 'does' or 'is': teaching/ teacher, mathematics/ mathematician (Brown 2001; Foucault 1990, 1991a). Individuals use them (and are used by them) to position themselves through choices that inscribe personal "life-trajectories" (Ball, Maguire and Macrae 2000). These choices reflect the ways they judge and evaluate themselves and others as inhabitants, consumers, or "colonisers" of time (Giddens 1991). Modernist progress produces time as a perishable resource or commodity: we have to spend it or waste it, expressing our selves through these decisions. Its discourses emphasise an imminent future and set the "general existential dimension of the contemporary social world" (ibid, p3) as managing the opportunities and dangers in risk. This requires a response of looking ahead through planning, and looking back through narration and reflexivity. As Rose (1999, p87) says,

> [Individuals] must interpret their past and dream their future as outcomes of choices made or choices still to make. Their choices are, in turn, seen as realizations of the attributes of the choosing person - expressions of personality - and reflect back on the person who has made them.

This does not mean that dissent does not happen. On the contrary, Nowotny (1994) identifies "uchronias" (such as 'having all the time in the world' or 'overcoming time') as the apparently subversive fantasies that are current in modernist discourse. She shows how wanting to experience time differently, i.e. taking part in these resistances, is a practice that inscribes subjectivity as agentic. The neoliberal self has to control time for its own purposes which means managing time by choice (e.g. downshifting) and not by constraint (losing overtime). The differential temporalities that subjects experience can either signify individuality, and perhaps economic success, or, very easily, abject failure (Parkins and Craig 2006).

This close relationship between accounts of choosing, futurity and progress was evident throughout the students' talk but particularly strong in the year 12 interviews when I asked how they had chosen their A-level subjects. At that stage, with only a few early module results and before entering on the technologies of UCAS, students could still position themselves in *expectant* time, waiting to make final decisions about university courses, or *abstract adventure* time, free to follow any trajectory into the future. In these cases, the way they talked about their 'choices' corresponded, as Rose and Nowotny suggest, to their self-positioning as agentic, and both were concerned with how they could move/improve their future selves.

I have included ten students in this chapter (see Table 5.1 and Appendix 1 for biographical details). In most cases there were other students who used discourses similarly, and I chose between them on the basis of effective communication. Broadly, I use Clive, Steve and 007's accounts to consider how the discussion of reasons positioned students as aspirational future-makers concerned with the practices of a meritocratic education system. I use excerpts from Joe and Paul to show how students were positioned as securing individual progress through mathematics, and from Charlotte, Simon, and Sukina to show how this progress was articulated differently as 'getting ahead' through further mathematics. Finally AgentX and Tom most powerfully articulated a resistance that positions further mathematics as precocious, and used their self-exclusion as evidence that they had already achieved realistic maturity. As we shall see these positions are complex; they interact and define each other; so that no discourses can be completely unravelled and separated from each other.

Site	AS Further Maths	A2 Further Maths
Capital	Joe, Sukina, 007	-
Grants	AgentX, Tom,	Simon
Moorden	Clive, Steve	Charlotte, Paul

Table 5-1 The sites and participation levels of students in Chapter 5

5.2.1 The rationality of looking to the future

In year 12 only one student had a firm plan for a future after leaving school (Simon, work in IT). Many had a range of aspirations, more or less ambitious, but most described their A-level choices in terms of progress to an unspecified future. For example, Clive asked himself:

> Well, would they be helpful to me in the future? Would they look good on my application forms? Cos I don't want to do subjects well like - not being harsh - but subjects that aren't as well thought of like, so easier ones.

Clive is focussed on the technologies of 'becoming'. The subjects he chooses are oriented to the future but are not in themselves the future. What he does foresee is a continuing process of being scrutinised, part of the *panopticon time* associated with adolescence. Within this process he felt able to position himself strongly as knowledgeable about the relevant technologies of "my application forms" and social judgements of subject difficulty. Clive was a White middle-class[13] student, confident in using the informed advice gained from school and family (cultural capital, cf Bourdieu 2004) to help him pick the right university course: one where "at the end of it you have got a job set in stone, ready for you". He gains information from family about business and education that he sees as pinning down his niche in the economic world. Clive uses the discourse of risk but he positions himself according to the modern norm as controlling his future, ensuring that moving on is equivalent to improving until he comes-of-age by inheriting 'success'.

In contrast, Steve had a clear goal that he wanted to work for himself and had chosen a range of appropriate courses such as Business, Law, Economics and Young Enterprise. Steve was a White working-class student whose mother and brother both studied accountancy. Unlike his friend Clive, he was concerned about the relationships between his present choices and his imagined future, and was trying to create the context in which this abstract adventure could be realised:

> What I actually want to do in the future is own my own business but then I am just thinking of a way that you can actually get to that.

In year 12 Steve questioned whether A-level choices led on to his career, and in year 13 whether he was suited for university. He resisted the *expectant* time of sixth-form study, wondering whether its endpoint matched his vision of self-sufficient, hands-on adulthood. However he continued to represent his personal progress as depending on achieving well in school examinations: "cos for the future, so you want to do your best, to do what you want". He explains this as a common-sense matter of economics: you need money to own a business, and qualifications to earn money. Passing examinations is thus construed as one of the normative technologies that sixth forms use to produce a sense of staged progress, that extends beyond the personal to institutional and economic rationalities.

[13] See Appendix 1 for how I defined social class.

Both Clive and Steve positioned their choices as rational and directed to the future. They show no doubt that some choices are the best or most "helpful" ones; it is a matter of locating them once you "actually" leave abstract adventure time. For Clive the responsibility of the choices is his own but he makes them by consulting others' judgements, and these are presented as inherited codes he has access to. Steve not only takes responsibility for choosing rationally but positions himself as somehow having to close the gap between educational success and his personal goals. Like other working–class students, he recognises the educational practices that are necessary for material success (Reay 2004), but also sees that in following them he risks alienation from his dream of being "hands-on" and subordination if he does not pursue them whole-heartedly. The different positions they take with regard to 'closing the gaps' within educational adolescent time-scales exemplify the different costs and dis/identifications required when students of different classes articulate similar discourses of social and personal mobility (Archer and Leathwood 2003; Leathwood and Read 2009; Reay, David and Ball 2005; Skeggs 1997, 2004).

One possible way of making this balance is to present oneself as having characteristics desirable in both school and work. In year 12 Steve uses mathematics as a context for positioning himself as persistent, able to concentrate (in the present) and compelled towards eventual success:

> Once I get started, if I can't actually work it out then I'll keep on going till I've worked it out. So I often can't actually stop until I've worked it out, cos it annoys me that you don't actually know the answer. So you can carry on with it.

He cites his mother's view that pushing yourself is more important than examinations: "She never believes that they're actually like set in stone so she only really looks at the effort that I'm putting in". However this changes by year 13, when in an email Steve looks back and describes A-level Mathematics and Further Maths differently: "I could try really hard and do loads of work and yet sometimes I still just didn't understand some parts of it". Time was no longer a means for him to demonstrate persistence. Instead he positioned it as a scarce resource in calculations for the future: "in terms of maths everyone is having to decide whether the amount of work involved is necessary and worthwhile for them". When he found that mathematics was not necessary for his preferred university course, he decided that the time "to achieve an average grade would be better spent on another subject to make that a high grade". Steve produces himself as compelled to succeed, and this is supported by his mother, teacher and friends. He participates in the pedagogically desirable practices of persistence and working to change and invest in himself However this accomplished joint production was not strong enough to outweigh the competing practices of spending time wisely according to the technology of examinations.

These two examples show how subject choices are not simply influenced by aspirations for the future but framed in terms of normative technologies of choosing/ applying and becoming. These technologies produce few tensions for Clive who treats them as an exercise of inherited social capital (Bourdieu 2004), not requiring any change in himself. Steve's attempt to shape himself for an entrepreneurial future, although neoliberal in its intent, is not sustainable. Reay (Reay 2004; Reay, David and Ball 2005) explains how school discourse facilitates self-discovery but makes radical transformation difficult. These are classed patterns that apply not only to schooling but work. They are similar to Brown et al.'s (2004) 'player' and 'purist' discourses of contemporary graduate recruitment, the first concerned with positioning oneself against others, the second concerned with achieving meritocratic worth and the 'right fit' between self and job. The recent middle-class push for 'marketisation' over meritocracy in selection (Brown, Hesketh and Williams 2003) legitimises the use of social capital, including practices of the self, as assets in credential competitions (Ball 2001; Ball and Vincent 2007).

Across my participants, nearly all students suggested that there were other goals than top examination grades, but middle-class students like Clive were more likely to actually deviate from that pursuit, citing compensatory benefits such as 'hard' subjects and personal drive that they were sure would be valued by universities and employers. Steve's aspirations are framed in a working-class background and require him to rely more on himself (Reay 2004). There are no school technologies of time that support his version of the 'self-made man' in becoming: he is still a child or already an adult (perhaps both, and always a 'he'). So in describing his experience of choosing subjects, Steve struggles to be an authentic, developing adolescent. He falls back on examination results as the legtmate way of knowing 'who he is' in school discourse, and spends his time in a way that shows him acting to improve.

For some students, the discourse of modernity helped situate them within a universally recognised context of global and social progress. 007 is a British-Filipino whose parents had moved to England to work in the NHS. He had thought about working in medicine or engineering and gave a classic modernist response when asked about his career choice, one that controls risk and purpose:

> Cathy What do you think is most important to you in choosing a career?
>
> 007 Job security and it's useful. It's useful in the world, because engineering stuff help us build...[14] help us progress in the future. For example, steel engineering is cars. Constructing buildings. And medicine because you help people get better.

Utility is associated with modernity and stability so choosing a 'useful' job may be 007's defence against the anxiety of insecurity. He has none of the trust in his social and cultural capital that Clive shows, nor Steve's reliance on being known as a hard-worker. I suggest that technological utility is also associated here with progress towards increasing freedoms and wealth. One of the jobs 007 considers is to be a doctor, a choice that continues and improves on – builds on - what his parents were able to achieve. However, as for many working-class urban youth (Archer, Hollingworth and Mendick 2010), medicine has the status of a dream job that he may well not attain (he is retaking year 12) so he has other options: "if I don't do medicine I'd like to do something mathematically related to medicine, and engineering seems like a good prospect". It may be an idiosyncratic figure of speech, but in the context of this exchange the "mathematical" relationship between engineering and medicine arguably stands in for all the individual benefits of security and status he hopes to gain from modernity. For 007 the discourse of modernity links his parents' progress to his own, maybe better, prospects and ensures that mathematics is an inheritance not just a useful individual tool (Nixon 2006; Walkerdine 1988).

I have chosen these excerpts to show the dominance of the discourse of moving/improving in students' talk about choosing subjects. Despite their similarities in the way that students cast their choices as guiding trajectories, there are differences that relate to aspirations, cultural backgrounds and how this discourse of modernity constructs gender, class and ethnicity (Atkinson 2007a; Ball 2010; Ball, Maguire and Macrae 2000; Devadson 2006; Furlong and Cartmel 2007; Reay, David and Ball 2005; Skeggs 1997). In Steve's case I have also shown the failure of his attempts to produce an identity that experienced time and mathematics in a way that allied him with persistence in the present rather than speculating for the future. Although he initially rejected the power of school to affect his future in self-employment, he is compelled to take up a different relationship

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[14] I use ... in the transcripts to indicate that a phrase tails off, apparently unfinished.

with time by the powerful economy of examinations. In the next section I look more closely at how mathematics has a particular role in framing individuals as steadily progressing and how further mathematics troubled this association and thus disrupted students' use of mathematics to secure their futures.

5.2.2 Are mathematics and further mathematics safe?

The data I introduce next came from the task of selecting three adjectives that applied to mathematics and three that did not, repeated for further mathematics. Figure 5.1 shows the twelve adjectives in word-clouds so that their relative size indicates the frequency of selection (by 21 students, see appendix 4.6 for details, colour irrelevant). The images show that mathematics was considered *safe*, *straight* and *hopeful* while further mathematics was emphatically neither *safe* nor *straight* but instead *new* and (more) *hopeful*. (It is also notable that *talkative* was regularly chosen in all the response categories. My observations and the students' explanations suggested that this choice matched their classroom practices, as I discuss in the next chapter.)

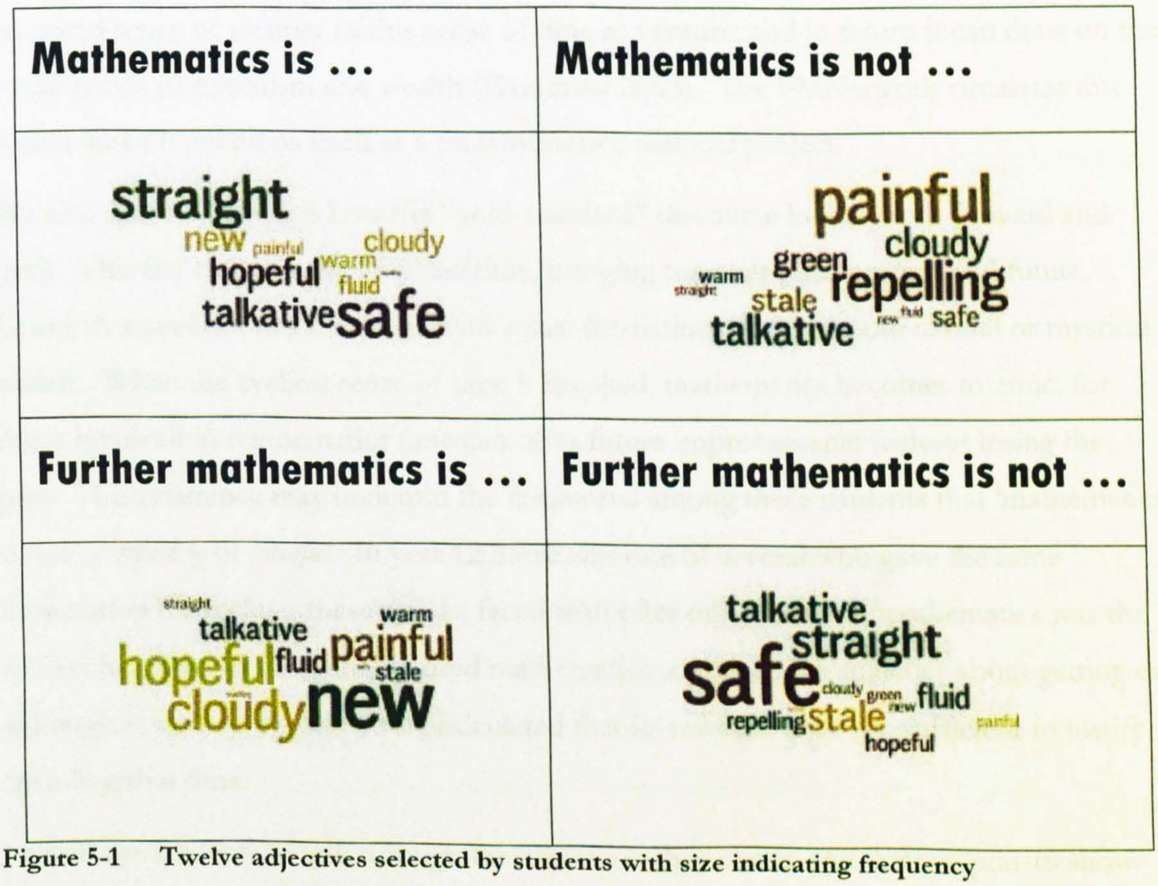

Figure 5-1 Twelve adjectives selected by students with size indicating frequency

All four adjectives that change between mathematics and further mathematics convey a sense of time moving on: *straight* and *safe* give a sense of endurance and longevity, while *new* and *hopeful* suggest speculation. Harvey (1989) offers a useful deconstruction of the multiple senses of time entwined in discourses of modernity and considers how money, time and space function as "interlocking sources of social power" (1989, p227). He extends a typology originally developed by Gurvitch (1964), characterising eight senses of time: enduring, cyclical, in advance of itself, deceptive, erratic, retarded, explosive, and alternating. I recognised three in this context of further mathematics. Here, *straight* and *safe* fit into *enduring* time: found in the social formations of families, traditional education and inheritance, and marked by easily quantifiable progress from past to present and future. The practices of mathematics that produce mathematical ability as innate (Mendick 2008; Solomon 2007a) and those that confer entitlement all contribute to this sense of natural (heterosexual) longevity. Recall, for example, the promotional materials in Chapter 4 where policy-makers ally themselves with STEM experts to enlist the next generation as leading Britain's future.

New and *hopeful* fit into *time in advance of itself* (also described as "pressing forward"). This is the sense of time found in speculative capitalism, where the future triumphs over the present. Mathematics underpins the language of market economics: it offers control and a co-opted sense of security to this sense of time as venture, and in return it can draw on the social goods of optimism and wealth (Woodrow 2003). The FMNetwork circulates this power when it positions itself as a transformative national project.

We also saw in Chapter 4 how the "gold-standard" discourse looked both forward and back. This fits with a sense of *cyclical* time, bringing together past, present and future. Gurvitch associates this discourse with social formations that promote natural or mystical beliefs. When the cyclical sense of time is invoked, mathematics becomes totemic: for those involved in mathematics time can offer future improvements without losing the past. This assurance may underpin the consensus among these students that 'mathematics is not ...' *repelling* or *painful*. In year 12 Steve was one of several who gave the same explanation for picking these words: faced with piles of homework, mathematics was the subject he chose to do first. He used mathematics to reduce his anxieties about getting on, although as we saw by year 13 he calculated that its rewards were not sufficient to justify spending that time.

I asked the students to talk through the adjectives they chose, and their responses show how these discourses move from social to personal. For example, Joe is a White working-class student from Capital, only the second in his extended family to go to university. He gives a typical explanation that mathematics is *safe* because it ensures progress:

> Safe, because if you do maths it is the subject where you know you can get something out of it at the end of the day. You know you are guaranteed to go somewhere. Like you go, you apply for a job, if you studied maths at university you have, like, you're certified maths. I don't know it's probably, I think it would be anyway, if you've got like at least like a B or above you know in maths, they are going to look at you and think like you know, he has got something there.

Like Clive, Joe is aware that others will be scrutinising him in the future. Unlike Clive, who confidently owns the technologies that will produce his identity (talking about "my" forms), Joe expresses his security least strongly in his knowledge of the grades "they" want, and most strongly when he disappears into the subject – claiming "you're certified maths[15]". Joe positions mathematics as having this totemic function of guaranteeing improvement, and he identifies with mathematics when he needs to associate that progress with himself. He strengthens the guarantee when he also describes mathematics as *fluid*:

> because like when you learn one thing it goes on to another all the time. You are always progressing slightly. It gets harder as you go on through, yes.

Here the continuity of past going to present and future is emphasised, producing a sense of *enduring* time that suggests quantifiability, dependability and inheritance, but also of *cyclical* time in the ebb and flow of his repeated statements. There are echoes of the discourse of slow expectant development in "you are always progressing slightly", and in looking ahead to the endpoint of "hard" adulthood. This combination of linearity and repetition, and the ambiguity over who/what is progressing – you or/and mathematics – also appeared when students described mathematics as *straight*:

> Straight because sort of the way the course runs, you sort of run straight through it and each bit will use everything you've used before so you have to sort of you know, straight through it. (Paul)

Here again the repetition conveys both *enduring* and *cyclical* senses of time, with "each bit" in the future/present revisiting or (in Brown's (2001) terminology) inspirited by "everything you've used before" in the present/past. These metaphors of progress in mathematics have been noted before (for example, Gerofsky 1997) and seen to be relevant in students' choice making. Mendick (2006) shows students borrowing from the discourses of mathematics as hard and rational masculinity to prove something about

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[15] Although Joe's transcript allows a reading of ownership, "you have [like] your [certified] maths", the audio suggests that "like" interrupts the phrase, which starts again from "you're" with the stress on "certified", inferring identification.

themselves. Here they produce their experiences of mathematics as steadily improving and borrow them to secure their own futures.

I have tried to unpick how different senses of time combine to position mathematics as offering safe progress, but students themselves summarised this concisely in the reason they gave for choosing both further mathematics and mathematics – that they had always been good at it, that their ability, once gained, was timeless. When I asked them if they had any memories or images of themselves doing mathematics, many gave examples in which parents, especially fathers, engaged them in mathematics, so that mathematics was indeed an inheritance that endures.

We can see this with Joe who, as we saw above, saw mathematics as a guarantee of safe progress in the future. His account of choosing mathematics relies on a forward-looking strategy to position him as taking on the responsibilities and freedoms that his family have given him. He couples this with a strategy of looking back, and suggests that his choice of mathematics was partly handed down by his dad:

> Joe Yeah so it's like my whole family have got expectations of me. They don't force me or tell me to go into this or that. They just take it. I think they know that I will make the best decision for myself. The only thing I can say is that my dad, he was really good at maths you know. Even when I was young he used to do maths with me, and he actually made me quite competitive, I feel, in that sense....
>
> Cathy Yes.
>
> Joe which was... quite a good thing to be honest. Like when you compare with, it makes you work a bit harder. You don't like other people doing a lot better than you and stuff.
>
> Cathy So does he do maths in his job?
>
> Joe No not at the moment no. He was just naturally good at it

Here Joe positions his father as passing on mathematics practices that produce Joe as competitive and aspirational. These continue in Joe as he makes his own decisions, and the hand-over is more complete because Joe's father now lives in a hostel because of deteriorating mental health. He acknowledges his mother as a strong presence concerned with "maintenance", that is the concerns of the present, but distances her from his school work:

> Cathy And how about your mum? Is she interested in maths? Or not at all?
>
> Joe My mum is interested, obsessed with herself and the house you know. It's like maintenance. My mum is very maintenance. She cares about me and my education a lot,

yeah. But when it comes to ... like I could never ask my mum anything about my work. My mum would go 'I just can't help you, Joe. I really can't help you'.

Later Joe returns to doing mathematics calculations for his dad as being the source of his good feelings about mathematics: "I remember we used to ask for more as well. I used to go up to him and say 'Dad can you give me some more questions?'". These memories position Joe within the family but also as agentic. Mathematics is inherited *and* it prepares him for the challenges of adulthood. This looking both ways associates mathematics with the expectant time of adolescence: it progresses without arriving. It keeps his father as a daily presence in his life even though he is not in the family home.

007 also responded to my question about any memories or strong images of working on mathematics in the past in terms of his father:

Well, my dad teaching me... Like my dad, yeah, he was trying to teach me long division when I was ten years old, I think. Yeah, ten years old and he was trying to teach himself first before he could teach me. And then he taught me and then I just couldn't get it at all, the way he taught me.

Like 007s career choices, this account again positions his education as a shared family project with the aim of progressing beyond his parents. Although family time is taken to be pleasurable, this memory was also painful because 007 did not 'get' long division at the time, though he jokes that he eventually learnt it at A-level.

Another example relating mathematics, progress and family comes from Michael (cf Chapter 8). Both Michael and his sister do mathematics "for" their father who "has a passion" for mathematics and politics that Michael attributes to the discontinuities experienced in migration:

Michael He migrated over from Vietnam and ever since then he has just been reviewing maths with me and he has been teaching me since a young age. I have learned quite a lot from him, yes.

Cathy So did he do his further education in maths?

Michael I am not quite sure. I mean he has got, he knows a lot of maths and everything past A-level but he hasn't got the qualifications for it, that's why. So yeah, he is a bus driver right now and. But he knows quite a lot. But he hasn't got no qualifications for teaching. He uses that time to teach me when we are at home.

Cathy That is fantastic. And your mum, is she interested in maths?

Michael Not really, no. I mean she knows a bit but no, she doesn't take an interest in maths.

Cathy And have you got any brothers and sisters?

Mchael yes I have got a younger sister. And she is quite keen on maths as well, for my dad obviously.

Although there are disturbances in these stories, the common thread is that mathematics, and mathematics ability, endure and improve from childhood to adulthood, and from parent (usually father) to child. This dependability of mathematics is also significant in the next chapter as it plays a role in students' strategies for balancing work and happiness.

Since students gave ability as a reason for doing both further mathematics and mathematics, they might have expected that learning further mathematics would provide similar opportunities to demonstrate personal progress and inherited choice. In the next section I show that instead it produced rather different senses of time, which explains why it was considered neither safe nor straight.

5.2.3 The possibilities of further mathematics

As we saw in Figure 5.1, students' sense of time as personal/mathematical progress was disrupted in further mathematics. Joe again exemplifies the common responses, describing further mathematics as *cloudy*, *new* and *hopeful* and not *safe, straight* or *fluid.*

> Hopeful: because like when I started it I was I hoped that I would do good in it. I knew it was going to be difficult. In fact it's probably the most difficult subject that you can pick up at A-level I think. Yes and I was hopeful that I would do well. (Joe)

This hopefulness was directed mainly towards assessed work. Like many of the students who gave up, Joe said he "felt good" about the questions in his first AS Further Maths module but when the results came he found he did not "have a great grade". He describes this disconnection between present experience and future outcomes as "strange" and "tough", and it is this deceptive, unpredictable quality that he links to giving up further mathematics, rather than its difficulty. In fact, as in this excerpt, Joe consistently construed difficulty as a reason *for* choosing further mathematics. Even Charlotte, one of the highest achieving mathematics students, echoed the uncertainty of further mathematics in homework as well as examinations:

> It is more hopeful. Probably the one that I was always a bit uncertain. So I was more hopeful that I will understand. I usually just hope for the best when I do questions, because I like, in Further Maths I find it difficult to know if I have got it right or wrong. So it is more just might write it down and hope for the best.

The progress and predictability experienced when working through mathematics questions is absent, and this lack is what she (at least temporarily) finds "difficult". "Hopeful" was thus a way of talking about further mathematics that positioned students flexibly. There is a risk that their progress might not be ensured by further mathematics. By hoping, they could be seen as confident to take the risk, or as not fully responsible because they are naturally unable to control risks, or as sensibly never entirely committed to an uncertain journey. It was not simply the case that students who continued found further mathematics predictable, and those who did not find it predictable gave up; all students struggled with the tensions of hope. The practices of further mathematics resisted the discourse of safe, dependable progress that they used to characterise mathematics. Whether the students gave up or continued, this resistance was complex with both precarious and productive possibilities.

5.3 Doing extra and getting ahead

The tensions in further mathematics bring me to the second discourse used by students: *getting ahead*. As we saw above, Gurvitch's sense of *time in advance of itself* is associated with speculation and risk, using the present to compete for the rewards of the future. I argued above that when students said they chose further mathematics because they were good at it, they drew on senses of *enduring* or *cyclical* time that conferred natural rewards. There were two more reasons they commonly gave for their choice: further mathematics is an 'extra', and further mathematics gets you 'ahead'. Both these make use of the sense of *getting ahead*, and they show how the 'hope-full' challenge from further mathematics can function productively.

Doing extra positions students as consuming time in a way employers will like. It indicates the value of activities that run alongside what is seen as normal progress. Doing extra is not a guarantee in the way that straight mathematics is, rather it concerns appearance and impressions, "looking", "sounding" and "wanting":

> And it sounded good, and they said at the interview that it was a very respected subject to do, because it's sort of extra on top, it showed you're doing more, and employers like it apparently. [...] I always like to do that sort of thing because it helps you along. Employers think 'Oh they tried extra so they can do the extra bit, good', again looks as though as though you're doing extra. And universities should, I hope, will think that as well. That's why I do them. (Clive)

> To start with I did it because it was an extra A-level and I thought it would look good, to be honest. (Charlotte)

> Because it's an extra one, people who have picked it actually want to be doing it. (Steve)

As with 'hopeful', further mathematics being 'extra' was used flexibly, both to justify choice and also as a reason not to worry about achievement. Many students are very clear that they *should* try to do extra, positioning it as a practice of the self compatible with self-entrepreneurism. This does not mean that doing extra is necessarily about standing alone, instead it can indicate belonging to a group. Steve's people who "actually want to be doing it" are a powerful group of students because their participation has the effect of sustaining after-school FMNetwork provision. Clive's comments, too, stress visibility and continuity, and position him as accessing shared rather than esoteric knowledge.

'Getting ahead' has a similar purpose of distinguishing oneself, but here further mathematics is constructed as accelerating the normal linear progress of mathematics. Many students had heard from family, friends or teachers that further mathematics resembled university work. Studying it positions students in the present as "one step above everyone else". Moreover, they can use this advantageous knowledge to secure a "head start" and project themselves into the future.

> If I've already learned it now it's obviously gonna help me in university. So that's why I think it's a really important subject because it's quite closely related to what I'm intending to do at university. (Simon)

> At university they go straight into stuff... They go straight into the university stuff, they don't give you... They don't teach you the in-between stuff. I am glad I do Further Maths because that way I've kind of got a head start to students who aren't doing Further Maths. (Sukina)

These two comments, from students who chose to continue further mathematics, show the rationality and the pleasure in this reasoning. Doing extra and getting ahead accelerate the staged progress of mathematics, and move students more quickly towards the next stage of university. Another continuing student, Paul, explains how this changes his relationship with risk:

> sometimes like with Further Maths, not knowing and not being too safe, it makes it more interesting and challenging but sometimes with things like psychology it can be frustrating.

Paul makes an important distinction between the "not knowing" that is interesting and that which is frustrating, thereby setting up a dualism between autonomy and constraint. This relies on the existence of the underlying sense of progress in mathematics. We can see the contrast between his description (p 113) that mathematics "runs straight" but psychology lacks inherent and personal direction:

I'm not sure it's doing much in the way of like other skills and thinking about things too much. I guess it does a little bit but most of it is common sense, all about the exam technique and actual just sitting there and learning the studies.

These connections and contrasts suggest that the discourse of *getting ahead* builds on the discourse of *moving/improving* and the neoliberal focus on employability and transferable skills (Hesketh 2003). It distinguishes students who promote themselves by adapting and escalating the temporalities of staged adolescence. The unusual practices of the FMNetwork are cited in support of this disruption: it is out of school, you can email tutors, you learn "quicker" than in normal mathematics, "it is up to you just to know" how to behave. These are all ways in which further mathematics projects students towards adulthood.

In the last two sections of this chapter I examine first how the discourse of "getting ahead" is challenged by students on the grounds of inauthenticity, and then how it can be used productively.

5.3.1 Bright lights and maturity

The discourse of doing further mathematics as *getting ahead* was valued by all the students, including those who had not chosen it. It also raised the strongest opposition, when students who had chosen to drop further mathematics questioned the maturity of those who had continued. They presented the *getting ahead* argument as illusory, an unrealistic view of what can be achieved. In this excerpt from year 13, Tom and AgentX looked back at further mathematics and contested the discourses that led to their original choice:

AgentX I kind of thought about it as kind of bright light syndrome. You hear about Further Maths and you ... You know, I heard it from somewhere that it was nearly degree level mathematics.

Tom It's because it's worth more.

AgentX Is what I heard. So I thought to myself 'oh that'll be good', you know universities would like that.

Tom That's the lure of that. People that are doing any sort of standard A-levels almost, it's like some sort of... Maths, Chemistry, Physics is a common one, Further Maths is something that's... something that's more, that's extra. I mean the other things are something like D of E[16] and stuff, you want as much as possible to distinguish you from other people. So Further Maths being worth more and being widely considered the hardest A level, by doing that you're showing that you're ambitious and that, you're sort of the top level of student. So that's why a lot of ... Well I know that's why I chose it.

Tom and AgentX aspired to careers in the engineering/computing industries, similar to the kind of work their fathers do (Jimenez and Walkerdine 2011; Osgood, Francis and Archer 2006). After AS-level results they had decided to concentrate on their "core" subjects and not to continue Further Maths. Tom describes the "lure" of further mathematics as still present, still "being" there, but goes on to construct his choice to drop it as understanding his own limitations and "sacrific[ing] one thing to be better at other things". To do so he opposes the pragmatic (work he does see the point of) to the theoretical (further mathematics topics such as complex numbers). This is lined up with the temporal frame of aiming for realistic grades now rather than possible superiority in the future. Thirdly, as we saw earlier, steadiness allies mathematics with the certainties of modern progress. Here this purposeful slowing down is associated with authenticity and opposed to the 'getting ahead' and illusion of further mathematics. Tom and AgentX both articulate giving up further mathematics within the neoliberal practice of finding their authentic selves (Francis, Skelton and Read 2009; Lawler 1999; Reay 2004; Skeggs 2004).

Together, these oppositions construct a dualism similar to the gendered and classed dualisms between the natural child and the civilised adult, or between earning and learning found in the talk of urban working-class 16-year olds (Archer, Hollingworth and Mendick 2010). Within these discourses, 'core' subjects including mathematics are aligned with practicality, masculinity, authenticity and steadily becoming adult; while further mathematics with theory, illusion and precocity. There is one mismatch in these oppositions: usually, when the academic is opposed to the practical it is feminised. Further mathematics could equally be feminised by this discourse of "lure" and "bright lights" but, in the end, it is still mathematics, and so Tom returns to the language of "hard", "ambitious" and "worth more". Tom and AgentX do rehearse some ways in which mathematics and further mathematics are different but I suggest they cannot successfully challenge from within mathematics without undermining their own position of authentic masculinity (Davies 1989|2004; Francis, Skelton and Read 2009; Halberstam

[16] Duke of Edinburgh: a scheme that organises and makes awards for extra-curricular activities such as volunteering, physical activity, learning new skills, and outdoor expeditions.

2005). The apparently impervious masculinity of further mathematics turns their opposition into ascribing illusion predominantly to immaturity.

AgentX and Tom are attached to maturity and this is evident in the way that they showcase their use of school planners, targets and deadlines to demonstrate that they are becoming independent, disciplined and mature:

> Obviously as you grow up you become more mature. You appreciate what you've gotta do. So I think that's vitally important that you know, you understand the work you've gotta do. I suppose disciplined as well really. You ... as well as being set deadlines in your job, or set deadlines in your course, you need to set yourself your own deadlines, give yourself goals.

They contrast these attitudes with those of their friends who have continued struggling with further mathematics. Agent X also contrasts it with the precocious demands of the FMNetwork for independent learning: "really we shouldn't have been made to do that anyway, should we, at this age? We're still in A-levels". Whereas 'becoming' mature is desirable, precocious claims to 'get ahead' are inauthentic, taking them away from their age-based selves. Although they agree that further mathematics is "the hardest A-level", they dismiss their friends' lower grades in it as proof that they are "immature" and "lazy", allowing the examinations to speak more strongly about the persons than the subject-choice. This construction reproduces a discourse in which the lure of further mathematics is only permitted to the young or the clever, and they also contest that distinction. Using the metaphor "bright lights" suggests that cleverness may in fact be a self-deceiving performance that is as naïve and unrealistic as celebrity or the entertainment industry (an allusion supported by Tom's reference to "the lure of" the subject). It is used as a forgivable excuse for the young but not for one's peers or oneself.

> There's a lad I worked with who's in Year 12, and he's doing Further Maths, exactly like I was when I started it. I think he's cleverer than me, or than I was in Year 12. But he's not… And he tells me. He's got that look in his face, he says 'Oh I'm doing really good; I'm doing Further Maths'. So I think he's kind of got hit by bright lights as well if you like. But I think he'll be alright at it because he's quite clever.

I have given these extensive examples of Tom and Agent X's judgements because they illustrate how time-related discourses of mathematics as 'safe', 'straight', and further mathematics as 'doing extra' and 'getting ahead' strengthen each other but also inspire oppositions and resistance. These tensions have to be revisited in one's own neoliberal identity project if one considers leaving the subject. AgentX's and Tom's talk shows how negotiating these tensions involves practices of the self that construct maturity alongside gender and class (Archer and Leathwood 2003; Currie, Kelly and Pomerantz 2006; Skeggs 1997; Swan 2005). As with adolescence, doing further mathematics gains meaning in relation to its end points, so that student claims of being advanced are precarious, and can change rapidly into a lack of control signified by/as immaturity. This has strong effects for many students (like Tom, AgentX or Steve) who used mathematical claims to position themselves as practical, progressive future earners, and found instead that further mathematics positioned them as over-civilised, over-accelerated learners, distanced from their "authentic" selves (Francis, Skelton and Read 2009; Jackson 2006a).

5.3.2 Further mathematics as precocious/immature

As we saw earlier the *getting ahead* discourse positioned further mathematics students as accelerated in their maturity and drew evidence from the independent learning practices of the FMNetwork. Maturity was seen both as being prepared to do a lot of work outside school and as accepting realistic goals for what they could achieve. When further mathematics students were judged within the context of mathematics, this accelerated maturity showed them as successful. My analysis of AgentX and Tom' s identity work, above, showed a resistance that retained maturity and rationality for mathematics but used the discourse of dangerous precocity to associate further mathematics with illusion. This interpretation was supported by other students and by the wider discourse of adolescence. In their comments about each others' choices , the most successful students were described, and described themselves, as missing the "play" appropriate to their age, no longer having a social life or appropriate adolescent interests in sport and television. This certainly revisits some of the 'born mathematician' discourses current in schools and is consistent with social representations of mathematicians (Mendick, Moreau and Epstein 2007). For the most part however, this disruption of time was represented not as natural but as a decision: a loss to be regretted rather than an incapacity to value anything outside mathematics. It signified students' heightened attention to the future and the rewards of progress more than a desire to appropriate the social incompetence and isolated heroism of 'geek chic' (Mendick 2006). In Chapter 7 I follow three students who use the separation produced by altered temporalities and others' reactions (as well as other discourses of further mathematics) to position themselves as individuals who can exceed the expectations of those around them.

There were also examples when students actively produced a sense of themselves as precocious in mathematics, welcoming the flexibilities involved. For example Charlotte describes her mathematics as disrupting, in a gentle way, the regular rhythms of family Christmas:

> Actually, this is the sad thing. I have got, my dad bought me for Christmas "How to cut a cake", the book about algorithms, and I think he thought I was going to put it on the shelf, but I actually started reading it on Christmas Day and it was actually very interesting.

Here she can be both a child and a precocious mathematician, simultaneously inheriting mathematics from her father and striking out on her own by "actually" reading mathematics in social family time. Positioning herself in this way identifies with the disrupted temporalities of further mathematics, claiming the advantages of progress and the disadvantages of immaturity. I suggest that this is more possible to her because she is a young woman. Male middle-class 'nerds' do not need to 'grow out of' nerdiness and their ability in mathematics is portrayed as eventually evoking female desire (Mendick 2006). However female nerds must be redeemed: both extended adolescence and a passion for mathematics are incompatible with adult female sexuality. Girls who choose mathematics have already encountered some of the possibilities of resisting the highly-sexualised norms that produce femininity. I suggest that when in addition they choose further mathematics there is no great increase in the threat of 'further' immaturity being read on to them, and that in any case immaturity for any young woman is transient. Eventually there will be all sorts of difficulties in maintaining a life as a woman mathematician (Day 1997), but the recognised existence of these constraints-in-waiting has the side-effect of removing some of the accountability that choosing further mathematics incurs, and this in itself can be productive.

Charlotte introduces her story as a confession, aware that in a discourse of connected femininity (and consumerism) "this is the sad thing", but it is in effect a claim that she is an authentic mathematician and seen as such by those who value her authenticity. I suggest that Charlotte's anecdote situates her in her family, the recognised context both of childhood and of inherited adult femininity, because this gives her permission to do further mathematics as a form of precocity and also protection while she hopes it will work out. It is also interesting that Charlotte does not bring her mother into this story as another parent figure. Elsewhere she describes her family as "My mum is not at all [mathematical]. She is English lit, and Art and my dad is kind of more practical." While her mother is clearly a strong presence in her education, she is not highlighted in Charlotte's anecdotes about loving mathematics. Discursively, she stands for an alternative female futurity that Charlotte does not associate with mathematics. Mendick

(2003) discusses how girls and boys do mathematics as masculinity and there are similarities here with how Joe (above) as well as Michael, 007, Clive, Paul, Mario, Steffi and Helen (see later chapters) position their mothers as strong presences when they make educational choices but not tied discursively into mathematics memories and practices in the same way as some fathers are.

I want to finish by connecting this with the story of another student, Sukina, who I read as negotiating a trajectory that also projects her as precocious within mathematics but as immature outside it. Sukina presented herself in her interview with a very clear account that she is naturally an exceptionally conscientious student who is enabled to show this through mathematics and science. A second overall theme was the comparison of her route through education as running parallel with her elder sister's, and influenced by the "great inspiration" of her sister's husband, a local science teacher. In Sukina's talk, her past, present and future are connected by the two themes of getting ahead and helping others. She started AS-level mathematics early after she and a friend attended an acceleration program with a local university. This gave her a status that allowed her to replace her mathematics teacher: "When he used to pop out of the class, we used to go and tell them 'It is like this, it is like that'". Sukina was the only one of 50 students on the program to attempt an AS-level module in year 11, and it encouraged her to try Further Maths. In her mathematics A-level lessons her teacher boosts her confidence and she feels "We're as good as teachers. We could only be as good as the teacher, we are learning from them". Similarly she values her FMNetwork tutor's expertise and how she explains the course and exam techniques, sharing the examiners' thinking. These features of Sukina's account positions her as accessing adult expertise within mathematics.

Sukina is considering becoming a mathematics teacher, which she explained animatedly as something she enjoys, that has status within her Bangladeshi culture and *should* have higher status in modern society: She connects her choice to the support of her brother–in-law:

> He helps me a lot and I respect him so much and even though he is my brother-in-law, he is like my own brother. So for that reason I really want to see myself like that, you know teaching and having that relationship with the students. Having people look up to me and pass ... pass their exam because I helped them out and I taught well to them... I taught well, and it is not always about you being able to learn well it is about the teacher teaching you well. So I want to be part of that, be part of ...a successful student, I want to know that I helped them out and I was part of... Just fulfilling for myself. It is rewarding. I know teaching isn't... It is not that highly looked at in terms of career in this society, in this day and

age. But to me teaching is just... is one of the most rewarding jobs. I mean I look at it as you end up building up the future experts.

At the end of this quote Sukina challenges "this" society, day and age, evoking a discourse of neoliberal progress that constructs her as moving away from her Bangladeshi culture and her position as a daughter (Butler 2008). She balances this in her account by repeatedly referring to her "inspiration" and "respect" for her brother-in-law, who teaches Science in a local school. Early in the interview, Sukina tells her elder sister's story as a parallel with her own. Her sister left education at 16 to get married abroad but returned after her marriage, first working as a teaching assistant and then returning to study at a local college:

> And then now she's doing her A levels. So she's... she's doing the science as well. She is doing science and stuff. So we're in competition. I told her Yeah, you know. See who gets more than you. She's older though, but it'd be nice to get better than her.

This is a happy ending in Sukina's story, combining both family and education, and she makes the same alignments in her own story, so that her mathematics class is "like a little family" and she recalls her further mathematics tutor saying "You are my girls. I am so proud of you." when they spoke at a revision day. I suggest that for Sukina becoming a mathematics teacher is a way in which the expectant time of adolescence can be extended into adulthood without meeting coming-of-age rituals such as leaving school or marriage. Being advanced in further mathematics and being aligned with the FMNetwork positions students as ahead of school, nearly-already part of university mathematics.

It is reasonable to consider Sukina as experiencing frustrating tensions between the timescales of cultural expectation and educational aspiration, but this returns us to the confines of the psychological. Butler reminds us that the hegemonic discourse of western modern progress relies on symbolically positioning Islam as fixed and "anachronistic", entering 'our' time only to disrupt it (Butler 2008). Ahmed (2008b) suggests that stories of migrant families usually represent the conflict of generational want as over-determined, requiring a narrative of reconciliation between the parents' wants (associated with the past and the culture of origin) and the children's wants (where we are now). So here too, it is easy to over-play a generational clash whereas many class, social and gendered identities are coming into play. In fact Sukina rarely mentions her parents in her interview, talking instead of her own generation in the family. Her story is more subtle, with further mathematics constructed as both progressive and traditional, moving her on towards adulthood but keeping her in the asexual world of the teacher. The tensions relate to discursive positionings of high-achieving, female Bangladeshi students that are not fixed but changeable "as Bangladeshi young people accept and modify some traditions and forge new cultural identities" and with an increasing range of occupations accepted as "decent" and "prestigious" (Smart and Rahma 2009, p10).

Although Sukina presents herself very strongly as belonging with/in mathematics, this position can very easily be threatened, as she found when she visited a prestigious university admissions event:

> I said to him 'I am doing Further Maths at AS out of college. Can I still apply for maths?' He said 'No. You need Further Maths A-level'. And then he goes 'You can take a gap year and finish it off'. And I'm like 'how dare you. Take a gap year to finish off Further Maths'! And then he goes 'Frankly we get enough students doing Further Maths A-level'. I was like 'Right I don't want to come anyway'.

This tutor dismisses any notion of AS-level Further Maths as 'getting ahead' by adding in an extra year of study. Although a "gap year" is part of the adolescent story for White middle-class students, and perhaps for this tutor, it is unthinkable for Sukina. The "gap" in her sister's education is precisely what mathematics can help her avoid. Sukina introduces a real disconnection here, positioning herself as forging her own way of getting ahead that draws on aspects of both traditional and institutional cultures while recognising their constraints. On one side, a traditional family timescale schedules education first and then social maturity (Smart and Rahma 2009). On the other side there is an episodic timescale of education in which academic and social progress go hand-in hand through predictable stages. A gap year is an effective way of making progress in "the economy of experience" that is known to exacerbate socioeconomic differences (Heath 2007). Sukina welcomes the neoliberal aim to have a career that is personally fulfilling and describes her choice of mathematics as one of becoming more mature, adult and self-aware:

> Everyone wants to do medicine at first and then I really thought about it. I thought no I don't want to do that, I really want to do Maths, so I stuck to it. Definitely I am going to stick to it. Yeah. I would like to teach maths in the future. I mean there is a long time, maybe later life when I settle down I would like to teach maths.

However she rejects maturity that is framed primarily as a social experience of induction into peer society free of past authorities. This relates to her anger when her Biology teacher promoted peer-led research. She speaks of this as a failure to "go through it once with us, properly in detail", an unnecessary preparation "for the social side [of university] rather than the academic [...] Examiners aren't looking to see 'oh is she independent? Let me give her a grade, boost her grade'." Her rejection of peer-led independence has echoes of the earlier discourse of illusion applied to further mathematics: it is a middle-class aspiration that she would be foolish to think applied to her. This is self-exclusion that is rational and yet perpetuates class patterns.

Devadson has examined the discourses of ethnic minority young adults who have successfully reconciled tensions that might position them as "victims of circumstance" (2006, p168). He suggests that neoliberal "life stories of empowerment" do allow them to create individualised trajectories that coexist with persistent cultural structures. I suggest that further mathematics is providing Sukina with such a story. Further mathematics helps her to produce herself as moving on, agentic and predictable, but not yet adult. Sukina's position is a negotiation of the discourses of *moving/improving, getting ahead* and im/maturity, and she makes clear it is not experienced alone but framed by teachers, family members and further mathematics itself. It is a fragile position, not a reconciliation but a wobbly trajectory, as her encounter with the university tutor shows, and in the end she can use the 'extra' status of her FMNetwork AS-level to get an offer on one competitive degree course but not another.

5.4 Summing up

I have used this chapter to introduce my two main lines of argument:

- Students make choices about further mathematics that are guided by a neoliberal model of subjectivity as being engaged in a rational and purposeful project of self-expression, self-discovery and self-control directed towards economic ends.
- It is not the case that different students adopt different discourses of aspiration or mathematics that determine their different outcomes. There are common, contested discourses of further mathematics that intersect with wider social discourses to construct patterns of inclusion and exclusion.

For some students the discourses of authenticity, maturity and practicality that allow them to start further mathematics are also those that prevent them continuing. In order to be worth what it promises, choosing further mathematics demands practices of the self that reformulate meanings of time and maturity in ways that introduce tensions into the neoliberal model of 'doing' further mathematics student. These tensions follow patterns that have implications for student choices and that reinforce wider social patterns of inclusion and exclusion.

We have seen that students choose mathematics and, sometimes, further mathematics to establish a temporality in which they are moving and improving, settled on a safe trajectory to future job security. This sense of time is associated with inheritance, the natural progress of adolescence and the totemic guarantees offered by access to privileged mathematical knowledge. There are two major areas in which this self-positioning can be contested. The first is when students aim to inhabit expectant time in a non-standard way: to experience time slowly as a way of expressing their enjoyment or developing skills suitable for employment. We saw that Steve failed in his attempt to use mathematics as a prestigious - yet - practical means of learning-by-doing. The academic student practices required at A level are incompatible with a "hands-on-learner" identity because they do not point towards adulthood as self-reliance but rather as a time when credentials are exchanged. Ultimately the educational economy of time creates it as a scarce personal resource hypothecated for examination grades. Spending time on developing skills or interests that are not measurable as progress visible to others can only be a luxury.

The second is through the learning experiences that construct further mathematics as accelerated and thus hopeful or risky. In the FMNetwork these contesting discourses treat further mathematics as the distinctive extreme of mathematics. Because it is accelerated it offers possibilities of 'getting ahead'. Choosing further mathematics is thus productive in resisting and adapting the discourse of slow, staged, deficit 'becoming'. It allows students to colonise their future, treating this exploitation of time for personal ends as part of their required identity work in their present. However the adolescent discourse of development is dominant precisely because it includes in itself ways of thinking that answer this form of resistance. Students in advance of themselves are disrupting the normal progress to maturity. They are projected into a state that is both adult and child, where development is both achieved and halted. Peer reactions to their precociousness emphasise that their maturity is an illusion and, by claiming it, they cannot access their authentic socially-maturing teenage selves. There is an assumption of middle-class masculinity underlying this argument, since women, working-class students and students from non-western cultures cannot escape the times imposed by the body. The examples of Sukina and Charlotte show that this does allow possibilities for students to use the local context of the FMNetwork to create spaces of autonomy within extended adolescence, albeit local and temporary.

In the next chapter I develop the connections between choosing further mathematics and the practices of the self constructed by educational discourses. Here I have analysed the social construction of senses of time and how they are used in justifying choices and framing experiences in mathematics and further mathematics. I now turn to constructions of work and happiness which played a similar role in students' talk.

Chapter 6 Work and Happiness

In this chapter I continue to argue that the decisions to participate in further mathematics are closely linked with the neoliberal model of the self constructed by the technologies of education. Time and maturity were two of the important discourses which structured their talk of decision making and identity; another two were work and happiness, and these were also linked. We have seen them already: entering into Steve's account of calculating the pleasure/pain of spending time working on mathematical problems, and AgentX's enjoyment of mastering deadlines. In this chapter I first review the different ways in which modern and neoliberal discourses frame the relationship between work and happiness. Then I introduce four imperatives that arose in students' talk: by imperatives I mean dominant discursive positionings that they could adapt and resist but not ignore. Finally I look at the particular practices of further mathematics that were linked to these imperatives in students' descriptions of their experiences, and I examine which ways of dealing with tensions were effective in enabling students to present themselves as successfully using mathematics as a "promise of happiness" (Ahmed 2010).

6.1 Theorising work and happiness

The relationship between work and happiness is central to 'practices of the self': the processes that inscribe what it means to be an individual within a particular culture (Foucault 1990). For Foucault, work and happiness are simply two examples of discursive concepts involved in practices of the self. I have focused on them in my analysis because of their prevalence in educational discourse, sociological theory and student data. Teachers and students are enormously concerned with managing work: as a synonym for learning, as an output and as a process. We are used to hearing layered messages about work and its goals. In one A-level lesson I observed, the teacher started by reminding students that they must work very hard in mathematics, and then presented the rest of the lesson as ways to make work 'easy'. This was a familiar practice that only became 'strange' when I used a theoretical tool to analyse talk about work. I use this example to illustrate how classroom discourse calls on different constructions of the relationship between work and happiness and that this can cause tensions: is it desirable to make an effort or to avoid it? What desires, and whose, are being enabled by such practices?

Sociological theory offers help in unpicking these messages. The seemingly 'natural' relationship of work and happiness in education is that they are opposed to each other. Analysing the 'spirit of capitalism' that underpins modernity, Weber deems a personal ethic of life-long work to be "irrational" from the "viewpoint of personal happiness". A person acting autonomously would work sporadically and for immediate gratification. Weber suggests that education is the necessary "long and arduous process" (1930, p62) that constructed individuals as the workers of capitalist society. The importance of this theory to me is not its historical accuracy but its lingering discursive power: it positions the uneducated – school children – as individuals who have to be taught to work beyond what they enjoy. Their resistance is assumed but it will always fail because capitalist economics is positioned as inexorable. This relation leaves traces in adolescent discourses such as 'uncool to work' (Jackson 2006b). When students emphasise their opposition to schoolwork, they position themselves both as autonomous dissenters who refuse a dominant discourse and as part of a 'natural' community who find work unpleasant. Balancing both positions allows them flexibility in their contestation of power. In the previous chapter I made a similar argument about maturity: challenging the expectant time of adolescence allows students to be both adult and child (rather than in-the-middle and neither). This resistance to modernity can be co-opted into a neoliberal self-project as it situates happiness in both adult autonomy and childhood authenticity.

This construction of work and happiness as 'opposed' is the first of three constructions that I have used as categories for analysing student talk. I have introduced it as a way-of knowing that challenges schooling; but it is also used to reproduce positions of conformity. A familiar example is the promise of deferred gratification obtained by studying mathematics in order to gain qualifications or a prestigious career. This reconstructs the natural conflict between happiness and work by positioning work in the present as an unhappy experience that can be offset against future gains, but only by conforming individuals. Thus each discursive construction can permit more than one way of positioning individuals; and my analysis examines not just *what* relationship is used but *how*.

My second construction is that of 'managed' work permitting individuals to be happy. Bauman (2001) suggests that individuals naturally find pleasure in their own work, with the key role of mass education being to habituate them to an ethic of working *with* and *for* other people. He sees work and happiness as co-existing for individuals in certain circumstances, typified by independent craftsmen, so it is the *conditions* of work that need managing. In his analysis of twentieth-century western governance, Rose (1990, p119) explores the growth in practices designed to align happiness with work. Schools and workplaces are increasingly structured by "institutional technologies" that mitigate the unpleasant aspects of work: technologies such as ergonomics, fitting the right person to each job, choosing the right subjects. Schools become necessary for this management because they are expert in selecting the right individuals for the working roles needed by society, and providing them with tools and circumstances so they can both work and be happy. The move towards managing work is accompanied by a change in the understanding of happiness not as a passive state, a 'hap' that happens by chance (Ahmed 2008b), but as a goal. These two approaches to happiness are typical of Western post-industrial modernity: "the proclamation of pleasure, or happiness, as the supreme purpose of life, and the promise made in the name of society and its powers to secure conditions permitting a continuous and consistent growth in the sum total of the pleasure and happiness available" (Bauman 2001, p82).

My third significant construction of work and happiness follows from this goal of happiness and the neoliberalism of recent UK (and global) social policy. This position returns us to choice as a way of expressing individual identity, because choosing is itself viewed as work that we do in pursuit of happiness (Ahmed 2008b). Rose suggests that in seeking to explain ourselves and our choices, we equate work *for* ourselves with work *on* ourselves in a "biographical project of self-realization" (ibid, ix). Since work is then both psychological and economic, happiness becomes the same as success:

> The antithesis between managing adaptation to work and struggling for rewards from work is transcended, as working hard produces psychological rewards and psychological rewards produce hard work. Rose (1990, p119)

As Rose makes clear, this neoliberal incorporation of work and happiness into identity work does not replace other understandings but is layered with them. More meanings are possible in the relationship between work and happiness than was the case for time, where time-as-progress underlies both modern and neoliberal policy discourses. I suggest that these three theoretical constructions of work as *opposed to* happiness, *managed for* happiness or *work on the self* allow students to take up multiple and overlapping positions within the discourses of selfhood and mathematics learning. Work and happiness function as discursive tools that we can use in combination to explain ourselves *to* ourselves and to others.

6.2 Imperatives of work and happiness

In my analysis I identified thematic relationships between 'what can be said' about work and happiness and the power effects of saying it. In year 12 interviews, students introduced their un/happiness in further mathematics as a way of retrospectively evaluating their choices. In the same interchanges they introduced descriptions of kinds of work as evidence for these emotions. In year 13 interviews I followed up the preliminary analysis and asked directly when students were happiest and unhappiest in their school work. Students also described their working practices when I asked them about their lessons, and there too the emotional evaluation of these experiences took meaning from (and gave meaning to) inferred or explicit relations between work and happiness.

Individuals used these different characterisations of work and happiness at different stages of talk, in contradictory or supportive ways. I have again used a range of students whose sites, study choices and pseudonyms are shown in table 6.1:

Site	**No Further Maths**	**AS Further Maths**	**A2 Further Maths**
Capital	-	Bob, Joe, Li Mai	-
Grants	-	AgentX, Tom, Rcky	Helen, Randall, Simon
Moorden	Esther	Clive	Charly, Jodie, Paul

Table 6-1 The sites and participation levels of students in Chapter 6

Analysing the students' talk demonstrated their use of four thematic imperatives concerning work and happiness to explain how they governed (or should govern) their lives. These emerged mainly from the discussion of mathematics lessons rather than further mathematics, perhaps because it had the more central position in school life. I look at each of the imperatives below, and return to how experiences in further mathematics contributed to them in the next section.

6.2.1 You have to work:

All the students described how at times they had "to put a lot of effort into mathematics", and found that doing this could be "painful". This opposition of happiness and work was presented as not needing any further explanation. The general question of whether you have to work at mathematics was, however, presented as arguable; it recurred often in their talk and especially in the ways in which they contested their own statements. For example, Charly contrasted the qualities that she shows in avoiding work with a growing awareness that it may be necessary:

> If my parents just be quiet and don't say anything I'll do the work 'cos I know I have to. But if they push me into it I just don't want to do it! I suppose lazy but not in the sense where I... I think I'm a bit complacent, I don't think that I need to work. And I think... Well I sort of know I need to but then there's a little bit of me that just thinks well if you don't, you're not going to do too badly so don't worry. But then that's so unrealistic cos you do have to really work to do well in your A-levels.

Charly casts herself as satisfied rather than lazy. She is proud of her personal qualities of independence and confidence: stressing that they are what she naturally "just thinks". But alongside this, Charly constructs another position: work *is* necessary in mathematics and she is becoming realistic by accepting that. She emphasises that "you do have to really work" and so associates herself with the authority and maturity of parents and teachers, critiquing her natural self as complacent. Here Charly is challenging the *opposed* relationship between work and happiness, and also drawing on it to do some *work on herself*. She constructs herself as someone who would naturally prefer to avoid work, and may be able to do so without repercussions, but also someone who reflects on her own goals and modifies her beliefs as part of becoming an adult.

Jodie also acknowledges the existence of a position of effortless achievement in mathematics (Solomon 2009b), but for her it is one she cannot occupy:

> You know some people just have the talent and can do it. Some people have that talent but they can't do it until they work at it. And I'm one of them people that has to try hard to do that work.

Jodie acknowledges the accepted power of "talent" (or ability) by placing it first in her argument, but then echoes "talent" in her description of people who *do* have to work, challenging its exclusive status. When she describes a classmate who is proud of his easy understanding but also jealous of her better results, she is backed by the authority of her results to go further in this challenge and claim that his pride is a naïve individual position that ignores the structural power of technologies such as examinations:

> I guess it's one thing knowing the rules and it's another learning how to use them. I guess in a way because he knows the rules he thinks 'Oh I know that. I don't bother learning it' and you do have to. I don't think anyone can just walk a Mathematics exam. I think you do have to try it no matter who you are and how clever you are.

For Jodie this is an important claim for belonging in her mathematics class. She discounts the natural-seeming opposition of work and happiness, and becomes powerful through her understanding that you do have to "bother". Jodie does not try to change her self – in a later interview she says that she still finds work frustrating - but she makes a claim to be successful through knowing and managing the technologies of learning mathematics.

Although they position themselves differently as individuals – Jodie *needs* to work, and Charlie *chooses* to – both students use the imperative *you have to work* to indicate their maturity and engagement with the education system. They reject the place of effortless achievement in long-term success for themselves and of "how clever you are" as a claim for others. This echoes the discourse of youthful illusion that we saw in the last chapter associated with further mathematics. It is immature for students (including their past selves) to be taken in by the "unrealistic" complacency of not working. Again they use this sense of illusion as a powerful way of including or excluding others, although for them further mathematics lines up with mature authenticity rather than precocity.

6.2.2 You have to not work:

Above I have described how avoiding work is cast as desirable, but in that form it was merely a natural preference. Not working was also constructed by the students as a position that one *had* to take. One explanation of this came with a light-hearted insult from Clive: you "mustn't just be a little Kermit in your room doing work all day". This was important to Clive because the amount of time he spent doing sport and paid work gained him respect from his friends and family, and also because of his view of himself as working to create a balanced life. So he claims: "I could probably get five As. But I'd rather not be a sort of all-working boy. I would rather have a life". This kind of statement clearly draws on the *opposed* relationship of work and happiness, but Clive is also taking on responsibility for *managing* the conditions in which he works and the story he tells about himself, and thus I read him as engaged in *work on the self*. As we saw in the last chapter, being "all-working" is incompatible with Western adolescence which must use time *expectantly* to distance itself from the submissive labour practices of the colonised. Clive's reflexive attention is similar to the "onerous and consistent identity work" engaged in by 12-13 year olds aiming to 'have-it-all' academically and socially (Francis, Skelton and Read 2009). After Year 12 Clive decided that mathematics required too much of his work-time and he tried to drop both mathematics and further mathematics. His family and teacher persuaded him to continue mathematics by stressing the exchange value of an A2 grade.

This tension remained influential however, and when he chose an economics degree, he deliberately ruled out any mathematics-based courses that "would just drive me insane". Clive used the *opposed* and *managed* discourses to suggest he does not work happily at mathematics and cannot imagine circumstances in which that is possible, so that giving up is the rational solution. Making that choice is a practice of the self that displays Clive's capacity to act on self-knowledge.

The second reason students gave for having to not work was the discursive construction of further mathematics students as having immediate effortless access to knowledge. Randall explained that his choice of subjects calls up in (unspecified) other people an unrealistic imperative to be a 'genius': "I'm like 'Oh, well Maths, Physics and Further Maths'. They're like 'Oh. You must be a gen-...' No! You have to work hard at it to even..." He resents this representation of instant clarity because it does not match his experience of further mathematics as "all mixed into one". His route to success is through hard work and slowing time: "make sure you don't move on past anything until you absolutely know it. Keep on going back and revising it". Randall has difficulties in representing himself as successful using any of the relationships between work and happiness. When he constructs them as opposed, then he is just like other people – "we all can be a bit lazy sometimes" – so is not suited to the distinctive work ethic he sees as characterising mathematics. When he considers how they might be managed, he blames the school's technologies – teachers, lesson timings and physical conditions – for creating problems, and suggests they leave him too much responsibility. Finally, the mismatch between his experience of effort and the imperative not to work, prevent him successfully 'being/doing good at further mathematics' as work on the self that will be useful in establishing his employability (Mendick 2006). He expresses this frustration with jokes about esoteric obscurity: "We just learn about the root for minus 1, don't they? Not how to... Not what black matter is or whatever, dark matter".

These tensions in working on himself have consequences for Randall's choices. He is one of the few students who talks explicitly about pursuing happiness. When I suggest that his middling further mathematics grade is not properly valued within education, he disagrees – "it is recognised but I'm not happy with it" – and he introduces another space for pursuing happiness: "I think there's more factors involved in being happy than just your school work". In the end Randall opts out of planning and university and hopes that a gap year will let him fall into something he likes. Despite his personal rejection of education he allows room for mathematics in his future: "[it's] not necessarily the person I am but I will... I will use it, what I've learnt".

These are two forms of the imperatives not to work; both described as coming originally from other people and the judgements that others might make. In each case the purpose of 'not working' is to display success to others and oneself. Both lead to decisions to stop studying mathematics: Clive because he is successful in constructing an all-rounder identity that precludes time working on mathematics, and Randall because he is unhappy with how his experience of working positions him compared to dominant discourses about further mathematics students.

6.2.3 You have to be happy.

Few students talked explicitly about an imperative to 'be happy' but their talk made constant reference to what they liked, preferred, and enjoyed, and this implied that happiness was a significant ongoing concern. One explicit use was in citing enjoyment as the strongest imperative for making subject choices. Students associated it with the advice that people from their closest relationships would give them: "my parents and stuff just mainly said to me – do what you are happy with". This kind of apparently open statement does three things: it establishes happiness as a consensus, it reinforces associations between close family and happiness and it allocates a "happiness duty" making the student responsible for their own and the speakers' happiness (Ahmed 2010, p7).

At the extreme, work depended on enjoyment: "you are not going to do good in something you don't enjoy because you are not going to put in the effort". The liberalism of such attitudes is considered to be characteristic of the White middle-class (Ball, Maguire and Macrae 2000), but it was also the main criterion for subject choice given by the White working-class students in my study. The only real challenge to this imperative came from several ethnic minority students who described happiness as a secondary factor. Bob, a British-Asian student, described how he still regretted giving up his favourite subject, Art, because it would not qualify him for medicine or business. Simon, a British-Indian student, told me that although he did not enjoy working alone, he felt "better" doing so as he was not able to make comparisons with others' progress. In these examples, neither suggested that work could not be aligned with happiness, but described managing their choices otherwise because of other imperatives. This corresponds to Hernandez-Martinez's (2008)'s finding of a 'becoming successful' repertoire amongst ethnic minority students. However, Simon and Bob's narratives acknowledge that these choices to forego happiness need explanation, so they do not – maybe cannot – ignore the dominant cultural positioning of happiness in identity work.

6.2.4 *You have to work at making yourself happy:*

This is the imperative of neoliberalism, and students made it explicit by denying its 'other'. They did not often admit to feeling unhappy (which would have contradicted the imperative above) but when I asked directly about unhappiness, they presented it as something to work on. For example, in a pair interview, AgentX initially denied ever being unhappy but this is challenged by his friend, Tom:

> AgentX I suppose... I suppose… you're never unhappy. We're never unhappy.
>
> Tom During exams I've seen you unhappy. During the exams...
>
> AgentX *He*[17] is unhappy moaning. Ok. He *is* unhappy. He moans... He sits in Geography like [yawn] 'Exam in five weeks time'. He moans a bit like that. Sorry Tom. But I've... Honestly I don't think I've ever been unhappy... You know, in schoolwork, maybe in an exam yeah, but in schoolwork I've never been unhappy...
>
> Tom You were unhappy before you got that Physics tutor.

AgentX first positions an abstract ideal student as never unhappy and then repeats this for himself and Tom, moving from "you're" to "we're" to position them both as ideal. Tom contradicts him, challenging the legitimacy of the representation and/or AgentX's authority in making the claim, but he softens the challenge by bringing in exams as special circumstances. AgentX counter-attacks; he accuses Tom of being unhappy and moaning even before exams. He knows Tom cannot accept this ("Sorry, Tom…"), suggesting that they both recognise the imperative to be happy in your work. Tom is still prepared to resist the imperative and admit unhappiness for both of them but importantly only temporary unhappiness. When he acknowledges that AgentX worked on his un/happiness by getting a tutor, this is an acceptable positioning that ends the dispute for both. Their conversation then develops into describing AgentX's growing independence as evidenced by organising his own tutor. Working to resolve unhappiness is thus a practice of the self that shows autonomy and success. AgentX is 'active studenting' in a similar way to the "active parenting" (Ball 2010) that commodifies education as an investment extending beyond the school. Three of the students at Grants told me about finding private tutors to supplement school and FMNetwork teaching, and none at other

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[17] I use italics in the transcripts to show a particular emphasis on certain words.

schools: this may reflect the academy's aim to give students personal responsibility for their learning. Ball describes such New Labour policies as totalising, individualising and commodifying families (and presumably students) as "consumers of education and investors in cultural capital" (2010, p163). This imperative is significant for mathematics and any other challenging school subjects: if being unhappy demands an individual solution, and solutions have costs, sometimes the only solution is to give up. In the data excerpts I have already described, AgentX, Tom, Clive and Randall all suggest they are dealing with this imperative, and they were not unusual.

There are clearly tensions between these multiple imperatives concerning work and the neoliberal requirement to experience work as happiness. Not all the tensions were problematic: using different identities at different times is also a way of constructing subjectivity (Currie, Kelly and Pomerantz 2006; Francis, Skelton and Read 2009). Charly and Clive, for example, negotiate their way skilfully between claiming personal empowerment and knowledge of how the world works. However some tensions were experienced as distressing and students sought practices and explanations to resolve them: Randall provided an example of this. The next section looks at two particular practices of mathematics learning that recurred as significant when students described problems of being unhappy in their work and what they could do to transform those experiences towards happiness.

6.3 Happy Objects

My second phase of analysis considered the school practices that students juxtaposed with their descriptions of working in mathematics. I identified two sets of practices that students used repeatedly to contextualise explanations of why they were happy or unhappy in their work: the dependability of mathematics, and working with other people. Ahmed describes how "happiness is attributed to certain objects that circulate as social goods" (2008b, p127). Happiness is shaped by contact with these 'happy objects' and is intentional, directed towards them. Some, such as family, are widely recognised as promising happiness, others are more specific. Individuals work purposefully to keep these objects proximate, within their 'horizon of happiness'. I argue that *dependable mathematics* and *working with others* both function as 'happy objects' within school mathematics. To do this, I show how student talk attributes happiness/unhappiness to these concepts, and how the local contexts of mathematics and further mathematics teaching support these attributions and help or hinder students from claiming intentional proximity. This discursive positioning of happy objects connects with my analysis of imperatives in the first section through the notion of self-governance. I consider students to be *managing* happiness when they focus on the conditions and technologies that permit proximity to happy objects, and *working on the self* when they also rework what they say about their aspirations and feelings to achieve that proximity.

6.3.1 Dependability

The first theme is the construction of mathematics as logically consistent, predictable and so dependable. Dependability supports students in aligning school-work with happiness by factoring out risks and uncertainties associated with time and chance. In the previous chapter I showed how the discourse of *moving/improving* established mathematics as safe and controllable, and how this offered students opportunities to borrow that safety as an analogy for their own progress and also to use it to show themselves as having mastery of time. The certainties of mathematics discourse instil certainty into an individual's life-trajectory just as "the charm of numberese" gives control over social futures (Sfard 2009). The practices that students commonly described in relation to this discourse were predictable exam tasks and the promise of high-status careers to mathematics students: these set up relationships between individual goals and the school curriculum as a means of achieving them. I now extend this argument to show how students can use these technologies of self/ schooling to manage the opposition of work and happiness. For example, Jodie enjoys applied mathematics because:

> It just seems to actually have a point and a purpose and a use, which makes me more interested. I guess that's... I can see it helping me get somewhere. I can do well in that, if I can do well in Maths and Further Maths it could totally change my future.

In this quote Jodie's vision of future success does not just allow her to predict happiness in the future; it positions her as feeling happy in the present. It fits with a neoliberal collapsing of temporality which understands an individual as responsible for their life-trajectory by making current choices, and happy when they meet that responsibility (Rose 1990). Jodie expresses her desire to assert personal control but also some hesitations: the final "if I can" and "it could totally" resolve her personal uncertainties through the potential determinism of mathematics.

It was possible to represent mathematics as dependable because school and examinations ensured connections between students' work in different settings and timescales. Students described the "safe", "straight" progress from lesson-work to homework; from teachers' examples to students' follow-up work; from practice papers to exams; and from exams to grades. These connections mean that work can be depended upon to give results, so that AgentX summarised his group's feelings as "whereas in maths you know what you've got. You can tell". Joe also provided evidence that working was necessary because mathematics has no loose ends:

> Whereas mathematics you have to work hard. I'm not saying that you don't in other subjects, but you have to do these questions, you have to know certain topics and you can't get away with not knowing one little bit. It is all connected, mathematics. It applies everywhere and one topic leads to another topic as well in mathematics.

The recurrence of "whereas" suggests a special role for mathematics as dependable in an uncertain world. Chance factors such as "not knowing what you've got" or "getting away with it" are eradicated, and there is security that only people who do not work will fail.

In further mathematics, however, students could not be sure that success in current work would bring success in the future; and this was used to illustrate unhappiness. Charly described "normal" mathematics as making her feel "warm" because "even if I can't do it I still feel comfortable about the fact that I will be able to do it". FMNetwork practices do not enable her to make similar claims: "cos in further mathematics like we move so fast, if I can't do it I worry a bit". She attributes this to the pace of teaching rather than problems with herself or the teacher, so that it can be read as a positive. Although Charly plays down her "worry" in further mathematics, her use of the contrast attributes happiness to the dependable progress in mathematics.

One of the roles of dependability was to allow students to manage conflicts between the imperatives of having to work and having not to work, and again this role was threatened in further mathematics. Early in AS mathematics Clive enjoyed the control he had about how and when he would work and could confidently state: "I have just got to put my head down a week before the exam, and get it in my head right". He contrasted this with further mathematics where he couldn't ensure that the time spent working would bring success: "I'm not going to sit there for two hours thinking; there's no point". Many of the AS-level students explained they were used to having time to chat in mathematics lessons, knowing they could pick up enough in class to catch up at home. They complained that in further mathematics, "if you don't listen for one little bit then you don't know what to do" (Ricky). High-achieving, popular students combine socialising and task-completion as working practices (Francis, Skelton and Read 2009); so that a failure to do so is not simple laziness but a threat to a privileged identity. Several students interpreted this failure as the responsibility of the school for scheduling after-school lessons. By constructing further mathematics as a faulty educational technology they suggested that neither they as individuals nor their pleasure in dependable-mathematics were to blame for their failure to enjoy the lessons. Students in all sites had heard of students who studied further mathematics in school time and felt they were under-privileged in comparison.

In all these examples, dependability is an object that both shapes happiness and is sought. Dependability points towards the happiness of bright futures and the reassurance that students' work will have value. Since the award of futures and value is seen as an exchange in the market of employers and universities it is important that dependability yields public results, as in examinations. Students seek it as a resource for aligning work and happiness that is made proximate by mathematics teaching practices and then –by its metaphorical nature – can be kept proximate. It promises success not only for work in mathematics but for work on the self. Further mathematics challenges students to keep this happy object within their horizon of happiness. To borrow Ahmed's (2008b) phrase, further mathematics is a "conversion point" – something that gets seen as turning good feelings into bad. This raises the question: how do mathematics students let go of dependability in further mathematics? Or, because discourse constructs subjectivities, how does further mathematics let go of dependable students while circulating the same promissory powers as mathematics?

6.3.2 Working with others

Dependability appeared mostly in students' reasons for choosing and liking mathematics. *Working together*, however, was a theme that appeared when they described what they had to and chose to *do*. All the students represented working with others as evidently pleasurable. In the career-photos task they all chose images of groups and talked about teams, mutual support and collaborations. Many represented it as part of their work on the self. For example, they found power and pleasure in helping each other and described this as progress to autonomy and adulthood. To some extent, then, *working together* can be seen as an object that shapes happiness independently of mathematics or education. For almost all students, however, interacting with the teacher and others was also described as central to learning: "it helps you understand, to learn what they might say and then you might think that's what the teacher said and then linked together you understand it" (Jodie). This kind of comment positions other people as important in the alignment of academic success and happiness.

A-level teaching practices contributed to this alignment by building social interactions into mathematics. Lessons usually included time for students to collaborate; they all worked on the same problems and were encouraged to seek out and prefer other students' explanations: "If you don't understand it then you need a different point of view of how to explain it to you" (Esther). These practices positioned mathematics as objective but in a world of subjective knowledge. Many students characterised both mathematics and further mathematics as essentially interactive because the shared, factual tasks enabled working together and thus created spaces for comparing journeys to the same understanding. When Esther contrasted mathematics with "creative" subjects, it was not that either was more talkative but that in mathematics you talked "about how you could get the solution" and in English, "your opinion changes that solution". It was also clear that students linked these interactive work practices explicitly to happiness. For example Helen described taking part in the "little argument/ debate things" going on in mathematics lessons as the marker that you "really really enjoy it".

Three students took a contrasting position that mathematics lessons were not about working together. One was Simon, the student described above who disliked working alone but chose it as "better for him". Joe also chose to work alone to avoid distractions, and was allowed to leave the mathematics lessons to do so: "I am better to come and sit by myself and then I will concentrate". The emphasis on making these choices suggests that they do not challenge the relationship but have made a sacrifice of the pleasure of *being* with others. Li Mai suggests that "with maths you can study with lots of students or a small group of students, it makes no difference actually because you have to work on your own" but she also says she helps her friends as much as possible so that the class can progress faster. These students have adopted the discourse that it is possible to learn mathematics in isolation, although what they and others say about their practices shows that they do at least discuss their lessons with their peers.

In further mathematics students reported pleasure that their lessons, despite time pressures, were also largely based on teacher-student talk. One exception met significant criticism - lessons with a tutor who allowed "no room to openly discuss". Esther gave this as the cause for feeling acute unhappiness in the further mathematics class and wanting to drop out of the "stale", "painful" experience. There was a similar conversion point for other students who initially enjoyed interacting with their tutor when they did not understand, but decided to give up when they individually stopped feeling happy about contributing to the class talk. The dominant positioning, then, was that work was pleasurable because – and when – it was collaborative, and this was constructed as shaping experience in both further and "normal" mathematics.

Tensions were associated with this characterisation when students described the work they did alone. As the 'other' to collaborative work, extended homework was positioned as a contrasting and so unhappy experience but one that was necessary for further mathematics and also for A2 mathematics. A minority of students found ways to resolve the tension. As we saw earlier, Joe and Simon chose working alone as "better" for them, and Li Mai saw it as necessary. Another example is Paul, who continued to A2 with FMNetwork classes. Paul relinquished *working together* as a shaper for experiencing happiness. He stated his individual commitment to mathematics by repositioning his solitary further mathematics work as pursuing individual interests:

> If some facts are interesting I'll read through the chapter. Look at more detail and learn about it and look it up elsewhere. If I'm still interested which isn't that often... But yeah, if things are going badly it can help if you go through the examples and just make sure you understand what you're doing and teacher's doing then it all comes together.

Here Paul avoids mentioning work, and minimises any idea of consistent effort with his throw-away phrasing, '*if*'s and '*just*'s. Although he is addressing a situation where "things are going badly", he positions his response not as work he has to do, but an activity that is a lifestyle choice, perhaps a happy object in its own right. This kind of response places him amongst those who have achieved success in their self-project even if their mathematics does not work out. Only four out of the twenty-four students I interviewed made this sort of claim based on interest, all confident of top grades. It is worth comparing Paul's response to Randall's, when he struggled to position his need to work hard as anything but failure at being a genius. It seems likely that the successful grades of high-achieving students insulate them from the inherent threat of making failure personal when they align their work-towards-happiness with independent, solitary work.

The most common response to the problem of unhappy solitary work was to try to limit it by scheduling opportunities to collaborate. Sometimes these opportunities were negotiated individually with teachers out of lessons; students told me about schoolteachers who supported mathematics learning by welcoming queries in lunch times, registrations or other lessons, and FMNetwork tutors who answered questions by email, text and phone call. Teacher availability was always valued but varied between schools, teachers and individual students. Students also got together regularly in free lessons. Tom and Helen jointly described a pattern of work that positions *working together* as a means to put an end to individual uncertainty:

> Helen: We tend to like ask each other if we have problems and stuff sometimes
>
> Tom: What we usually do is we'll put... We'll sort of work on it ourselves and we'll get so far and then stop half way through or three quarters of the way through it. And leave some of the questions. Then we'll come in on a Monday and because we've got... Some of us have free periods on a Monday we'll sort of go through it together, see if we can...
>
> Helen: Tend to see each other, you're like 'Did you do this question? Because I can't do it'.

They have thus planned how to avoid the dual unhappiness of solitary work and work that does not progress dependably. Since they understand other people as key to their learning, *working together* has educational validity as a way to schedule and socialise aspects of work that are making them unhappy. From this perspective students are not relying on friends, but are taking over from teachers in creating collaborative learning spaces and thus becoming more independent. They manage proximity to one happy object – *working together* – to make up for the perceived loss of another – dependability – that they cannot so easily control. In her year 13 interview, Helen still thought of further mathematics questions as initially painful, but her work – which by then was mostly done alone, some with other students, occasionally asking the further mathematics teacher - had shown her that she could make them predictable:

> I think some of these questions can be quite like daunting. You'll stare at them and see like a really long equation thing with like trig functions, and you'll be like 'Oh my god!'. Whereas if you work it through like logically and slowly and kind of bit by bit, you kind of realise 'Actually, I can actually do this and I know what I'm doing'. So I think that's the way that I would approach it. That's the way I've always been taught to do things. [...] Sir always says like, the well-written questions always follow on from each other.

This re-articulates the description of mathematics and now also further mathematics as dependable and powerful, but only to those like Helen who have engaged with them. Helen's work on herself in finding ways to become independent positions her as able to share the 'epistemic authority' (Solomon 2009b) of her teacher and regain the guarantees of mathematics.

6.4 Summing Up

In this chapter I have argued that students use imperatives concerning work and happiness to construct narratives of themselves as mathematics students and as individuals actively managing goals and strategies in their identity projects. My theoretical framing of the work/happiness relationships as *opposed*, *managed* and *work on the self* identified three public, historical discourses that position students as working, desiring subjects.

The opposition of work and happiness ran through these students' descriptions of everyday learning. Their agency was produced through managing this opposition and the way they experienced it. In the previous chapter I showed how students were positioned between childhood and adulthood, with the technologies of schools imposing a normative model of development. Students could vary that steady progress to some extent by positioning themselves as choosing further mathematics as a way to get ahead (projecting themselves beyond school) or to stay immature (keeping themselves in it). However these escapes from the technologies of time were not secure. They were challenged, and then it was not only the students' academic progress that was scrutinised but their ability to choose rationally and in their own best interests. In this chapter, too, the primary responsibility for reconciling work and happiness is allocated to students, but the further mathematics discourse itself provokes tensions. These can be read as institutional weaknesses of teaching and timetabling – and indeed some students do this (particularly in Grants where the FMNetwork was only a temporary arrangement) – but throughout the data the students' main response is to treat these as threats to their project of self-entrepreneurism. Thus this chapter contributes to my argument that students' choices are guided by a neoliberal model of the self as a purposeful project of self-expression and self-control directed towards socially-constructed ends. It makes clear that these ends are both economic and reflexive goods. In this project work is one such good that is simultaneously economically and reflexively valuable. It is a directional resource, like time: you can waste it or you can use it. Managing work brings socioeconomic success and also constructs you as autonomous. Happiness is another such good; it has currency in economic practices since success and happiness are mutually dependent, in reflexive practices of the self since happiness is a feeling, a promise and a duty (Ahmed, 2008, 2010).

Education establishes adolescent identity as a trajectory of self-evaluation and change in order to make one's working life happy and successful. You have to be happy, you have to work at being happy, and you are a successful student to the extent that you manage all these imperatives. This is continued into adulthood in the neoliberal discourses of life-long learning (Young 1999) and flexible reskilling (Hesketh 2003). Thus working for educational success comes to mean the same as working for and on happiness. As Helen says about choosing a mathematics degree:

> I don't wanna be one of these people who goes to work every day and thinks 'Oh, I hate doing this. I wish I did something different'. Like I wanna find something maths-related, but something I just enjoy doing. [...] I think there's a lot of things that you can do with maths that you don't realise that you can do with maths. So, hopefully, like I'm just gonna investigate really and be like 'Oh well, I've got this degree, so what can I do with it?'.

The promise of mathematics is that it removes doubts and threats to the neoliberal promise of happiness.

For most students the happiness of working for/on happiness was experienced personally, here and now. Like Jodie, they used a modernist framing of managing and controlling their resources. They gained pleasure in the present from the promise that hard work guaranteed future individual success and happiness. We also saw Paul starting to reformulate school work as following his interests so that all educational work he does is also work *on* his self and *for* himself, and thus pleasurable. However this is not the only construction: we saw that Simon and Randall found it difficult to enjoy their present work despite investing in the future, and Li Mai's happiness was shared with/dependent on her parents' happiness. My analysis suggested that for these students the goal of 'the fulfilled life', or eudaimonia (Hesketh 2003), is dependent on producing oneself as, minimally, *managing* happiness in work, and, preferably, as experiencing work itself as happiness, control and fulfilment. In this respect school work acts as a proxy for employment. However it is clear that the conflicts between managing work and psychological rewards are not as easily or fully transcended as Rose (1990) suggests they should be for an ideal neoliberal subject.

I can now take my argument further and note that further mathematics works in two contrasting yet overlapping ways for students. First, it is a example of 'pure' learning that typifies school work. Therefore success/happiness in further mathematics enhances a student's claim to experience here and now, while still in school, the promise of success/happiness in later life. Secondly, it is also positioned as qualitatively *different* from "normal" learning, more advanced, more adult and closer to employment, and so it produces possibilities for a claim for happiness based not on being a good student but on getting nearer to an authentic adult self. The authentic, mature student must accept the responsibility to work towards being happy because adults who are unhappy or who do not work are alien to themselves (Rose 1990; Savage, Bagnall and Longhurst 2001; Sveinsson 2009). There are cross-overs and similarities to the *inside-outside* and *breadth plus depth* discourses of the official documents that I described in Chapter 4. Further mathematics is 'inside' by being one of the school technologies that produces pleasure in being a good student through teacher-student relationships, grades, a sense of learning and being recognised as special (Mendick, Moreau and Epstein 2009). It is 'outside' by requiring self-management, teamwork, risk-taking beyond what is normally acceptable for students. Further mathematics is deep because it is a more theoretical (higher) form of learning and offers access to one's hidden, waiting-to be-actualised self. It is broad because it includes more practical and more 'real' mathematics, and aligns students with the world of employment and economic rationality.

Dual possibilities can be productive in their ambiguity, as some of these students show. But the balance that allowed students to keep on representing themselves as happy in choosing to work at further mathematics was fragile. Choosing mathematics can seem a passive choice. You discover you are 'chosen' by mathematics (Mendick, Moreau and Epstein 2009) and the happiness of that self-discovery sets it up in opposition to work. In contrast choosing further mathematics not only required school work, but also active work on the self, managing your maturity/precocity, how you value your success now, and how this orients your identity project into the future.

In the latter part of the chapter I continued identifying practices of the self that mattered in establishing positions as successful/happy or unsuccessful/unhappy mathematics students. I characterised two main themes as 'happy objects' used by students to manage accounts of their work experiences while keeping happiness within reach. Students equated happiness in mathematics with the practices that produced it as dependable and involving working together. When they found they could not make the same claims in further mathematics, the logic of resolving unhappiness led them to give up. As we saw in the last chapter, mathematics works as a guarantee of safe personal progress in the future. The data in this chapter shows a spiral effect where students attribute happiness to the dependability of mathematics: and then experience happiness by keeping that dependability proximate. "Once an object is a feeling-cause, it can cause feeling" (Ahmed

2010, p28). Dependability is valued as a practice that moves from mathematics to the self, displacing the pain of working with the promise of closure. In further mathematics dependability was much more difficult to appropriate as a discourse of the self, but this was read as a failure of individual students to align themselves properly rather than a challenge to the nature of mathematics. Paul attempted a resistance that "not being too safe" was interesting, and Helen positioned further mathematics as eventually teaching her how to impose predictability, but both these were sustainable only when students had good examination grades to back their success. "Not knowing" was more often linked with experiences of frustrating work and/or the pain of being surprised by bad examination results.

The second happy object was *working together*. Students described with pleasure the practice of mathematics lessons as individual engagements in shared, public tasks; indeed the majority saw collaboration as natural and necessary for learning. This perception does not however challenge the familiar perception that GCSE mathematics is an isolated activity (Nardi and Steward 2003) since togetherness was marked as a classroom practice rewarding those who had chosen A-level. Practices that required working alone became causes of unhappiness and oriented students away from further mathematics. Some students addressed this threat to the imperative of happiness by working on the self, restating their personal commitment to mathematics as a pleasurable life-trajectory regardless of how others viewed their work, but again this was sustained without reservation only by high-achievers. Others adopted the more robust strategy of scheduling time to work with others, limiting the unpredictability and isolation of homework by providing both structure and help. Students who did this identified themselves as taking over from teachers in creating collaborative learning spaces, and as becoming independent through organising their shared responsibility and dependence on others.

Finally, I suggested in the last chapter that one could not explain students' decisions to drop out or continue further mathematics by mapping individuals to particular discourses of time. Instead all these students made use of the same range of discourses of moving/ improving and getting ahead. Some of the different decisions resulted from intersections of those discourses with identity-practices relating to class, ethnicity and gender; but there were both currents and resistances. In this chapter I showed that most students encounter tensions in presenting themselves as happy in their choice of further mathematics. This provokes a complex and long-drawn out self-assessment of whether they can successfully stay included. It is true that a few students – those who consistently gain top grades – do easily represent themselves as successful in their projects of the self. This does not negate the experiences of the majority but adds to them. What this analysis of discourses of further mathematics has shown is that 'successful', 'happy', 'hard-working', 'mature' students are constructed by the same discourses of mathematics and neoliberal selfhood as the excluded students. Success and exclusion co-exist in these discourses of time, work, and happiness. Academic success is widely accepted as fulfilling a duty/promise of happiness (Beard, Clegg and Smith 2007; Hughes 2007; Rose 1990, 1999). This may veil the ways that students have, along the way, found solitary, unpredictable further mathematics work to be painful. This recalls the way that the FMNetwork's website represented doing further mathematics in terms of students' pre-existing and unproblematised enjoyment, ambitions and interests (§ Chapter 4). However the difficulties of *becoming* someone who can be happy, mature and ambitious within further mathematics do matter, because school discourses affect later mathematical study (Burton 2003; Daskalogianni and Simpson 2002; Solomon 2007b) , and more importantly they add up to reproduce inequalities.

Within my thesis I now make a shift in emphasis. In the previous chapters I have focused on identifying significant discourses of choosing, schooling and further mathematics, that is starting from research question Q1a. I found these in the official discourses of further mathematics and in student discourses related to time, maturity , work and happiness, and I have examined how these are interrelated and their effects on student choice (Q1b). I have traced the power relations that construct further mathematics students according to these discourses and reconstruct the discourses as what the students are learning about mathematics and themselves (Q2a and 2b). In the next chapters I start from the last questions: what articulations of subjectivity are constructed in further mathematics (Q3a) and what practices of the self are used by students to be intelligible in those positions (Q3b)? I consider how these discourses, and new ones that I identify, construct possibilities for students to 'do' further mathematics alongside 'doing' other student subjectivities and how these intersect with neoliberal technologies. In the following chapters I use my data in two ways. I give overviews of how the students positioned themselves as aligned with further mathematics and school through accounts of belonging and independence, and I connect these with the choices they made. I also use individual students as examples so that I can trace how these discourses come together to construct coherent subject positions in which students are positioned as able/having to choose to participate (or not) in further mathematics.

Chapter 7 Individual and Collective

In this chapter I consider what students said about themselves as individuals in relation to an 'imagined collective' of further mathematics: whether they felt they belonged or not, whether they identified with a classroom group or a wider community of 'further mathematicians', and what practices served to include or exclude them and/or others. As I discussed in Chapter 2, identifying oneself as a further mathematics student is not an isolated decision. It is implicated in discourses of gender, class, ability and ethnicity. The two previous chapters have shown that it is also articulated through discourses of modernism, adolescence and neoliberal self-management. All these constitute who one is and who one is going to be – as do the other discourses of society and education that each individual is part of. In this chapter I look at these multiple belongings as processes that articulate, suture, over-determine and under-determine a self. Selfhood is thus assembled but not subsumed into any one identity (Hall 1996a). Overall, I am asking what makes it possible for us to think about currents and tensions between being a further mathematics student and being something else, whatever those 'something else'-s are.

7.1 Constructing subjectivities

> Subjectification is simultaneously individualizing and collectivizing. (Rose 1999, p46)

I argued in Chapter 2 that there are "powerful consequences of particular ways of telling the truth about ourselves" (Ramazanoglu and Holland 2002, p92). Different discourses make possible different meanings and strategies with which to construct the self *as* a self. One way of telling such truths is through who or what we belong with: the identities that are discursively and emotionally aligned with our own. Collectives – the imagined or real groups of other people that we might belong with - are a "fulcrum of personal identity" (Rose 1999, p177) and also a way of organising social practice and knowledge about self-in-practice (Lerman 2001). This means that belonging and not belonging, how these are enacted, experienced and narrated are all part of the discursive framework that inscribes our subjectivity. To examine practices of the self in further mathematics I need to examine how it is possible to think about belonging. Conversely, to investigate a collective such as further mathematics students, I need to examine what it is that individuals can describe themselves as belonging to, how sameness operates across difference, how symbolic boundaries are bound and marked (Hall 1996a).

In this chapter I examine the relationships between individual and collective that are permitted in further mathematics. One of the reasons I do this is to tease out further the discursive strategies that operate when students choose further mathematics. We saw in previous chapters that belonging with mathematics is important to these students' sense of progress and security, their pursuit of happiness and their self-management. It is a ground on which the self is formed, specifically a neoliberal self. As we saw in Chapter 2, it is a 'truth' of modernity that membership of social groups is determined by choice and self-discovery, and not only by fact, territory, custom and constraint (Bauman 2001; Harvey 1989, 2005). The practices of neoliberal institutions such as the FMNetwork constitute belonging as a choice and create collectives for us to belong to (see Chapter 4). Indeed by choosing 'who to be' in this way we fulfil a duty to express ourselves, govern ourselves and succeed (Rose 1998). Thus students' 'ability' to belong to further mathematics is also an 'ability' to produce themselves as neoliberal selves.

Secondly, I have established in the previous chapters that continuing further mathematics is associated with tensions about precocity/maturity, work/happiness, authenticity and distinction. These discourses set up their own collectives, imagined around being mature or immature, managing work or following interests, being genuine or being fake, being known by peers and teachers and/or being special (Currie, Kelly and Pomerantz 2006, 2007; Reay 2004; Warin and Dempster 2007; Warin and Muldoon 2009). These may provide a current of support to further mathematics, or tensions that make one's belonging precarious.

Thirdly, I want to contest the notion that identity is driven by a 'particular' unifying construction of experience and examine instead the processes that assemble selfhood (Rose 1996). Collectives are a key pressure in dispersing the self, powerful because feelings of belonging with others evoke both love and resistance (Griffiths 1995). There may be a whole spread of people and discourses to whom we have to make ourselves intelligible: collectives such as school, family, friends, further mathematics class, mathematics and other subject classes, and the criss-crossing discourses of gender, ethnicity, ability, ambition. Amongst these multiple, fragmented identities "a degree of coherence is an operative necessity of selfhood" (McNay 2003, p7). This is recognised in Griffiths's (1995) notion of the web of identities (that we saw in §2.2.2 as inscribing agency within multiplicity), or the communitarian view that selfhood is the interweaving of narrative strands into an intelligible and continuously revised narrative unity (Macintyre 2007). There are always pressures somehow to reconcile one's diverse collectives and ways of belonging around a coherent subjectivity.

My poststructuralist approach recognises this trope of coherent interiority but pays attention to the discursive strategies that cause it to stabilise and consolidate (Butler 1990; McNay 2003). Walkerdine shows that contemporary practices of labour, education and selfhood establish the neoliberal subject as "sustained by a stable centre, an ego capable of resilience" (Walkerdine 2003, p241). An incoherent self is regulated into being hard to bear, creating a painful "problem of contradiction between positions, possible identities, identifications and the shaky move between them" (ibid, p247). Hall (1996) examines the painful and pleasurable experiences that accompany the interplay of discontinuous identifications around ethnicity and race. Therefore it is important to trace the continuous play of currents and tensions in being a further mathematics student and being something else. We may see how these are unbearable, leading students to give up further mathematics, or bearable in certain situations (for example, Stinson's study shows how mathematics coincides with some practices used by African-American males to resist deficit models of education, allowing for the performance of "robust mathematical identities" (2010, np)).

In order to show the complexity of different forms of belonging, my next section (7.2) introduces practices of belonging and "imagined communities" (Anderson 1991). I then give an overview (7.3) of how the students talked about belonging to a further mathematics collective. The main section (7.4) focuses on the accounts of three students who talked about themselves as resisting some identifications and accepting others, articulating a discourse that supported them in continuing with further mathematics. This complements the next chapter where I look at students who struggled to belong. Here I show that each of these students is positioned using practices associated with the FMNetwork's imagined community, and they invest equally strongly in a discourse of 'going it alone'. I argue (in 7.5) that:

- Students' choices to position themselves as belonging are negotiated within the neoliberal pursuit of success and autonomy.

- 'Going it alone' is consistent with belonging to further mathematics if you understand yourself and/or the further mathematics collective as escaping from school constraints.
- Tracing how memberships of different collectives play out for these students is helpful in understanding how discourses of further mathematics operate with wider patterns of inclusion and exclusion (Archer, Hollingworth and Mendick 2010; Leathwood and Read 2009; Lesko 2001; Martin 2006; Mendick 2008; O'Donnell and Sharpe 2000; Reay, David and Ball 2005; Solomon 2009b). However not all differences are tensions that need resolving – some are productive and keep possibilities open.

7.2 Further mathematics as an imagined community

This brings me to the question: what kind of collective is further mathematics? In Chapter 2 I discussed identity in terms of the theoretical construct 'community of practice' (Wenger 1998) which is produced around the ideas of mutual engagement, joint enterprise and shared repertoire. I rejected it because it did not adequately explain how mathematics undergraduates felt excluded by the collectives with which they shared practices (Solomon 2007b). For my purposes, the requirement to bring together the different motivations and experiences of students, teachers and policy-makers in a 'joint enterprise' did not give a recognisable account of the power relations within further mathematics. Others have used Gee's notion of Discourse-community (e.g. Cobb and Hodge 2002; Solomon 2009b) to investigate how shared sense-making practices construct the mathematics classroom. I rejected this because it presupposes an inclination towards unity: towards finding *the* Discourse of further mathematics. The FMNetwork operates both remotely and intimately: online, across schools and in schools. Here, more than in most studies, I need a concept of collective that starts from experiences of belonging across varied practices that gather, maybe loosely, around the concepts of further mathematics and/or the FMNetwork.

I therefore propose to think of further mathematics as an imagined collective in the sense of Anderson's "imagined communities". Anderson argues that collectives larger than the face-to-face are cultural artefacts which are "distinguished not by their falsity/genuineness, but by the style in which they are imagined" (1991, p6). He gives examples of communities that are imagined without physical proximity such as nations or the readership of newspapers. You do not meet most further mathematics students but you can imagine community with them.

Producing an imagined community entails certain ways of belonging, and these are permitted by contemporary space-compressing technologies such as travel and communication. The online resources of the FMNetwork are an example of these technologies: they provide help in different sites, to individuals, schools and groups, possibly at the same time. Anderson argues that our perspective on time is another such technology: things that happen at the same time 'go together'. Sitting further mathematics module exams, being given textbooks, attending joint revision days all make sameness happen in time and across sites. We saw in Chapter 5 that the 'getting ahead' discourse of further mathematics could position individuals as precocious, thus excluding them from the togetherness of simultaneous development, but an imagined community can include them by highlighting what they share.

Imagined communities need to be boundary-oriented because membership does not flow out from a physical or dynastic centre. They need homogenising practices that mark who is included and excluded. These practices articulate kinds of sameness among difference (Gunn 2006), such as using a common language (and mathematics is often seen to be unifying in its use of signs) or the construction of cultural trajectories within the community. Anderson argues that nations were produced by the socio-geographic career paths of 19^{th}-century civil servants. Further mathematics membership is similarly produced by the 'case histories' presented on the FMNetwork website and in its schools, by practices such as registration and receiving your password, and by teaching that aims to foster a 'gang mentality' of 'we're all in it together'[18]. These institutional FMNetwork technologies construct a range of samenesses that constitute students as belonging to a certain kind of community.

Solomon (2007a) distinguishes three kinds of identifications articulted in school discourses. There are samenesses that are produced by your relationship with school technologies, samenesses that appear to be essential or inherited because they derive from your personal history, and there are samenesses that are made new in you. She calls them identities based on institutions, nature and affinity, respectively. It is only the manner of production that distinguishes these samenesses, and this is why we need an attention to

[18] Advice given at a training day for FMNetwork tutors that I observed..

students' accounts. For example, Solomon's (2009b) study traces young adolescent girls performing femininity as a belonging based on repeatedly underlining affinity, while they perform ability as a natural identity that is recognised institutionally through setting. However, Mendick (2003) finds A-level students performing ability as an affinity with other clever students through choosing mathematics. In doing so they position themselves as able to create institutional samenesses, and thus as autonomous. (This recalls §5.3 where Steve describes belonging with the people who 'do extra'.) It is clear, then, that managing the interplay of these samenesses is a practice of the self, and one that can produce self-enterprise. As we saw in Chapter 2, contemporary neoliberal thought constructs 'inherited' belongings such as class, gender, ethnicity and culture as constraining. They interfere with the meritocratic technologies necessary to respond to global economics and to promote individual freedom (Beck 2000, 2007; Furlong and Cartmel 2007). The neoliberal subject is enjoined instead to 'get up and get out' (Walkerdine 2003), although the possibilities of freeing oneself completely from past identities are limited (Lawler 1999). Alongside this, neoliberalism associates affinity samenesses with freedom - the freedom to choose who to be (Bauman 2001). Rose similarly points out the rise of therapeutic discourses that allow individuals to claim "the natural right to be recognised individually and collectively in the name of one's own truth" (1999, 196). These discourses locate pleasure and value in working on the self, accepting the responsibilities to find and sustain one's 'true' affinities in order to achieve autonomy.

Happiness is also a border-practice. We saw in Chapter 4 that the recruiting materials for further mathematics emphasised enjoyment as inclusion. Conversely, a lack of pleasure in mathematics lessons is often seen as failing to 'engage' students with mathematics (Kyriacou and Goulding 2006; Rodd 2002). As we saw in Chapter 6, happiness orients us towards that which gives pleasure and so belonging can be a social good, a happy object in its own right (Ahmed 2010). When some belongings feel inauthentic, a matter of 'passing' or 'pretending', this causes bad feelings because the duty to be happy-in-belonging conflicts with the duty to be autonomous, to manage oneself so as to belong *with* oneself and *to* oneself. This kind of conflict is found in the accounts of working-class students engaging with non-compulsory education. Educational technologies position the subject as 'naturally' learning how to become White, male and middle–class. The doubts and desires of trying to become such an ideal subject have been recounted by working-class students succeeding in education (Archer 2003; Brooks 2003; Reay 2004; Reay, David and Ball 2005; Skeggs 1997), black students who feel they must act White to succeed (Gillborn

2010; Hall 1992; Martin 2010), and women in mathematics (Davis 2009a; Day 1997; Solomon 2007b). Any academic success that demands a transformation of the self can feel inauthentic and cause unhappiness. If you can tell a story of yourself as happy in your belongings, it means that you are successful, you have recognised affinities and made choices, and thus you are an individual with a coherent identity (Sfard 2009; Sfard and Prusak 2005; Solomon 2007a, 2007b, 2009b). There can also be pleasure in exercising the power to reject belonging, although rejecting too many of your options to belong is pathologised (Muschamp et al. 2009). The neoliberal subject is not passive; and must choose to be something.

7.3 The overall picture

In the interviews and emails I asked students about their decisions, about what usually happened in their mathematics and further mathematics classrooms and how they fitted into the group. The data I discuss in this chapter comes from those direct questions. It also comes from occasions when students discussed samenesses, pleasure and relationships while making sense of their own and others' decisions to stop or continue. Table 7.1 shows all 24 students with their schools and their decisions about when/if to stop further mathematics. The three students I discuss in this chapter, Bob, Simon and Jodie are in bold.

	No Further Maths	**Stopped after January Year 12 module**	**Stopped after summer Year 12 results**	**Stopped after January Year 13 module**	**Completed to summer Year 13**
Moorden (A2 in two years)	Ellie Hayley	Esther	Clive Steve	Steffi	Charlotte Charly **Jodie** Paul
Grants (A2 in two yesrs)			AgentX Ricky Tom		Helen Mario Randall **Simon**
Capital (AS in two years)			Joe Michael		007 **Bob** John Li Mai Sukina

Table 7-1 The timing of students' decisions to continue/drop further mathematics

We can see that seven students stopped Further Maths A-level after one year. Six of these (Steve excepted) are students who continued with Mathematics. In the previous chapters I drew on Clive, Steve, Joe, AgentX and Tom's elaborations of differences between the discourses of mathematics and further mathematics. The way they explained their experiences operated to rule themselves out of a further mathematics collective and so their decisions to give up 'made sense'. In the next chapter I look further at students who struggled to continue: Michael who negotiated a web of family and school identifications that eventually led him to feel it was rational to drop further mathematics; Steffi who found further mathematics unbearable part way through year 13, and again at Randall (who we met in Chapter 6) talking about his struggle to stay both practical and successful in further mathematics.

The majority of the students I interviewed continued further mathematics for as long as possible, choosing therefore to be considered as belonging. However within this belonging there were different relationships. In the next section I discuss three students, chosen to illustrate these differences. Bob produces himself as the same as other further mathematics students, happy and secure in that imagined collective and thereby escaping the exclusions he associates with school. Simon is the student who is represented most strongly by others as a typical further mathematics student, but tries to adapt this position and construct his own trajectory in mathematics. Jodie is positioned by herself and others as a surprising further mathematics student; she uses her belonging as a way to 'turn around' this and other exclusions. I use this analytic set to show how discourses that construct belonging as a pursuit of independence position students as secure in a project of self-entrepreneurism.

7.4 Bob - finding himself

Bob is one of the students who positioned himself as unquestionably belonging to the further mathematics, although he takes a particular view of what that means. By belonging to the FMNetwork collective Bob articulates a discourse of neoliberalism in which he 'goes it alone' to overcome the disadvantages he inherits from his school. He articulates an 'authentic' self in further mathematics that is not however constrained by having to rely only on himself. Instead he imagines himself-in-further-mathematics as an ideal yet average learner, not the best but equipped to improve himself through the expert practice of the FMNetwork tutors.

Bob is taking Mathematics, Physics and Accounting A-levels at Island Park, an 11-to-18 comprehensive school in a socioeconomically deprived area. He takes Further Maths AS-level with the Capital FMCentre. Five students from Island Park started in the January of year 12 and Bob was the only one to complete AS over two years. He takes a 20 minute bus journey once a week to his two-hour lesson. I interviewed Bob at the end of year 13, when he had reflexively developed a particular self-history and critique of his school experience. His repeated phrase "to be honest with you" structures his account as a confession about himself and his school.

Bob is British Asian, of working-class parents, and his family plays an explicit role in framing his ambitions. Bob hopes for a C in mathematics to study environmental engineering at the local university. He is exhorted to succeed by his pharmacist brother, who tells him that success and failure are down to individual hard work: "I didn't need my teachers, I did it all myself".

Bob organises his story around a changing understanding that his school setting does not equip him to 'do it all himself'. He had originally felt happy at Island Park: one of the better students since year 7, supported by friends and teachers. At A-level he was the only student to choose Chemistry, for which the school had no teacher but instead offered him textbooks, fortnightly tuition and online learning. Bob gave up reluctantly after a few months, relinquishing his dream of a job in medicine. At the time he considered the school and himself as constrained by a lack of resources, unable to succeed but aligned in working for his interests.

In Bob's account, the pleasure and security he drew from relying on school to show him the best way forward were then overturned by two encounters with the outside world. These justify him in a new moral position that the school "isn't as good as it should be", and he no longer wishes to bear the constraints incurred by belonging to it. The first is (again, like Sukina) when a admissions officer visits the school and tells him that universities do not consider Accounting as "a full proper A-level". Bob had followed school advice to take Accounting as a "backup" subject, more "realistic" than medicine and more academic than his favourite subject Art. He is shocked to hear that Art would have been "much more preferable". Art is not valued by Asian academic achievers (Mac an Ghaill 1994) and so this discovery puts him in conflict with both his family and school knowledge. He describes it as a cynical self-interested betrayal of the school's caring role:

> And especially this is a sixth form based on business and things like that. So they would encourage you to do something like that, whereas [they should] tell you that it's not really, you know not really liked by a lot of universities, which I just... I just can't believe. That was very selfish of them to be honest with you.

The second, more important engagement is with the FMNetwork. As we saw in Chapter 4, the FMNetwork paid close attention to quality-as-conformity so that its online materials and face-to-face teaching are visibly relevant to examination and UCAS requirements. Bob contrasts this with the faulty advice and his struggles to understand mathematics and physics at school, and finds a more hopeful outlook for himself as an individual belonging to further mathematics:

> I was able to make that comparison and notice that it wasn't just my ability or I'm lacking in my maths abilities. It's that the teaching isn't necessarily 100% or ... not even close to 100% to be honest with you, and I knew that from Further Maths, it gave me so much more confidence that, you know if I actually put my... more effort in I may be able to do some of these things.

Here Bob shows some of the tensions that lead to him rejecting school mathematics teaching. They justify him in a new moral position that the school "isn't as good as it should be", so that he no longer wishes to bear the constraints incurred by belonging to it. The natural belongings that he inherits from school and family both, in different ways, convey that success depends on individual aspiration and effort. He has taken advice, aimed high and worked hard, but is not succeeding in staying the same as his brother or the best students who seem to understand effortlessly.

Bob had a "low point" after AS results where he came to an understanding that he couldn't do it any more, and accepted his new position as "part of the lower students". However his FMNetwork tutor allowed him to continue into year 13. This surprisingly secured belonging allowed him to position his failure not as located in himself but in the school mathematics collective. Doing further mathematics provided a way of managing his work that promised improvement, and reconnected with his family ambitions. It gives him an authority to speak for others, such as here where a hesitant criticism of one teacher is bolstered by appealing to collective knowledge:

> I think every single person in my class would agree with me in saying that… at least... especially in the second year, 50% of the contents that he teaches us I can't understand. And they wouldn't say, and they would say they can't understand either.

What changes Bob's perception is not the vision of a bright future offered by further mathematics. He now mistrusts the success of new educational initiatives (and purposefully avoids an otherwise attractive new university course). Instead it is the nature of the teaching in further mathematics lessons and the practices of the self they inscribe. He describes this as professionalism and care which all schools should provide, appreciating that his tutor prepares handouts, shows them examiners' mark schemes, and explains Mathematics as well as Further Maths topics. Most importantly, the FMNetwork has expertise in personalising learning: "the teaching is tailored to you specifically". He repeatedly describes how his tutor "noticed different ways of how people learn. And for me she has to break it down and explain it to me, and that's the best way I learn". He contrasts this with school teaching that does not recognise his presence as a learner, and so prevents him progressing:

> No matter how many times he explains it to you because it's the same way he'll say things over and... It's like he's repeating himself but you're telling him that 'I still don't understand' but then he would repeat himself again, so it's like... it's a circle basically, you're not really going anywhere.

Bob imagines the further mathematics collective as a collective of individuals who are enabled to express themselves and go somewhere through education. They are ideal pupils, responsible for their own progress. However they are not yet adults so have teachers who help them to discover their individuality. The security of belonging to yourself and the pleasure of authenticity is the guarantee that makes their work so effective:

> If like for example, if [tutor] didn't help me in the ability to break things down and derive things then I think I still would have been stuck because that is a key part of being, you know independent. They should help... explain to you the skills you need to do independent learning rather than not help you at all and force that upon you, and that's what I felt like from this sixth form. But I think because I did do that Further Maths I had much more confidence in myself and hopefully later on in life in... If anything I find initially hard I will just work at it until it gets easy enough.

Further mathematics constructs Bob as becoming independent, flexible and reflexive, "key skills" that will later make him employable (Brown, Hesketh and Williams 2003). He invests in the risks and hardness of mathematics rather than its dependability: "It's not like if you don't understand it then you'd never understand it, or you can't do it, it's like you try and try and you get better". Further mathematics makes mathematics feel "so much easier" for him and this positions him in a discourse of 'resilience' that helps him keep working in mathematics and may be protective at university (Hernandez-Martinez and Williams accepted; Hernandez-Martinez, Williams and Farnsworth 2011).

7.5 Simon: going it alone?

Simon is one of the students whose aspirations and achievements align him most obviously with further mathematics. He is a successful student at Grants school doing a traditional A-level combination of Mathematics, Further Maths, Physics and Chemistry. He describes his family as professional middle-class British-Indians, and he intends to become a software engineer. Simon's father has a mathematics degree and works in IT, and his brother had just qualified as a structural engineer; his mother and grandparents did not go to university. I use him as an example because although he is positioned as belonging centrally in the further mathematics collective imagined by others, he insists that no such collective exists. I argue that he has other ways of belonging to mathematics and that his refusal is productive, stemming from a desire to position himself as not fixed into practices that limit his independence.

Simon chose mathematics in year 12 as an inherited, natural and affinity sameness that matched his individual preference and abilities, "I always liked it, I was always good at it", and because it would help his ambitions: "Dad said with these sort of subjects..." He expects me as a mathematics-related interviewer to understand the unspoken guarantee that mathematics gets you ahead.

In mathematics lessons Simon purposefully sets himself apart from other students. He summarised his attitude throughout year 12 and 13 as "I just try and keep to myself really, do the work I need to do". This is not always easy for him because he enjoys and values collaboration; his ideal job will involve other people "because I quite like working in teams" and indeed when he moves on to university he emails that:

> I tend to work with my friends on any of the assignments. I ask them for help and they ask me for help and we learn very well. It is also very relaxed at the university and so I like to work this way.

In Mathematics and Further Maths lessons, however, Simon did not allow himself to work with others. He worried that they would distract him from learning about mathematics and about himself: "With someone else and they understand something and you don't, you feel well why do they understand it and why can't I? It's basically if you do it on your own, you know you can understand it. That's why". FMNetwork lessons in year 12 happened after school, in the computer lab, so he also guards against his own and friends' tendency to treat it as an 'extra' subject: "They probably think 'Further Maths, it doesn't really matter if we talk a bit or do something else with things'. That's what I think. But if you separate them, they'd probably get on". Here he moves from thinking like his friends to adopting a mature, teacher's role, separating himself so he can get on. For Simon, then, working on his own is not pleasant but it makes him "feel better" and is part of proving that he is the kind of "special case" (Mendick, Moreau and Epstein 2009) who can use mathematics to aim for "the best in the world" (Simon, year 12).

Other students at Grants notice Simon isolating himself within mathematics and for them this does indicate belonging. When they talk about further mathematics they describe his success but also the cricket and socialising he has given up since starting A-level. The collectives that Mario and Randall see constructed around their own A2 Further Maths class clearly involve Simon – "Obviously. He's amazing. [Teacher]'s always 'Oh Simon's brilliant.' [...] Maths is his thing". They struggle to reconcile whether belonging in further mathematics requires natural talent or hard work, so that Mario says about himself (and Simon):

> I seem to be doing Further Maths at A level, so there must be an element of natural kind of ability there. Not as much as Simon though [...] But he does, Simon does put a lot of work in, and he is good [...] It just makes me think maybe, what can be achieved.

The male[19] students at Grants consistently introduce Simon as occupying the "extreme" site of fear and desire in mathematics, and wonder whether they could or would want to emulate him. In Grants, therefore, the further mathematics collective is imagined around the students who are physically present in the school. We saw in Chapter 5 that discourses of precocity, illusion and examination performance were used to construct boundaries for further mathematics, assigning true membership to the young, clever and successful. Here there is also an almost dynastic sense of community where belonging relies on proximity to the figure that Simon occupies. There was a similar sense at Moorden where students described their classroom practices as how close they were to Charlotte (see my discussion of Jodie, below). It was not so evident at Capital where the further mathematics students I interviewed came from different schools (although recall §5.3.2 where Sukina positions herself as an extreme mathematician, nearly a teacher).

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[19] There was one young woman, Helen, in the Grants further mathematics and A2 mathematics class. Simon was not mentioned in either interview where she was present, despite featuring prominently in the other interviews as someone to compare one's (male) self with. (Of course I was present throughout as a female interviewer) It seemed that this way of belonging was not used to exclude Helen, but it did not have the same explanatory role when she was included.

Simon himself avoids my questions about mathematicians as a collective, saying "I don't know what a typical mathematics student is". He narrows my question to the "people who do maths in my class" but they have a variety of reasons and are not distinguished by any mathematical sameness:

Simon	They're just normal people.
Cathy	Yeah.
Simon	They're not really into... They're not into maths a lot.
Cathy	Right.
Simon	They're, you know pupils.
Cathy	Yeah, pupils. Do you feel that you're more into maths than them?
Simon	Erm... Probably have a better understanding but not into maths as such.
Cathy	Are you going to be into software engineering? Is that...
Simon	Yeah I think so.
Cathy	Yeah.
Simon	Well I will be. Yeah. In the coming months I guess.

This conversation felt embarrassed as Simon's short answers resisted producing a classroom collective and positioning himself within it or against it. Simon describes his class as "normal people", which means "not into" the mathematics they study. Claiming ordinariness can be a strategic defence against evaluative judgements that fix you (Savage, Bagnall and Longhurst 2001) which suggests that Simon sees 'being into mathematics' as a potential constraint. This is also evident when he separates his ownership of "better understanding" from being "into maths": his mathematics success is natural/institutional but not a chosen affinity sameness. He also positions himself and the other students as "pupils", so still in expectant time and not ready for the mature choice of being one thing and not another. For Simon, the further mathematics collective as constructed by others is an uneasy place. He is positioned by others as taking on personally all the good and bad qualities of belonging to further mathematics, which include the risks of precocious maturity that would settle him as a deficient and isolated adult. He delays talking about belonging as long as he can, however in the end he clarifies that "in the coming months" he will be "into" his university course. In the end, the requirement for self-determination dictates what can be said about belonging: eventually, to be a successful student or employee, Simon must show an allegiance to the work he has chosen.

What Simon's example shows us is the interplay of two different ways of experiencing belonging in further mathematics. There are discourses such as working together for happiness, moving/improving, getting good examination results (especially in the important early modules) that homogenise the collective and create a sense of "all in it together". There are others that construct belonging as proximity to an extreme figure represented by Simon's success, isolation and hard work reconfigured as talent. Simon could have positioned himself as belonging with his classmates or with imagined collectives of distant further mathematics students, even as being particularly distinctive in those groups, but he tries not to invoke collectives at all. For him, belonging in the further mathematics collective is clearly problematic. What are the tensions, and the currents that keep him participating?

Mendick (2006) suggests that mathematics is a subject that students use to prove something about themselves. It helps them occupy powerful positions because it is discursively constructed as absolute, rational and masculine. Doing mathematics gives Simon the possibility of proving that he is able, technologically-oriented, and hard working. He certainly uses this discourse, drawing on family authority to make links between mathematics, science, technology and "how the world works around us" to project himself into a desirable future. He describes himself as "practical", "numerate", not "wordy". However he also positions mathematics as perhaps too "theoretical", only providing access to the world of work whereas for physics "you've gotta understand". So although Simon is willing to associate himself collectively with powerful financial and technological interests, he does not want to follow his father and do a mathematics degree:

> I felt a degree in mathematics would be too theoretical. I wanted a degree that would give me some practical skills and I think, you know, software engineering is... you can get a lot of practical skills in designing programmes, and testing programmes and stuff like that. That's more... You... I think even the workspace, the work environment could be more useful to that.

This imperative to be practical was often reiterated by his classmates (recall AgentX and Tom's emphasis on practical skills and maturity seen in Chapter 5, and see Smith (2010)). I argue that Simon's rejection of the theoretical strengthens his refusal to 'do maths' in a collective where he is repeatedly positioned as extreme. Belonging with mathematics means valuing learning over earning (the degree over "the workspace") and accepting the collective story that his ability is effortless. Simon has not found further mathematics easy, working long hours to make up the reduced lesson time and in year 13 asking his old

FMNetwork tutor to teach him privately. He does not want to appear theoretical or competitive: "my Dad says you've gotta get the highest A, and I'm like 'if I get an A for me it's fine'". Accepting his friends' comparative judgements would increase the isolation that he has imposed on himself in his work, and he is careful not to offer judgements about them in return. Choosing to belong to the collective in the way it is offered to him would undermine his own view of his understanding and his success in managing his work, and put him in a precarious position where working to keep on top precludes being there.

Simon has another ways of belonging with further mathematics: alongside his father and brother in a male family collective jointly constructed around high-status technological work. In my interviews about half of the students, male and female, recalled their fathers when I asked about their memories of mathematics and why they chose it. Mathematics is even more of an inheritance for Simon because it is associated with his British-Indian ethnicity and the "transnationalism" (Rogaly and Taylor 2010) of the Indian diaspora. He intends to find his first job in a big company in the UK but "I think America will always sort of... Obviously a lot of people are attracted to America as well". Family ethnicity and mobility was described as important in other interviews[20], for example when Michael traced his interest in mathematics to his dad's encouragement: "he migrated over from Vietnam and ever since then he has just been reviewing maths with me". In these discourses mathematics stands for an inherited sameness that lasts over time and travel. O'Donnell and Sharpe (2000) report that such family negotiations are important in migrant Asian families and do have effects of producing educational trajectories that feel authentic. Varma (2005) ascribes the mathematisation of Indian (and Indian diaspora) ethnicity to the simultaneity of two processes: west-bound migrants were changing their practices of aspiring and belonging at the same time as rationality became dominant in post-industrial societies. Simon articulates this construction when describing his family's beliefs by drawing on the link between mathematics and "basic knowledge" of how the world works. I therefore read Simon as having a strong way of belonging with mathematics as a British-Indian that supports him in 'going it alone' in school-based mathematics.

[20]All the non-White students at Capital explicitly associated choosing mathematics with their ethnicity; this was not the case elsewhere. Simon was the only British-Indian student in his further mathematics class in a school of mainly White and British-Pakistani students and talked about family rather than ethnicity. Similarly Hayley, the only non-White student in the Moorden cohort, did not mention ethnicity in her pair interview.

Backed by his family, Simon can thus refuse to accept a school collective that positions his hard work and success as natural to him but extreme for others. However he neither fully rejects further mathematics nor distances himself from his friends who do it. I suggest there are two reasons for this. First, although Simon constructs himself as simultaneously 'good at mathematics' but 'not into' it, he intends this to be temporary – only while he is a pupil. The practices of success and effort that position him as successful in further mathematics are inherited from his family and connect him to the present and past. He repeatedly associates the values of competition and doing what is 'good for him' with his father. In contrast he associates collaborative work and practicality with his own happiness and what he will do at university and at work. Thus Simon's future as a self-determining individual requires him to leave his current 'pupil' self. His ambiguity about belonging to further mathematics balances the threat of being fixed into an inherited-but-fixed sameness with trying to keep open the possibilities for the future. It can thus be framed as a neoliberal project and is supported by the institutional discourse of the gold-standard acting as a currency for the future that we saw in Chapter 4.

Secondly, the unease Simon feels may also correspond to a contemporary discourse in which the educational achievement of non-White (especially Black) youth is read as victimising White pupils (Gillborn 2010; Rollock 2007; Sveinsson 2009). He may reject the collective because it incurs risks of highlighting his ethnicity in an otherwise White group. This is similar to the experiences of British Chinese students (Archer and Francis 2005) for whom the assumption of mathematical ability is double-edged. It protects them against the effects of low teacher expectations in schools but keeps them as outsiders. In any case this refusal is rendered ineffective for Simon by the ways that others belong 'around' him, and the contradictory 'evidence' of high examination grades. Simon therefore both belongs (because of other pupils, school and family) and 'goes it alone' to avoid that positioning. Further mathematics aligns him with an ethnic and work-based identity that is apparently independent of school although not of mathematics. But in resisting the power of the collective to define him Simon keeps open possibilities for a future of collaboration, 'keeping it practical' and self-determination.

7.6 Jodie - finding a home

I move on to Jodie because unlike Simon she does position herself inside a further mathematics collective, and produces it as more or less homogeneous. However, she too 'goes it alone' by contrasting belonging in further mathematics with exclusions in school.

Unlike Bob, who considered all his fellow pupils to be disadvantaged by the school's practices, Jodie feels individually excluded. In mathematics lessons Jodie does not feel secure or authentic among the dominant, middle-class, 'popular' students. However in further mathematics she separates her aspirational self from her pupil identity: partly as a defence against failure and also as an assertion of her agency. Although she talks about ways in which she might not be aligned with the further mathematics collective, these discussions always finish with pleasure that she *can* rule herself in and is thereby securely enabled to "change her future". Jodie does not explicitly make her identity in terms of class, but I argue that she is positioned by the exclusions that class can operate (Savage, Bagnall and Longhurst 2001), in particular by the ways that dominant, confident middle-class students and teachers can close her down.

Jodie chose AS-levels in Mathematics, Health and Social Care, Business Studies and Psychology at Moorden, and added Further Maths with the FMNetwork. Her parents care for the elderly in nursing homes, and her sister is training to be a teacher. Jodie originally intended to pursue a career in childcare, having enjoyed Child Development GCSE. During year 12 she changed her mind because she "hated" Health and Social Care, which was "a bit of a pointless exercise". Instead she continued A2 Further Maths in a group of four students that included her best friend Charlotte. Deciding to move away from vocational aspirations towards qualifications with high academic legitimacy involves taking on middle-class values (Richards 2005) and changing the narrative inherited from her family (Cohen 2006). Care as employment is an articulation of working-class femininity (Lucey, Melody and Walkerdine 2003; Skeggs 1997) which Jodie rejects, eventually choosing mathematics and management studies at university.

Jodie described herself in year 12 as a passive recipient of her mathematics education, which has left her with a thread of failure:

> I don't get on well with basic maths because when I was younger, like in primary school, I was never good at maths. So I was in the lower groups and then I came here and I moved into the higher groups and I missed out the middle stage. So basic things like significant figures I really struggle with.

Things changed when she "got chosen" to take mathematics GCSE in year 10: "I didn't really recognise that I was any good at maths just thought I was average. Then I did that early. After I got an A, I decided then I wanted to do it at A level."

Later Jodie did poorly in an FSMQ[21] examination she took in year 11, a set-back to her new-found autonomy in mathematics. This is the memory she recounted when I asked for memories or strong images of mathematics. However she rewrites her pain as "a good lesson" that "woke her up" about actually needing to revise for A-levels:

> I'm glad it happened. It happened. So? It didn't matter that much. Yeah it upset me at the time but it doesn't affect my future.

Despite this claim of resilience, she suggests that it nearly did affect her future. She was no longer supported in doing mathematics A-level: "all my maths teachers were like 'Don't do it. Don't do it' and I was like 'No I want to'". This is another turning-point for Jodie and she repeatedly positions herself as hanging-on to mathematics despite others telling her she does not belong:

> I always wanted to do it and then people told me not to which made me more determined to do well. So that's what made me determined to do well in maths because I want to prove it to them.

This narrative thread of failure means that Jodie's participation in mathematics is continuously contested, but she uses this struggle productively to articulate a coherent identity of self-improvement. In lining herself up against the school she rejects the representation of a naturally successful student, usually considered as securely middle-class (Paterson 2008; Reay, David and Ball 2005), presenting herself instead as an individual entrepreneur. To do so, she resists the unwanted identity that her school inscribes as inherited and transforms it into an affinity sameness. Her position is made intelligible by neoliberalism which constructs its subject as an upwardly-mobile woman, autonomous despite continuous scrutiny, making or discovering her self "in the image of the middle class" (Walkerdine 2003, p239).

Jodie is very clear about the patterns of inclusion and exclusion that have organised her life, and these resonate with exclusions based on class. In her talk she presents herself as needing to work because she is 'ordinary': without access to privileged positions of talent, information about universities or recognition by teachers. Ordinariness is an ambivalent position that can be either working-class or middle-class (Savage, Bagnall and Longhurst 2001), it defends against being determined by others while acknowledging the power of

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21 The Free Standing Mathematics Qualification course bridges GCSE and A-level. Some schools teach it in year 11 when students sit Mathematics GCSE early (Pope and Noyes 2011). Jodie considered a pass as A-C.

those judgements. Her biographical details and the disjunctions of her relationship with (some) teachers and school suggest a working-class background and processes of class mobility (Lawler 1999; Rogaly and Taylor 2010). Jodie is aspirational, although not sure how high to aim without losing the security of being average:

> It's good not to think you're like a million times better than you are, because you're just gonna come down to earth with a nuclear bump one day if you don't [succeed].

As we saw above Jodie has been in lower and higher mathematics sets and feels that teachers' judgements have caused her to "miss out" on learning opportunities that continue to disadvantage her. She is also aware of social exclusions within her peer group. Before the sixth-form she and her friends were ruled out by the majority group of 'popular' students who "just [...] believe they're better than us. They don't mix with people like us". Other students in her school also talked about being positioned as "boffs" but suggest that in recompense they were given a voice by teachers. Jodie accumulates being excluded by both teachers and peers and positions herself as an individual seeking a context in which to avoid constraints imposed in the past.

Unlike most of the students Jodie keeps her home life separate from school, not mentioning her parents at all when talking about choosing A2 subjects or university, and warning them only when she feared things were going wrong. These practices of isolation and independence again position Jodie alongside other working-class students (Anderson 1991; Archer, Hollingworth and Mendick 2010; Hutchings 2003; Power et al. 2004; Reay 2004; Skeggs 2004). They are rational and protective practices when students feel their parents do not have relevant information about school choices (Ball, Maguire and Macrae 2000; Lucey, Melody and Walkerdine 2003). Jodie does assert the influence of a few friends, exemplifying the significance of such friendships in mapping the feasible higher education choices of students of all classes (Brooks 2003). This is particularly significant for Jodie's future because her close friendship with Charlotte is constructed around the further mathematics collective.

Jodie describes how she signed up for the course at the initial further mathematics meeting but, having only a vague interest, then needed persuading by Charlotte to actually attend. We have seen that Jodie's reluctant participation is part of the story of her past exclusions but it is also the joint story of their friendship, so in year 13 Charlotte remembers:

> Me and Jodie were always, she was just like 'Oh I'm going to quit Further Maths', and I am like 'No you are not because if you go I am going' and we always talked about it, but we never got round to.

Although Jodie is positioned (and positions herself) as insecure and needing Charlotte's help she is consistently successful in her A-level class (without Charlotte) and in all her further mathematics modules:

> I thought I was giving up; I went and got an A. Charlotte was like you can't give up now, you told me you'd stay if you got an A. It was supposed to be my get out clause, that one. But I'm glad it wasn't now.

So in further mathematics A-level Jodie is able to tell a story of struggling to be accepted that parallels her previous mathematics experiences, but ends with different outcomes: this time she ends up belonging, not only through success but through friendship. It is a context in which she overcomes the superficial judgements that others make about her. There is a running joke about an episode that position Jodie as emotive, childish and again nearly excluded, saved by Charlotte's intervention that confirms her potential:

> 'Complex numbers are our friends' [Tutor] thought I was mental when I said that because that was the first lesson he ever taught us and I couldn't do it and I got really annoyed with it and then he explained it... I mean Charlotte explained it and then I did it and I went 'Complex numbers are our friends' and he just looked at me. He thought I'd absolutely lost my mind.

Of course as we saw in Chapter 5, the exclusions of seeming childish and emotive are not always damaging. They can serve as samenesses in further mathematics where one can be simultaneously a child and get ahead, be practical, rational and "mental" (Mendick, Moreau and Epstein 2007). For Jodie, as with Charlotte (see §5.3.3), further mathematics is a place in which it is safe to be childish and experiment with failing.

This security of being able, with Charlotte's help, to legitimate her own belonging in further mathematics is accompanied by Jodie's continued sense of exclusion in mathematics throughout year 12. Although her module results establish her as successful, she distances herself from the "cleverest" students in her "normal" mathematics class: two boys who enjoy competing, race through their work and "like to argue about whose method is right even if they're both right". Each of these attributes contrasts with her description of herself as slow, quiet and "just do[ing] what I need to do". She is thus associated with femininity and 'not good at maths' rather than masculinity and 'good at maths' in the aligned binaries of slow/fast, collaborative/competitive, passive/active (Mendick 2006). Jodie does not challenge the boys' valuation of themselves. She is however upset when one applies it to her, and says she "doesn't deserve to do better" than him in examinations. As we saw in Chapter 6, Jodie resists this comparison by suggesting that she is more mature and has learnt from experience that what counts is work: "I did try and he didn't". We can see here how the discourses of mathematics work to exclude Jodie and how, in accepting the practices of others, she accepts that exclusion.

There is another classroom practice that distances Jodie from mathematics but not further mathematics. In mathematics she is reluctant to play the role of a good student by contributing publicly: "I don't do any class discussions generally as you have probably seen. I'd rather just sit and understand it myself". She knows that this refusal positions her as unconfident, perhaps immature, and that this will cause her teacher to judge her as lacking ability (Black 2002; Hardy 2004):

> I'd rather not say what I think or what I know because I... in case it's wrong. [My maths teacher] seemed to think that that meant I wasn't good at maths and he just seemed to be convinced that I was going to fail basically and he gave me 3's for my effort on my report [...]. But then he suddenly got this new found confidence because I got an A.

Here she uses her successful examination results to back her judgement of her self against the school's. Jodie is one of the few students to talk about peer exclusion. In the year 12 mathematics lessons she notices that the students who once "controlled" year 11 are getting less powerful. Adolescent popularity is constructed around audience (Currie, Kelly and Pomerantz 2007) and Jodie distrusts these "loud people who just say what they want [and] think 'We don't talk to you'". As we saw above she does not readily challenge others when they promote themselves. Her silence in lessons can be read as a refusal to be present in her subordination.

Jodie behaves differently in FMNetwork lessons:

> I guess if I'm with my friends, well a group that I feel close to, like in Further Maths I guess. I still won't answer many answers but I'm more likely to because I know all the people and it's a very small group, there's only like seven of us in it. So I'm not like as wary of people. And I understand what we're doing. It's like totally new to all of us. That doesn't mean we're all rubbish.

There are many overlapping reasons and fears here. The FMNetwork tutor (who they nickname "Mr Further Maths") comes from outside the school and is not implicated in past achievements and failures. At other times Jodie stresses that school teachers do not understand how further mathematics works, and therefore do not understand her. Secondly, further mathematics is hard for all the students who do it, a sameness which is collectivising, and they are all expected to talk about what they do and do not understand. The smallness of the group contributes to creating a collective in which they confirm each other's worth, especially in year 13 when they "all sit at one table, and work everything out together". For Jodie, "doing Further Maths has made us closer [...] we're the only people who can help each other", suggesting something of the loyalties of a gang but without the moral panic (Hall et al. 1978).

By year 13 Jodie sounded more established in both classes, saying that "in maths we're all kind of on the same level, and we all help each other". In further mathematics she sometimes feels "not as good" as Charlotte and Paul who are "way up there", but she makes this into a reason for "trying harder" because she wants to be able to do it. For Jodie then, belonging to the further mathematics collective is about shared aspirations, a place to experiment and construction of autonomy. Within the collective she can 'go it alone', matching the past rejections by school mathematics to her discovery of belonging in further mathematics. This not only allows her the benefits of academic success, but positions her as reclaiming her authentic entrepreneurial self. School mathematics did not seem to value her: silent when she should have spoken, practical not theoretical, hard-working rather than 'naturally able', achieving whatever was not predicted. Jodie uses the imagined collective of the FMNetwork to express her independence and as a technology for bringing together – although not completely reconciling - her aspirational identity of autonomous self-entrepreneurism with her identity of past institutional exclusion. Her choice to combine mathematics with management studies in her degree (in case it was "too boring" and theoretical) suggests that the insecurity of her position remains (Rodd, Mujtaba and Reiss 2010).

7.7 Summing Up

I have explored these three examples in depth to show how it is possible to think about currents and tensions between belonging with further mathematics and other forms of belonging. I have argued throughout this thesis that students make choices about further mathematics that are guided by a neoliberal model of subjectivity as being engaged in a rational and purposeful project of self-expression, self-discovery and self-control directed towards socioeconomic ends. In this chapter I have shown that the way students experience themselves as belonging in further mathematics can be reconciled with the requirements for coherence and autonomous self-determination that such a project requires.

The production of autonomy is evident in all three accounts of belonging. Indeed they go further and build in a trajectory that distances them from samenesses, particularly school -

constructed ones, that they experience as inherited exclusions. In doing further mathematics, they are doing independence: producing themselves as autonomous, distanced from constraints, able to 'write themselves differently' within further mathematics (Luke, 1995; see 1.2.2). Both Jodie and Bob constructed the further mathematics collective in this way and themselves as newly enabled to choose where to belong. Although they framed their trajectories as aiming for individual success, the collective was necessary to their experiences. Jodie could not achieve without the security of aligning herself through friendships, nor Bob without learning the expertise of his teacher. They needed the practices of the self permitted by the collective in order to produce themselves as legitimately the same as other members, happy in this knowledge. Simon's position of autonomously 'going it alone' needed more careful negotiation as he was positioned as 'naturally' belonging to mathematics by his family, teachers and friends. However by refusing to accept as secure and pleasurable the affinity samenesses that inscribed him as having achieved belonging, and focussing instead on how the FMNetwork requires hard work that is 'good for him' as a pupil, he defers being fixed into a position that appears stable but is actually precarious. Instead he allows himself room to inhabit a more collaborative working future than his family ambitions and the mathematics collective might allow.

The autonomous transformations in these accounts are presented as intentional, aimed at creating a coherent self in face of the threatened unhappiness of being unable to reconcile multiple identities. All three students searched for ways in which to 'do' individual success without transforming themselves. They describe the belief that they can succeed as central to themselves (and their family collectives in the case of Bob and Simon) and thus it is one that would be unbearable to lose. The tensions that potentially prevent success come from samenesses imposed by others in their schools, that is threats that have power over them but that contradict their individuality. The *inside/outside* discourse of the FMNetwork and, for Grants and Capital students, the fact that further mathematics was completely separate from school were crucial in legitimating their claim to experiencing it as a place to reconcile or avoid tensions between autonomy and institutional positioning (Furlong and Cartmel 2007; Harvey 1989; Valentine 2007).

These accounts were thus told primarily as stories of success, conveying both a neoliberal requirement to work towards the happiness of belonging and coherence, and a developmental requirement that stories of adolescence end by reconciling generational conflict and psychological unease. However, unease does persist in them. Looking at the space "around" success as well as what it occupies (Mendick, Moreau and Epstein 2007, 2009) reveals the belongings that further mathematics does not completely reconcile, and I continue this in the next chapter.

The importance that students give to creating a coherent self is helpful in understanding wider patterns of exclusion and inclusion. Simon and Bob give two different examples of individuals reproducing themselves in the ways expected of them as young aspirational British-Asian youth. Although this belonging was expected, I have shown it was not without difficulties and they had to negotiate how they belonged to further mathematics in order to achieve their own adolescent identity projects. I also argued that Jodie positioned herself using discourses of exclusion – being silenced in the classroom, relying on friends not teachers, being slow and caring rather than fast and competitive - that all resonated with the ways that academic success is usually inscribed as White, middle-class male subjectivity. The parallel discourses that associate the FMNetwork with employability, practical applications and non-coercive spaces were important in allowing her to contest this representation and so to belong. All three students are working with tensions between themselves and their schools that they see as lasting into employment. All three maintain their experiences in further mathematics as self-entrepreneurial resistance that shows them as able to reconcile these threats to their future success.

This does not mean that students see further mathematics as eliminating the other constraints upon them, that they are 'subsumed' into mathematics (Hall, 1996). The way that students' talk embeds the FMNetwork in school practices (and contrasts it with them) produces it as having only a temporary effect in enabling a coherent resistance to institutional and social positions of exclusion. Students had continually to reiterate the FMNetwork discourse that further mathematics was both theoretical *and* practical in face of other discourses that it related only to school. This would explain why many students who enjoyed mathematics chose degree courses that included another subject. Table 7.2 below shows the students' choices of university degree course (for pre-UCAS interviewees these are intentions only). The shaded names show students who completed two years of further mathematics. Even students who continued further mathematics to the end hesitated about committing solely to mathematics at university.

University course …	Applied for	Intend to apply for
Mathematics	Helen Sukina	Ricky
Mathematics and another subject	Charlotte Charly Jodie	Joe John Li Mai Michael
Science/ engineering	AgentX Bob Mario Steffi	007
Computer science	Paul Simon Tom	
Business/economics	Clive Steve	Hayley
Arts	Ellie Esther	
Undecided/ not going	Randall	

Table 7-2 The university applications of participants

This chapter introduced the idea of further mathematics as an imagined collective, which could be extended to a university mathematics collective. I started with the theoretical notion of the FMNetwork as an community where belonging is legitimated by homogenising samenesses that are not contingent on physical proximity. These belonging practices could be specific to further mathematics. However, even when I asked directly, aspects such as the FMNetwork branding, online resources, textbooks and attending revision events did not feature strongly in students' accounts of experiencing belonging. The social practices of the school and classroom – how they allowed students to determine themselves as the same or different to others, happy and secure - were far more important in making it possible for them to belong or not.

One key practice that marked out sameness across the collective was examination achievement. It is no surprise to find that A-level students continue the practices of primary and secondary pupils and treat the outcomes of assessment as producing their selfhood and determining their capabilities (Putwain 2009; Solomon 2007a; Wiliam and Bartholomew 2004) In the crucial early year 12 modules, this emphasis was largely productive, providing comfort that students belonged. Later, Further Maths results featured strongly in students' accounts as unpredictable, with effects that will need to be explained in their identity projects and this risk to self-government was a main reason given for giving up.

I have already discussed how neoliberalism enables the discourse of 'going it alone' to override temporarily the exclusion of examinations, or in Simon's case the unwanted effects of inclusion. Bob and Jodie's examples show that constructing relationships with teachers is another way of negotiating belonging. Relationships that foster belonging were produced as good mathematics teaching, as responding to learning needs, but primarily as help that recognised the students as individuals who could succeed despite their perceived failures or differences from ideal students. Watson describes how mathematics classrooms often lack such relationships:

> The kinds of teaching available often fail to match with the adolescent need for support for the process of self-actualisation, and for other social, emotional and psychological moves from childhood to adulthood. Teaching can be exploratory and life-developing at all levels of mathematics, but is more often a mixture of offering rules which are hard to follow – a cruel mixture of apparent safety which conceals high risks. (2004, p376)

Although I would want to unpick the 'need for self-actualisation' and 'psychological moves', the characterisation that mathematics teaching offers deceptive comfort in rules which are hard to follow seems very like Bob's experience. He describes the independence he gains when his FMNetwork tutor is open about risks and explores his understanding rather than repeating mathematics's rules. This means he feels equipped to work towards progress. Jodie too finds it possible to participate and share her understanding when the small further mathematics A2 group works together and the subject's acknowledged difficulty makes "going wrong" common for everyone. The significance, and perhaps the complexity, of maintaining such relationships will be evident in the next chapter too.

Finally, I want to note the importance of the fact that the further mathematics collective was positioned as out of school. All three of the students I discussed here were enabled to produce themselves as successful precisely because further mathematics was not initially offered in school. They not only took up an opportunity that the school could not offer them, but they continued *because* it was not the school that was offering it. This aligned them with the policy discourse of employability that relocates the responsibility for lifelong and economically relevant learning to individuals rather than the state (Hesketh 2003). The 'war for talent' locates employability in individual skills and self-presentation over and above institutional credentials (Brown, Hesketh and Williams 2004). In the next chapter I discuss how students positioned themselves as becoming more independent through further mathematics and how (and in what circumstances) this could be understood as a product of themselves or of mathematics.

Chapter 8 Struggling with Independence

In this chapter, I argue two points. First, that students' participation in further mathematics is best understood as a means for them to experience independence. Secondly, that the practices of independence that are allowed at the intersection of further mathematics and school build in exclusions as well as inclusions. I do so by considering the ways that further mathematics meshes with discourses of independence, and how students can be inscribed within them. This develops my argument in the previous chapter that students positioned themselves as belonging with further mathematics as a way of escaping or at least adapting constraints inherited from school or family.

What does it mean for a neoliberal subject to be independent? This is almost a tautologous question. I established in Chapter 2 that individual self-governance is at the heart of the neoliberal subject and its theorised relationship with society. Discussions of modernity revolve around the freedom of the individual (Bauman 2001; Carter and Virdee 2008), the lingering power of societal constraints (Atkinson 2007a; Beck 2000; Mayo 2006), the authority to personalise identity (Butler 2008; Giddens 1991), the adequacy of describing experience as a pursuit of separate autonomy (Griffiths 1995; Walkerdine 2007), and self-management as replacing state governance (Rose 1990, 1996).

Here I take independence as a practice of adolescence (and colonialism, see Lesko (2001), Fraser and Gordon (1994)) that claims autonomy and freedom as qualities that are individual: not granted, devolved or imposed by others. Independent selves are produced as units of truth-telling, governance and will just as independent nations are. Thus the independent adult self is "transparent to itself and responsible for his/her actions and exercising conscious 'choices'" (Besley 2002, p335). Neoliberalism constructs individuals as naturally self-governing but fallible. As such, they are always under scrutiny and in need of re-shaping, but (in the first instance) by themselves and not others (Rose 1999). Normalising practices of (self-)surveillance and (self-)management are understood as desirable first for individual well-being and then for collective well-being. They are necessary to inscribe subjectivity: being a neoliberal self means knowing and acting on oneself and constructing one's independence in the spaces available. These spaces must include the economic and hence this entails becoming an entrepreneur of the self (du Gay 1996; du Gay 2000).

Of course, it is *social* discourses that inscribe individuals with the opportunities and responsibilities of exercising 'their' freedoms and pursuing 'their' autonomy. But 'becoming independent' is an ongoing process through which individuals are distanced/distance themselves from what is deemed social and external about these inscriptions, adopting them as internal practices of the self. It is this that we saw above in Jodie and Bob's accounts of escape and Simon's account of managing his own adolescence between family, school and friends. These students constructed new discursive landscapes in further mathematics where they could 'go it alone', ascribing themselves as with self-knowledge, a will for self-determination and responsibility for following this personal will.

Rose (1999) stresses that social control and autonomy are produced together. Neoliberal governments safeguard 'private' zones in which autonomy is to be respected, and simultaneously shape individuals' responsibilities for their conduct in these zones. Being autonomous therefore means you have to be accountable for your choices and how discourse positions you. In Chapter 2 we saw that practices of the self included moral codes and sanctions (Foucault 1984). The kind of punitive sanctions that work between the individual and the state, or between individuals, are exercised more subtly in a neoliberal society that relies on individuals governing themselves. Threats of direct punishment are replaced by re-organising the relationships between individuals and institutions in order to make visible the threat of failing to make economic capital of oneself (Steer et al. 2007).

This works in two ways: education is the primary disciplinary mode of the neoliberal state - it shows people how to deploy themselves effectively and 'fixes' them if they do not do it properly (Coffield et al. 2007; Steer et al. 2007). After compulsory schooling, there are the welfare/employment technologies of lifelong learning and entrepreneurism, psychotherapeutic technologies that teach self-knowledge and care, and market-media technologies that guide you in defining yourself by your consumption. All these are forms of education in which experts provide us with 'public' languages, practices, techniques and artefacts that we assemble into the 'private' effects of psychological interiority (Rose 1996, p226). Inside schools and colleges, teachers' roles have changed not just to be experts in their subjects but to be experts in how to teach students to be independent learners (Blenkinsop et al. 2006; Edwards 2008; Young 1999). Indiviudals need to be taught their responsibilities to monitor and improve themselves and be taught how to be happy with them.

Secondly, dependency is pathologised in a self-perpetuating spiral: the more suspect dependency becomes, the more individuals aim to eliminate its socio-structural basis. Men, middle-class women, pensioners and working women have in turn successfully variously constructed themselves as independent, leaving dependency to addicts and welfare recipients typically represented as poor, black women and children (Fraser and Gordon 1994). The sanction for not becoming autonomous is being judged as unable to choose for oneself. This renders one still a child, not employable, not civilised, and unable to take part in the practices of seduction and consumption by which contemporary society is simultaneously integrated and individuated (Bauman 2001).

Independence is thus a particular concern of students, who are positioned as lacking it but required to achieve it (Leathwood and Read 2009). Their need to become independent is continuously undermined by their need to develop expertise in the institutional technologies that demonstrate it. In this chapter I investigate the discourses that operate in further mathematics, how they produce students' claims to be independent and how they prevent those claims. These feed into my research questions: Q2 concerning the power relations in discourses of further mathematics and Q3 concerning the subjectivities they inscribe. I start by outlining the relationship between students' participation in further mathematics and their descriptions of becoming independent. In the last chapter I showed how strong accounts of belonging were supported by managing discourses of sameness and 'going it alone', and these gave new routes into advanced mathematics. Drawing on the samenesses of adulthood, students could frame their experience as a quest for independence within particular further-mathematical discourses of possibly-precocious maturity. Here I look at the same discourses first through the accounts of three students who struggled to find tenable positions doing school further mathematics, and then briefly through emails from students after starting university. Together these suggest the significance and continued effects of understanding further mathematics as producing independence. It also shows how old patterns of exclusion operate through the technologies of teaching responsibility.

8.1 Further mathematics as becoming independent

In this section I give an overview of how the students presented themselves as becoming dependent/independent while learning further mathematics. Independence as a personal quality was discussed explicitly by 23 of the 24 students. They also discussed their dependence on others, sometimes explicitly, sometimes through their feelings of pleasure, pain and maturity as they worked with others. In the later interviews and emails I initiated this by asking students to choose adjectives that did or did not describe them as learners (see appendix 4.5). Out of the seventeen responses to this question, twelve students picked *independent* as applying to them and four as not, and many students also picked *realistic, competitive, lazy, flighty* and *disciplined* (see details in Appendix 4.5). The subsequent discussion around these choices provided a fruitful way into investigating what was involved in students' descriptions of dependence and independence, whether mathematics or further mathematics were involved, and what effects there were for participation.

As discussed above, contemporary independence is shaped into a thinkable and manageable form through discursive technologies that require personal will, responsibility and expertise in self-management. This was certainly consistent with how students assembled the self-descriptions that combined other qualities with independence. Students who felt 'competitive' explained that they were more "willing" to "go for it" and achieve the best for themselves; while those who did not explained instead that they were autonomous in scrutinising themselves and *not* being diverted by their peers:

> Competitive, if you have a competitive spirit in a job you're more willing to be quick off the mark. You're more willing to try and get further in your career. And independent, able to work independently. Help, you know, go that step ahead, because they all relate in that respect. And then... but, then again, you do need to work as a team. But it's the independent spirit can help to further it. (Esther, year 13, independent and competitive)

> And I'm not... I'd rather not be competitive. That's just not in my personality because at the end of the day I'm just trying to find the best answers for myself, whether that's like just talking to [teacher] and getting answers or... You know, I'm not... I don't try and beat anybody. I don't try and get better than anybody, I just settle for what I've got and it's... You know, that's it. (AgentX, year 13, independent and not competitive)

Feeling 'lazy', 'flighty' or not 'disciplined' were described as not yet being able to control work practices as schools or examinations required, but accepting the responsibility to take over self-governance, the need to 'do it myself':

> No one really sort of focused me; it has to be myself that does it. So it's only when I have to be, only at the last minute when I sort of focus myself enough to get the work done, which I normally manage eventually. (Tom, year 13, independent and flighty)

> Discipline would probably be useful, but I think in the workplace I am disciplined in what I do, it's just with normal work, like school work that I'm not disciplined really. In the work place I just get on with things and do it myself anyway. I don't need someone there telling

me what to do and to get on with it, I just get on with it anyway. (Steve, year 13, neither independent or disciplined)

Students described themselves as 'realistic' when they accepted responsibility for their own working practices and achievements, but also when they realised that they could not be as independent as they wished:

> Realistic. I know that if I'm doing... if I need more help or need more work, I'll go and get it. [...] I'm realistic in my grades that I think I'm gonna get. I'm always quite like... You know, like people will be 'Oh well, I think I'm gonna get an 'A'', and I'll be like 'Well, I think I might get a 'C', so maybe I'll work a bit harder and try and get a 'B'', or something. So I think I'm quite realistic in that sense. (Helen, year 13, independent and realistic)

> If you email [the FMtutor], it's not like... 'cos she can't like make you see things, you just have to write it and you just have to accept that she's right and not... Then you might be able to answer the question. You might just have to be like, 'Yes I understand that you can do it but I don't think I can do it.' (Ricky, year 12)

In both those quotes we can start to see how easily realism can change from assessing the situation and taking responsibility to accepting that one may not achieve. There is a tension that realism may be necessary to give evidence of maturity and autonomy but accepting the 'realistic' view may limit one's pursuit of success/happiness

Independence was thus an imperative that underpinned students' progress as learners. It was also understood as significant for employment and adulthood. For example, it was chosen most often as the quality that would be useful for later life, because of its value to employers. In Chapter 6 I showed how the discourses of further mathematics made it difficult for students to find happiness in the ways that they expected in mathematics classrooms. Students negotiated these tensions by giving up on the secure dependability of mathematics, thus meeting the imperative to become independent by accepting risks. They continued to value working with peers but constructed it more productively as distancing oneself from adult support, and thus another route to independence. Students needed to make such negotiations because the dominant tone towards dependence was derisory, associated with regression to childhood:

> When you're doing A2s you can't be really dependent on anyone else to do it, you have to go with it yourself, find your own resources, etc make your own mistakes. Especially in Maths, I think that you can't... Like if you make a mistake with a problem you can't just go running to your teacher and be like I can't do it. You have to like do it again and again and again until you get the right answer. (Jodie, year 13)

> I'm not as independent as I could be. I'm used to my mummy making my lunch for me, and my mummy getting me up! (Mario, year 13)

> You're pushed so much by parents and teachers that it's just so un-independent however much they claim it is. But whereas next year I can do it when it suits me, even if it's after a big night out party, it's when it suits me and there's no one else to blame. (Charly, year 13)

I used these self-descriptions to examine how the 22 further mathematics students presented themselves as *being independent*, *wanting to be independent* or *not yet ready to be independent.* These three positions are not a priori distinct: they reflect the underlying imperative eventually to become independent adults and also the discourses identified in the data, which positioned students differently in different lessons, at different times and in different interactions. As in the quotes above, students could half-joke about being a mummy's boy and then describe completing extra homework unasked all year: there are a whole gamut of complementary ways of being in/dependent. Therefore I refined my analysis to focus on whether these accounts cited mathematics and/or further mathematics as contexts that required, allowed or prevented the practices they described as independence. The following three tables put the students' self-descriptions in the context of their participation in Further Maths. To do this I have grouped the students according to the position that they constructed/were constructed by most strongly in their reflective accounts: usually that taken towards the end of their participation when they reflected on their development and choices. I do this to show an overall pattern: the students who constructed the strongest claims to independence in further mathematics are those who chose to continue n year 13.

Table 8-1 'I am independent': shaded names are students who completed two years of Further Maths.

I am indepndent ...

... and I can be in Further Maths	... and I can be in mathematics but not in Further Maths	... and I am in a different subject
Bob		
Charlotte		
Helen		
Jodie		
Li Mai		
Paul	Joe	Esther
Simon	Michael	Tom

Table 8.1 shows the 11 students who constructed claims to 'already be/ have become' independent in their school work. In the first column are those who produced their independence within further mathematics. These include Bob, Jodie and Simon whose use of further mathematics to 'go it alone' I discussed in the last chapter. All these students continued for two years (as shown by the shading). In the second column are two students who worked mainly outside their school lessons in mathematics - Joe on his own and Michael with his father. After AS-levels they decided to concentrate on core subjects and did not continue further mathematics. I have chosen to discuss Michael's account in this chapter because there are ways in which further mathematics does inscribe him as independent although ultimately he cannot take these up. In the third column Esther and Tom explained that they had achieved their independence from having to manage the reading and research demands of English and Geography respectively, and both stopped further mathematics.

Table 8.2 shows the students whose accounts constructed them as wanting to become independent in their work: In the first column, Charly, Mario and Sukina positioned themselves as becoming independent in further mathematics and completed two years.

Table 8-2 'I want to be independent': Shaded names completed two years of Further Maths

I want to be independent

... and I am getting independent in Further Maths.	... and I can be in mathematics but not Further Maths.	... and I cannot be in either mathematics or Further Maths
Charly		
Mario		
Sukina	John	Clive

In the second column, John described himself as independent in mathematics because he found he "learnt more" by using examples from the textbook, but could not "get a hang of it" in further mathematics where he needed the teachers' explanations. He did continue however, because he felt he could eventually do well. He called on two protective discourses to legitimate this. These were his good early module grades in Further Maths, and also his British-Chinese identity (Archer and Francis 2005) which he described as "mostly Chinese people are good at maths". Finally, as we saw in Chapter 6, Clive disliked needing so much help in mathematics. He articulated mathematics as denying him independence and was thus tempted to give up. However he eventually stuck with it and gave up further mathematics. Within these accounts too, the discourse of wanting to become independent was contested in accounts of choosing further mathematics.

Table 8-3 'I am not ready to be independent'. Shaded names are students who completed two years of Further Maths

I am not ready to be independent

... but I have to be in Further Maths	... but I have to be in mathematics and Further Maths
AgentX	
Randall	
Ricky	
Steffi	
007	Steve

Table 8.3 shows the third group of students who explicitly said they were not ready to be independent in a school context. The neoliberal imperative to become independent was evident in the confessional nature of these accounts, and how they described their painful

experiences of trying to succeed alone. The imperative to be happy impels students to give up further mathematics, and the table shows that most did.

From this group I go on to discuss Steffi and Randall because they are students who continued further mathematics and tried to find their own ways to become independent within it. Steffi consistently tried to position herself as mature yet dependent on others; in the end this discourse becomes untenable within further mathematics and other family circumstances. Randall is a student who simply could not construct a coherent position in which he could sustain his idea of personal, practical independence with that required by the school.

The overall pattern suggests that becoming independent is indeed a significant presence in the discourse of student choice. Further mathematics is a context in which independence can be claimed and performed, but successful outcomes are not guaranteed. Where there are significant tensions between the neoliberal requirement to become independent and their experiences in further mathematics, then students tend to give up further mathematics. The students who varied this pattern were largely those taking only AS-level (Joe, Michael, 007, John) and it may be that the epistemic and social demands of AS-level emphasise independence less strongly. In the next section I use the three chosen accounts to show how students' sense of autonomous choice was produced by the responsibilising and personalising effects of discourses of educational independence, and how these contributed to constructing failure.

8.2 Discourses of independence

In this last selection from my data, I start with Michael and use his account to illustrate the discourses that students used to position themselves as becoming independent through further mathematics. These are *resistance* to school constraints (as we saw in the last chapter), *claiming authority* to speak for oneself as a learner, expertise in *learning for and about oneself* and *taking/accepting responsibility*. Then I use Steffi and Randall to explore some of the ways that students are excluded by the imperative to independence and how they tried to resist it. Finally I draw on emails from when the students had started university to illustrate how the discourse of independence in further mathematics persists in the form of self-management rather than solitary work.

8.2.1 Michael

Michael studied Mathematics, Economics and ICT A-levels in the large sixth-form of a London school and started AS Further Maths at Capital. His learning background has similarities with that of other students: like Sukina, he had been accelerated in GCSE mathematics and taken an AS-level module in year 11; like 007 he decided to retake his year 12; like many he talks of his mathematics as a childhood pleasure that creates a bond with his father. Although he constructs his account of independence as a combination of personal circumstances and qualities, the outcomes, choices and discourses he uses are the same as those that structure the accounts of other students who struggled.

Michael's family are working-class British-Vietnamese. His father is a bus driver with passions for mathematics and politics that have inspired Michael to study economics at university. I interviewed Michael once, when he had just decided to restart year 12 Economics and ICT, continuing with A2 Mathematics but dropping Further Maths completely.

When Michael introduces himself as independent he weaves together the discourses of independence as *resisting school constraints*, *claiming the authority* to speak for himself as a mathematics learner, and *learning for/about oneself*. He is positioned to make this claim because he does not learn mathematics in the classroom, but at home with his father:

> I usually walk in knowing it already. But at home I learn a different thing. I tend to read the text, basically our book yes, I read through how they explain it, examples, then I tend to do the easy questions first like straightforward questions when they ask you about that. Then they apply it to sentences and how they phrase different questions and everything. Then I try and figure that out as well. So that is how I do it.

The practices underlying this explanation of Michael's independence were similar for all the students who claimed to be independent in mathematics or further mathematics (that is, those in columns 1 and 2 of table 8.1). Around half the students insisted that their main learning was at home from textbooks and past papers; the others felt the teacher was most influential. I showed in Chapter 6 that working alone was a new and significant demand in further mathematics. Many students found this requirement painful and blamed it on their school circumstance: only needed because they found some teachers' explanations formulaic, hard to follow or simply forgotten by the time they got home after an extended FMNetwork lesson. Here, though, Michael uses his home-work as evidence of his independence in mathematics. It justifies him in challenging the normative position that learning takes place in the classroom, and distances him from his teacher and his peers.

Thus he introduces his independence as an act of silent resistance: "I usually walk in knowing it already". The timelessness of "usually" and later "tends to" establish him as having both self-knowledge and strength in this position. He then describes the way he reads mathematics textbooks, building from explanations to "straightforward questions" and word problems ("sentences"). The correspondence between what " I do" and what "they" do, sets up a personal dynamic that shares his rhythm of learning with the textbook's authors, aligning his own learning journey with their logic and giving him authority. Other students also gave similar overviews of the mathematics textbook. In doing so they presented themselves as effective in using the books independently, tailoring their work to their own needs. They also present themselves being knowledgeable about mathematics education technologies. By matching his learning with the textbook, Michael claims and reinforces his legitimate claims to speak for mathematics and for his own learning.

Solomon (2009b) identifies teachers' epistemic authority in the classroom as inducting students into the practices and literacies of mathematics. It is inherited partly from the certainties of mathematics itself, partly from socially-legitimated participation in a mathematics community. Teachers also have social authority that derives from the social practices of the classroom and affects who acts and what they are allowed to say and do. Students can take over both kinds of authority. Here Michael claims epistemic authority in his knowledge of books and learning and this permits an associated claim to social authority. After describing his work, his summarising sentence "that is how I do it" connects back to his initial claim "I usually walk in knowing it already". It supports his right to social authority and enables him to challenge school social practices that otherwise create him as dependent. Thus these three discourses are mutually supportive in demonstrating Michael as having an expertise (in textbook skills) that allows independence and also a sense of wilful pleasure in resisting the school norm and being able to learn alone.

Mathematics is the context in which Michael can show himself as able and successful, resisting school constraints but accepting the goal of investing in his own self and its economic self-actualisation. Because he learnt at home he could maintain a performance of ability and autonomy while fulfilling the classroom imperative 'not to work' that I showed in Chapter 6 : "Oh yes I am good in the class but I am very lazy, very lazy!" In the same conversation he argued for the mature imperative to work: "maths, if you don't work then you are not going to go nowhere, basically." He reconciles these contradictory imperatives by assigning them to the different practices of school and home, assembled as mathematics.

In further mathematics Michael also worked at home, trying to "figure it out together" with his father. Michael observed how his father would sit and spend the night working through the textbook so as to be able to explain unfamiliar topics:

> Oh that was different. I mean my dad didn't study that, so we basically went through that together as well. So that was a new thing for him and it was a new thing for me. So we sat down and read through the book ... yes it was completely different. It was good actually. I mean I enjoyed it. I thought I was alright, until the exam results.

Although further mathematics felt different to mathematics, Michael describes how it too involved the process of working with the text book and interrogating one's own understanding: that is, exactly what he used earlier to justify being independent. One interpretation is that Michael simply achieves this independence in school by relying on his father rather than his teacher, but Michael emphasises their actions as learning together. He makes a slightly different claim: that his father's example taught him how to teach himself, and this change marks him in becoming independent from his father and from school:

> Yes. I mean, I got that from my dad really. Before I used to rely quite a lot but then I started picking up how he used to do it so then I just started to do it myself as well. It's yeah, I teach myself.

There is a slippage here: he uses this discourse of autonomous learning to claim confidence and independence in mathematics but the experiences he draws on are those of learning further mathematics. He "used to rely" on his father's help in mathematics but when they had to learn further mathematics together, Michael adopted that model for teaching himself mathematics as well. Further mathematics is thus central to Michael's construction of independence as developing the expertise "to do it myself" even if it is not the context in which he chooses to show authority or resistance.

The discourse that Michael makes most use of is independence as *learning for/about oneself.* This discourse brings together two aspects of students' work: firstly, when Michael (and other students) talked about independence in further mathematics work they stressed their own decision-making (e.g. sitting down and reading the book), their feelings of tentative enjoyment ("it was good actually") and their maturity in discovering this "new" practice. All these associate learning mathematics with learning something *about* oneself. The second aspect is how students connect their experience of working individually and with uncertainty to the type of learning that goes on in FMNetwork lessons. In the previous chapter we saw that Bob saw himself as enabled to become an ideal, independent student when teaching recognised "how he learnt". Michael also described FMNetwork teaching as personalised, "aimed especially at you". One of the most fiercely independent students was Helen, at Grants, who in lessons treated many of her teachers as a nuisance, just "standing over me and being like 'Oh, you're doing that wrong', or 'Oh, you need to do it like this, don't you?' I like working it out for myself". When it came to further mathematics however, Helen connected her knowledge about the subject and herself to the model of mathematical processes that her teacher had discussed with her:

> You'll stare at them and see like a really long equation thing with like trig functions, and you'll be like 'Oh my god!'. Whereas if you work it through like logically and slowly and kind of bit by bit, you kind of realise 'Actually, I can actually do this and I know what I'm doing'. So I think that's the way that I would approach it. That's the way I've always been taught to do things.

The students' discourse of learning for oneself has similarities to the classroom teaching aspects of the broader 'personalised learning' policy discourse[22]. I use a similar term here because one element of the personalised learning policy is to help (and make) students recognise their learning needs and be responsible for their own learning. I think it likely that Michael, Helen and other students were aware of this aspect of policy discourse in schools and this helped to form their arguments that learning for yourself was a valuable indicator of independence.

Michael's independence in mathematics lessons showed itself as distance. In contrast he "learnt quite a lot" during the FMNetwork lessons, where the combination of a "good teacher" and a small group meant that he could ask questions and follow explanations. Michael explained that the FMNetwork tutor, like his father, connected mathematics to his own understanding. He did not resist his comparatively dependent position of having to be taught in further mathematics. Instead, because the teaching was personal, he used it as more evidence of being independent.

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[22] Personalised learning has been adopted as a policy term for educational reforms that might broadly be termed personalised pupil-management. School leaders are encouraged to tailor teaching, assessment and the curriculum to allow maximum individual student choice and rapid flexible interventions (Pollard and James 2004; West-Burnham 2008).

Despite this central explanatory role, Michael does not continue further mathematics after receiving his AS-level results, and he does not interpret this as relinquishing independence. This is because of the fourth discourse that constructs independence as *taking responsibility*, and as we saw earlier (§8.1) connects it to realism, maturity and sanctions. In Michael's case taking responsibility for his learning compels him to have to give up further mathematics. At AS-level Michael got a D grade in economics which he found unacceptable. He did not want to resit AS modules during year 13 and was allowed by the school to start year 12 again. This freedom to choose an unusual trajectory keeps students involved in choosing and managing their own 'personalised' learning but also ties them to the school that provides that technology of independence. Here choosing does position Michael as becoming autonomous, but he also has to accept responsibility for his decision and for his failure. One of the negotiated sanctions is that he gives up further mathematics, a decision articulated in his own interests: "it was because I decided to retake year 12. So I can't afford to... I would carry on, but I can't afford to slip up on my two subjects". The responsibility of choosing imposes a rationale wherein any out-of-school learning is a risk he must not take. It has the effect of binding him closer to the school and its opportunities, so that the school discourse of neoliberal responsibility becomes inescapable.

For Michael this was a moment when home and school discourses of independence collided. The school discourse prioritised responsibility and was backed by an institutional logic of deploying scarce resources. These were then read into the individual as constraints arising from his own scarce capabilities. In the home discourse, the priorities awarded to *learning for/about oneself*, time and ability are presented differently, without this limiting power. Michael had to persuade his father that it was an imperative he had to follow: "I talked to him about it, how I think I have got to concentrate on my two subjects. So he said yes, I should do that and maybe consider taking it next year again". This is the only occasion in Michael's interview when he suggests that his 'thinking' has any power to overcome his father's perspective on learning. He can do so because he is backed by the school discourse of responsibility that he is compelled to internalise.

Throughout this study we have seen how examinations are produced as disturbing old understandings of the self and bringing in new ones. We see it again here when Michael says "I thought I was alright, until the exam results". However, his example shows that it is not simply a question of grades presenting students with a new, 'truer' self-knowledge, neither is it knowledge they may accept or resist depending on their 'mindset'. The institutional effects of examination results position students as having to make certain kinds of choices within discourses of rational self-investment. They have to give some things up in order to stay responsible: Michael gives up the independence of sustaining a sense of going-it-alone in his learning, for the possibilities of independence as school success. This logic proved compelling despite the fact that Michael's home- and FMNetwork-based discourses of independence suggested that his work in further mathematics was not a scarce or minor resource that competed with mathematics but rather a productive source of help.

8.2.2 Steffi

Steffi is a White, middle-class student at Moorden, who studied Biology, Art, and Mathematics to A-level. At the end of year 12 she got C's in both Physics and Further Maths AS-levels and had already decided that she hated Physics. In January she dropped Further Maths too, after one more module. Steffi was one of the students who came to mathematics with a sense of belonging, because her grandfather was an accountant and her mother an accountant's receptionist. Until year 11 she had intended to build on and improve this history by studying mathematics at university:

> My mum's like 'you don't really want to do an accounting degree because then you're stuck doing accounting. So I thought well if I do a maths degree and then train as an accountant afterwards, I'd then have other ways to go if it all, if I'm fed up of being accountant. I can then go off to different things (year 12).

I have classified Steffi's account as one of not being ready to be independent because she explicitly said so, and because of the way her talk values and builds on connections with others. Much of Steffi's account of her education concerns gathering around her people, knowledge and experiences that will "help", similarly to Ball and Vincent's (1998) 'hot' knowledge. Here for example she describes what usually happens in her mathematics class:

> I sit next to Mihail and we like tend to work through everything together and so if one of us gets stuck we'll help the other. And then sometimes we'll ask Rob and Jay who sit the other side, sort of on the other pair, and then Anna will sometimes turn round when she needs help and doesn't understand something so we'll help her (year 12).

When she looks back on further mathematics she expresses the benefit of completing the January statistics module as the help it gives for her degree in marine biology. On the whole, though her memories of further mathematics were of not getting enough help.

> I think that will help me though just because I've done, well because this year we did, I did the Statistics 2 test and I did Statistics 1 last year so I've got quite a… which is the only bit out of the maths I think that's really going to help me at uni, because you do a lot of statistical studies of environment and stuff. So that's the only thing that's going to, I think out of the maths that will help me (year 13).

> I ended up hating it. It's like my physics which I ended up hating. I think when I get... I think it's when I don't get, when I can't understand something and I can't get the help to make me understand it, I'll turn against that subject, I won't want to do it(year 13).

Steffi's insistence on help is at odds with the dominant discourse that avoids dependence. Bauman considers traditional collectives as formed by a "fraternal obligation" (2001, p58) to give and receive help over a period of time. He uses the fraternal tag to distinguish this from contemporary communities of self-identification and self-help. His example is Weight Watchers, that he calls a "peg community" because it hangs on identifying a problem and sharing or treating it temporarily. Bauman contrasts this with the security that the mutual-interest of a help-obligation engenders: there are people who will give you help simply because you are proximate, not because they are the same as you[23] or also gain. This chimes not at all with the self-entrepreneurism and affinity collectives of neoliberalism, and only partially with the stress on patriarchal obligations in neo-conservatism (Rose 1999), but it does appear in educational discourse. For example, both Kyriacou and Goulding (2006) and Boaler (2008) put collaboration and mutually–helping relations at the heart of engaging mathematics classrooms. I question whether the distinction between traditional (mutual/'fraternal') and affinity ('peg') collectives is as clear cut as Bauman suggests. In Chapter 6 I showed that students, including Steffi, described managing happiness by managing help: working together in mathematics classrooms and collaborating on further mathematics homework. Here too Steffi's work of gathering the help she needs is a way of personalising her learning and producing herself as directed towards future economic goals.

Broadly, however, further mathematics could be seen as showing the insecurity of a peg community for Steffi because she is aware of a sense of progress towards independence that she does not keep up with. In further mathematics she feels "rushed" and "a bit pushed aside". When she described the experiences that cause her to give up further

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[23] Although Bauman's use of 'fraternal' seems to me (in English anyway) to invoke sameness in a way that does not support his argument.

mathematics she describes the tensions she feels around asking for help, and connects her feelings in the FMNetwork lessons with those she takes home afterwards. These add up to make each other unbearable:

> Steffi I think it was just the fact that it was two hours and it was not sort of like a little bit and then you do a lot of like practice like we do in normal lessons. It was we got only a little bit of practice and I found I wasn't picking up the techniques easily enough. And I felt if I didn't understand something and I asked questions, that like I was being sort of, not ignored, but it was dragging back the rest of the class because obviously they were then going to get behind. So I just thought, I can't be doing with this.
>
> Cathy So in a way was it not making you feel good about yourself?
>
> Steffi No. I'd come back and my mother used to... When I came back from Further Maths I used to be horrid. I was just so sort of fed and up and frustrated and I'd just fly off the handle at her and then go out and... I just couldn't cope with it in the end.

In her further mathematics class Steffi feels herself becoming excluded by the tutor and others, not necessarily from the class but from the practices of self that she otherwise values. Steffi presents her sense of belonging in mathematics as framed around mutual help. In further mathematics she recognises an imperative to be independent in order to belong with the rest of the class, not to 'drag them back'. This means she cannot accept the amount of help she needs (although from my observations this appeared successful in keeping her included in the lesson, and the tutor was keen for her to stay). Equally, the help she does accept is not enough to enable her to continue:

> Because we had to move at such a fast pace I found that there wasn't really time for me to sort of practice it with her there to help me. So I just didn't get on with it so I just decided there was no point in it.

The discourse of *moving/improving* runs frames this summative explanation of her choice and is present in her description (above) of how she feels different/excluded during lesson. But there is a second discourse of self-expression through family belonging and mutual help that is stronger. Steffi can bear the tensions until she reaches home, when her frustration causes her to exclude herself, this time from her family. It is this second exclusion that really marks her pain: when further mathematics starts to affect her sense of belonging at home. This was a particularly significant contrast as it happened during a period when Steffi's mother was ill, and needed her support. For Steffi the further mathematics collective is positioned as one where some help is given but cannot be taken happily, and home is where help should be given but is not, again causing unhappiness.

Steffi's example confirms a number of points. It shows that giving and receiving help is a discourse of belonging that has currency in the mathematics classroom in other ways than as entrepreneurial self-interest. Throughout my data giving and receiving help in further mathematics are recognised as mutually beneficial, but here (as in Chapter 6) it also serves as a happy object in its own right, promising secure belonging and causing pain when threatened. It also shows that further mathematics is understood as eventually requiring independence, even for students like her who try to resist the denigration of dependency. Help as happiness is a compelling discourse, and in this case it seems almost compatible with the imperative to get ahead and become independent through further mathematics, as she does persist despite slow progress in further mathematics. In the end though, the emotive tensions stack up in Steffi's experiences of lessons and at home and she gives up. Thus we see that contingent circumstances such as Steffi's mother's illness have effects on how students can position themselves that are not recognised by a model of an independent student. This recalls Leathwood and Read's (2009) study of 'higher education subjects' in which most undergraduates found themselves excluded at some time by the dominant construction of the 'independent learner' – whether by their family ties, finances, class, illness or disability, unfamiliarity with dominant culture, newness, shyness or any other condition.

Steffi, along with Esther, Clive and Ricky, gave up because of frustrations that produced them in an identity they found unbearable. Afterwards they rationalised this experience to minimise the pain and render it a choice that recognised their individuality. Steffi presents the decision as gaining a knowledge of both herself and the constraints of what is on offer. She is not to blame, rather she has made a mature assessment of the circumstances and is caring for herself (and implicitly her mother):

> If I had four hours a week like everything else and had a teacher that I'd go and see sort of like when I needed it, it might have been different. But with only the two hours a week it wasn't the right way for me to go about it.

These students did not reject their initial sense of belonging to further mathematics as illusory. Rather they give accounts of finding that they do not or cannot belong there in the FMNetwork context. They describe this choosing as finding "the right way for me", once again drawing on the authority to speak for themselves, learning for/about oneself and taking responsibility (McRobbie 2002). The discourses of choosing further mathematics position these students as becoming independent by giving it up; and hence by taking responsibility for their own exclusion. I do not intend to evaluate the 'suitability' of these choices for any one student, but to point out how discursive patterns of exclusion are read as individual self-expression and progress into realistic maturity (Currie, Kelly and Pomerantz 2006).

8.2.3 Randall

Randall and Mario are best friends at Grants, with exactly the same subject choices, Mathematics, Further Maths and Physics, and both hoping to work in sound engineering. Randall usually speaks with more confidence, but Mario is doing slightly better in examinations. The reason I discuss them is to reiterate that students who share the same discourses can nonetheless position themselves quite differently, and that one student can be positioned by a combination of discourses. Here I concentrate more on Randall, but I have discussed Mario in Smith (2010). In year 12 Randall presented further mathematics as being a test of "will power" and concentration in lessons, more like university "because you're going away and doing it all yourself". He argued that what he really needed in further mathematics was the answers to the exercise because "You can see how you get to that answer and you can learn how to do it and you can try it more and do it yourself". In this he articulated the discourses of epistemic and social authority, and learning for/about oneself that often shaped independence through further mathematics. In year 13 he and Mario jointly described their struggles with comparing lesson-notes and the textbook while revising for their (now school-based) further mathematics course. But when I asked if they took responsibility for their revision, Randall retorts with what "you generally expect" school to provide for you and then moves on to excuse the lack of success that he has achieved in trying to resist dependence and learn more directly from the book

> Randall Well I generally... you generally expect it for them to kind of like know what to teach you kind of thing, and know... to kind of guide you. But no I haven't been doing really checking up on the syllabus or anything. Just didn't... There's another thing, he [their teacher] doesn't mark the homework. He sets homework but he never marks it.
>
> Mario He used to.
>
> Randall No he used to, like a few months ago. Now it's just revision. But, you know he gave us homework then never marked and it doesn't really give you an incentive to do it. So a lot of them I just didn't do because I thought well he's not gonna mark it, what's the point? And I think that... that was bad really, because if I had done the homework I think I would have been a lot more... It's my own fault 'cos I just didn't do it. But I'd have been a lot more up to speed on certain things I think. But anyway. If he was... If I knew he was gonna mark it, and be like 'Oh, you haven't done it, why haven't you done it?' I would have made sure I did it kind of thing.

Cathy So you feel you want more kind of telling what to do ... more structure about that?

Randall Almost. I mean at sixth Form you don't expect it to be like uni kind of thing, where you go off and you do it yourself. I think in that environment, you know when you're paying for a course and stuff, you make sure you learn the stuff. Here you can't... you still... Even though they're trying to prepare you, you still kind of expect them to at least check the homework to see you've done it right and stuff. It is sixth form, it's not uni yet kind of thing. So I don't know.

[I asked if Mario felt the same…]

Mario I wasn't conscious of the fact that he was gonna take it in or anything, just... I just knew... I just knew I had to get some more practice, so I ended up doing the questions because... But not all of them. I do whatever I need to.

Here Randall is quite clear that it is the school's responsibility, not his, to structure the course and to make sure that students complete their work. In this argument his own independence is an issue only when an individual teacher is at fault in not checking homework. Unlike Michael, Jodie and others who 'go it alone' in their learning, Randall is choosing not to resist his positioning as a pupil, and here he starts to differ from Mario. Mario's defence of the teacher - "he used to" fits his own position that students should become more independent over time. He contrasts himself with Randall by comparing who they pay attention to: Randall is conscious of the social authority of others while Mario just knows what *he* needs to do. Mario expresses his independence not by emphasising that responsibility but casting himself as driven by self-entrepreneurism and thus choosing to learn for himself.

In this discourse of conforming pupil, Randall rejects the demands on him to be independent but he still has to accept the consequences of not having been independent enough. Within his description of further mathematics he uses the terminology that teachers are there to "guide" and "prepare" students, and that he owns the "fault" of not having worked. In my question I described him as wanting to be told "what to do" (a more negative position) or seeking "structure" (more positive), giving him an opportunity to refine his position. Instead he argues that independence is valuable only at certain times ("its not uni yet"). He distinguishes between school and university, a market-driven institution that *does* responsibilise you because you "go off" and pay for it. So independence is ascribed to adulthood and financial accountability, not learning.

In rejecting the personal responsibility to work independently Randall can be positioned either as immature, not yet ready to be independent, or as trying to challenge the logic that reads him as aiming primarily for economic freedom. In the adjectives task he describes himself as independent but his justification has many modifications ("try", "like", "and stuff", "kind of thing", "like I say", "all the time") and suggests that he is independent in further mathematics only by necessity, not by desire:

> Like I say, I do try and learn some stuff by myself, like teach myself it, and like look through the book and stuff, and read up about it all the time. That's partly because I don't ever understand it, and partly because I just need to kind of thing, to get the grades (year 13).

As we saw earlier, others position Randall as immature – maybe not clever enough to belong and too 'young' to see the self-delusion. In this quote he echoes their excluding valuation "I don't ever understand it", but as we saw in Chapter 6 he argues that the discourse of precocious achievement in mathematics is the delusion.

There is a different discourse of educational success that Randall attempts to sustain: studying as building up "experience" in the present. In further mathematics he suggests that 'trying' can be worthwhile for its own sake and not just for grades: "the more you do it, the more you're like looking at problems and trying to solve equations and stuff". Here he does appear to be challenging the logic of aiming primarily for economic freedom because he not only applies this to working in mathematics but also to his aspirations beyond school. By year 13 Randall is thinking about entering the music industry directly, without going to university. Again he describes this as learning from doing and experience: "there's technical but you're just kind of... You can be taught it like and learn it from experience. It's all about how a piece of music sounds and stuff like that". This discourse of valuing experience in a slower timescale allows him to position himself as successful and realistic without the responsibility of making progress: "I've still got ambition and stuff, but I'm just realistic as to the fact that it might not happen as soon as I expected". Slowing down avoids the risk of 'getting ahead' of one's authentic self. It is more desirable than progressing towards independence in further mathematics, which he positions as running the risk of losing touch with coherent selfhood because you are so concerned with learning as moving away from the present. We see this when Randall challenges Mario's plans:

Randall	I'm going to be there. But Mario's gonna be like working out all these equations.
Mario	And I'm gonna be paid ten times more than you.
Randall	And I'm gonna be the happier one. It's not all about money Mario.
Mario	No. I'm gonna be happy (year 13)

Randall's attempts to adapt the discourse of independence towards authentic activity rather than responsibility colour his descriptions of struggling in further mathematics classrooms. He represents himself as not belonging because he is not active, simply watching the board and thinking "well I don't understand what the hell you're doing". Instead he prefers to go through questions himself (or with Mario), producing an active independence that way even if it is not successful. He does use the textbooks quite extensively in order to organise his experiences of mathematics but they often do not give him the feedback he needs when he needs it:

> I honestly, I read. I don't know like how many hours I've spent trying to find stuff in there. And then it gets to it and then it gives you a question that says, 'Now why is this like that?' And I was like well that's what I want the answer to and you've just told me to work it out myself. Give me the answer... (year 12)

Several other students also described the textbooks as frustrating in this way, and here the online FMNetwork resources did seem useful in providing them with another source of examples and explanations to make comparisons with. Randall did not comment on using this website, though Mario found it good.

Randall's alternative valuation of authentic active experience over accredited progress is sustained strongly by discourses of practicality and immediacy. These can be the same discourses that mobilise to exclude working-class 'people like us' from higher education (Brooks 2003). When Randall talks about studying further mathematics he says "we don't seem like the kind of people that would I suppose", and later he extends this exclusion when during year 13 he decides not to apply for university. He is unsure whether his future is in continued education, in casual sound-related work or in an industrial apprenticeship. Staying in post-compulsory education, and studying more abstract disciplines are the types of choices that produce structural class inequalities (Atkinson 2007a). So here the tensions that Randall experiences when trying to challenge how the discourses of further mathematics and independence add up to exclude him in a way that re-articulates class.

The three students I have discussed here, Michael, Steffi and Randall, are connected by being 'casualties' of further mathematics. Their exclusions are inscribed in various ways by the understanding that further mathematics requires independence, and the related meanings of independence as *resisting school constraints*, *claiming authority to speak*, *learning for/about oneself* and *taking responsibility*. All three students claimed epistemic and social authority in the mathematics/ further mathematics classroom; and all three welcomed the envisaged autonomy of being able to use a range of technologies to organise their own learning. These are necessary practices for successful adulthood and successful belonging in further mathematics. However students who tried to resist these practices risk being positioned as dependent and out of place in further mathematics. Steffi eventually found it impossible to reconcile these discourses of independence with her sense of learning and speaking for herself as gathering and managing relationships based on help. She could not articulate belonging in further mathematics alongside belonging within her family collective. It was the discourse of responsibility that caused tensions for Michael and Randall: they felt pressure to give up as a way of expressing themselves as having self-knowledge and being aware of how they were judged by others.

There is one last empirical contribution that adds to this weighing up of the discourses of independence, and that comes from students' emails after they had moved on to university.

8.2.4 After school

My agreed research framework allowed me to email students for the Moorden and Grants cohorts in the term after leaving school. In practice, it was not easy to maintain contact into the third year of the study, but eight students did respond (just over half, see appendix 1). They were broadly the students who had followed mathematics-related degrees. I asked them whether their working practices had changed since they left school, and also whether further mathematics had had any lasting effect. Once again their responses focused on working practices that could be characterised as managing work with others, and producing oneself as independent. Further mathematics was repeatedly linked to these negotiations:

> I often just rely on lesson work in some subjects, not doing much work on my own. I think further maths has taught me to do more work outside of school, even if I feel that I can already do what is required. I think I am working the same way I did at school – try do as much as possible on my own then meet up afterwards and fill in any blanks together. (Paul, computing)

> I've found that self learning is my favourite way of working through material. I currently have 17 hours of contact time with staff but would be perfectly content with much less. This isn't because im lazy, but because i can work through text/work books at my own pace (plus im not much of a morning person!). With the learning side, its very much an independent thing (same with others i suspect). But problems and coursework (after a stab at it yourself) tend to be discussed between a group. (Mario, physics)

> I always attempt work, but I find other people working motivates me, and therefore I very regularly will sit and do work with other people, even if they're on an entirely different course, I almost find it easier sitting working with people doing different work than the same, as it then pushes me to try and figure out my own work, rather than ask for help straight away. But I do find that when revising for tests, or important pieces of work, a group of us from the course will get together and study then! (Charly, mathematics and business)

What is evident in these responses is the confidence of students' claims that a combination of working with others and working alone is a legitimate practice of learning in advanced mathematics. These are not now the casualties of further mathematics. They are students who have already negotiated a stance in which they can produce themselves as autonomous and self-directed while working with others. For them doing independence with the FMNetwork is not narrowly defined as solitary independent work, but rather as recognising how one needs to learn and claiming both the authority and the responsibility to manage the details for oneself. It was this that constituted most of them as belonging to the further mathematics collective while at school. Once at university they articulate the same discourses of going-it-alone but belonging with others. What is less evident is any discourse of resistance, although all three emphasise that their motivation is their own. This suggests that independence as *claiming epistemic and social authority*, *learning for/about oneself, responsibility* plus – crucially - collaboration is a resilient way of belonging in mathematics. In fact Paul and Mario (and Simon who we met in Chapter 7) make stronger claims for themselves working collaboratively at university than they did at school.

This does suggest that doing further mathematics has an effect on university study, because it contrasts with research findings that students are generally wary of accepting organised peer support when they make educational transitions (Davis 2009b; Hernandez-Martinez, Williams and Farnsworth 2011; Hoyles, Newman and Noss 2001). It has also been suggested that they tend to rely on maintaining the continuity of existing work practices associated with their 'authentic self' and do not readily try out new relationships with others (Warin and Dempster 2007). Where mathematics has been articulated as requiring isolation, this is likely to continue and lead to a cooling-off of engagement (Daskalogianni and Simpson 2002). It is clear that peer-support does help students, especially when it is institutionally supported, for example with work-rooms (Solomon 2009a). These few results suggest that further mathematics students are ready to take up such practices and see them as productive work on the self rather than remedial action.

A second way that further mathematics had supported students was in freeing them from relying only on one institution. This recalls the *inside/outside* positioning of further mathematics, where the productive effects came by bridging the aspirations of further mathematics learning with the systematising technologies of schools. The effect seems to have been that students see a personal value in making use of a range of resources and perspectives from outside the university course. These all become resources in their project of independence as *making learning personal*. These university accounts paralleled their accounts of further mathematics, but with their previous experience taking the place of the FMNetwork tutor as showing them how to become experts in independence. They mention their management of minor technologies such as being used to late evenings, emailing tutors and once-a week lessons, but also the books and the FMNetwork website if still available to them:

> Now im here, its amazing how much of a difference learning the further material at a level has aided me. Even though I had forgotten the majority of a level, I wasn't seeing any maths based material hadn't seen before (complex numbers, further integration, power series.. etc.)- whether i understood it is a different matter(!). I was able to go back on notes/books from the further maths a level course and things would spring back. (Mario)

> I had to do a lot of self learning for both subjects (especially further maths) and I am using similar methods to learn here too. Learning Further Maths has definitely helped me in the Maths content of my course and has allowed me to have a head start over people who hadn't done it. The teaching of maths here is not very good so I feel very relieved to have done further maths and maths to a certain extent. (Simon)

As I argued above, the significance of this range of resources is not solely that it exists but that it allows students to manage their own learning for themselves and widens the practices that they experience as successfully doing mathematics. As independent learners they can draw on their own selves as experts in managing these technologies.

8.3 Summing Up

I have used these three students and the university emails as examples of how further mathematics positions students as engaged in a project of independence.. My analysis showed four discourses – *resistance*, *responsibility*, *learning for/about oneself*, and *authority* to speak for oneself - that all contributed to this self-determination. These were supported by the discourses and technologies of further mathematics. Some of these technologies unambiguously produced students as required to manage their own independence, for example when schools started study leave after the further mathematics examinations, allocating no time for students to revise. Others are more ambiguous, such as lack of contact time or more demanding examination questions. In the last two chapters I have shown how further mathematics provides routes for students to produce themselves as independent and independence provides routes to choose further mathematics. The three unique contributions made by the FMNetwork context were:

- students met a range of texts, teachers and online resources. Engaging with these positioned students as authorities in mathematics and in their own pursuit of self-improvement-as-autonomy.
- Further mathematics was sufficiently 'outside' school that students could map a personal route through resits, schedules for learning, relationships with teachers and negotiations with universities; it was sufficiently 'inside' school that the outcomes of these choices had value. This gave students authority and expertise in learning for and about themselves
- The ambivalent discourses that abound in further mathematics – precocity/ maturity, breadth/depth, you have to work/not work, inside/outside - allow students some flexibility in negotiating the tensions in their positions as currents of opportunity, at least until they are closed down by responsibilising technologies such as examinations.

Producing independence is an important discourse of education and adolescence, and it also has particular resonance in mathematics. As we saw in Chapters 2 and 4, the socioeconomic value of mathematics comes from its ability to circulate power as individual, rational mastery that is realised in authority and wealth-creation (Walkerdine 1988; Wright 2006). The discourses of neoliberalism allow understandings to slide between individual and social governance, and the discourses of mathematics allow understandings to slide between the qualities of the discipline and qualities of its students. I have shown how students can take advantage of this, using their constructions of mathematics as safe and straight to bestow themselves with guaranteed future success. But this elision of mathematics and 'doing mathematics' also imposes imperatives onto participants to re-produce themselves in certain ways. In this chapter we met students who were casualties of independence: they nearly managed to assemble themselves as both further mathematics students and happy, self-entrepreneurial adolescents but ultimately failed. All three students tried to adapt discourses of independence in order to become more successful: Michael by drawing on the ample resources of home rather than the constraints of school, Steffi by valuing mutual help as a way of building secure communities, and Randall by emphasising his experiences of engaging in mathematics rather than progressing in it (or not). These adaptations did not and could not succeed.

One reason for the tight-hold of independence on mathematics students is its neoliberal role of governance. Mathematics and independence go hand in hand to predict progress, self-direction and wealth. For example, policy makers consider that "the global maths economy is driven by high personal capability, initiative and logical thought" (Kounine, Marks and Truss 2008, p5). This comment makes the familiar demands for economic participants to be 'good at maths' (invoked in "capability" and "logical thought") but also translates these into generic "personal" skills owned by the individual beyond the mathematics context, so that with enough "initiative" they can be transferred anywhere. Experience of mathematics is thus read as a certain way of becoming independent – logical, collaborative but not emotional, self-directing and not directed by custom or other people – through which private entrepreneurism becomes a public good. In the new economies of neoliberalism "the value of an individual to an employer is no longer represented by the denomination of academic currency but the economy of experience" (Brown, Hesketh and Williams 2003, p120). It is simultaneously the case that individuals studying (academic) mathematics are valued as "our very brightest young people" who "by doing so are ensuring that Britain has a bright future" (Wright 2009). Both make sense as discursive constructions because within contemporary policy the academic currency of mathematics depends on constructing the student mathematical experience as one of becoming independently capable. Mathematics can accommodate other discourses – geeks, nerds, geniuses and madmen - that render students incapable in particular fields (Mendick, Moreau and Hollingworth 2008) but this only serves to accentuate their social distance and thus their independence.

This policy discourse is in line with historical and contemporary requirements that university students should be independent learners. Historically, universities framed the reward of academic citizenship as developing an 'independent personality', and this constructed the university student as male, adult, civilised and belonging to the western intellectual tradition (Leathwood and Read 2009). The contemporary discourses of neoliberalism and technological progress encourage universities to use resource-based and online learning technologies that enable large numbers of students to 'up-skill' themselves for the labour market. The discourse of employability has changed the demands of/on mathematics departments: fifteen years ago, the London Mathematical Society (1995) called for students who were fluent and accurate in A-level content, now they value 'thinking mathematically' above teaching for near-perfect A* grades (London Mathematical Society 2010). Undergraduates need 'stamina' and 'mathematical habits of mind' to persevere through perceived failures (Hoyles, Newman and Noss 2001); they have to be able to study independently to combine their new conceptual learning with "drill and kill" practice of techniques (Engineering Council 2000, p11). Leathwood and Read's (2009) study of undergraduates (across subjects) found that most found themselves excluded at some time by the dominant construction of the independent learner – whether by their family ties, finances, class, illness or disability, unfamiliarity with dominant culture, newness, shyness or any other condition. As independence is so significant in mathematics, it seems likely that similar exclusions would operate when independence is central to further mathematics.

This all adds up to the conclusion that neoliberal subjects are discursively required to position themselves repeatedly as *becoming* independent in order to develop their identity as students and future economically-active adults This chapter completes my argument by showing that engagement in further mathematics is a way for students to produce themselves as a neoliberal becoming-independent educational subject starting to capitalise on his/her individual self. A central concern throughout this thesis has been to show how this production of neoliberal subjectivities through further mathematics contains with in it discourses of exclusion that make it difficult or impossible for some students to continue with further mathematics. I have shown how these exclusions operate around the social dimensions of class, gender and ethnicity, yet are constructed and lived as individual narratives.

Chapter 9 Conclusions

In this chapter I draw together the various analytic strands of what it means to participate in the further mathematics network. In Chapter 1 I suggested that the current model of rational individual choice is unhelpful because it excludes other ways of making sense of how students do and do not participate further mathematics. More complexity is needed: in particular to understand why there are patterns in who chooses to study further mathematics and how these patterned choices are related to ways of understanding mathematics, identity and society. I argued in Chapters 2 and 3 that a poststructuralist approach provides the theoretical perspective and methodological tools to unpick existing understandings of choice and further mathematics, and to examine the new understandings inscribed in the practices and contexts of the FMNetwork. I came to see that choices were made *by* individuals but were not simply individual. Instead, choosing further maths articulates practices of the self in discourses of education, employment and personal fulfilment, inscribing rather than furnishing young people's relationships and identities.

My search for complexity and difference continued throughout the five year study, directed by the way my theoretical research questions unfurled from their starting point: identifying discourses of choosing, schooling and further mathematics (Q1a). The five empirical chapters of this thesis show how I used these research questions to unpick the discourses in official texts and student accounts. I have examined the power relations and the classroom practices that support them (Q2a), how they position students and what practices of the self are intelligible within further mathematics (Q3a). I have looked at how different discourses relate to each other (Q1b), how they construct individuals and collectives (Q2b), and how they combine for individuals in ways that support and challenge participation in further mathematics (Q3b and Q2c).

In these empirical chapters I gathered my thinking around discourses that are coherent because of the way they function together in participants' talk and practices, presenting very strongly in the data, for example around time and maturity, and breadth and depth. I also sought theoretical coherence, where discourses work together to shape forms of conduct and meaning and when they inscribe students as subjects positioning *themselves*. My data includes discourses within further mathematics that function as practical moral codes, systems of self-judgement and modes of subjectification, which, as I suggested in §2.2.3, are necessary for analysing practices of the self. Overall this is not a question of matching students with discourses (which would have been incoherent from my theoretical perspective) but of analysing the similarities, and the surprising differences, in how these discourses worked on and are worked by students, and tracing the outcomes that they make possible.

I also find theoretical coherence where I can trace continuities and discontinuities between the discourses of further mathematics and the wider discourses of contemporary education, employment and politics. By showing how 'doing further mathematics' (or not) can also be 'doing' progress, maturity, work, happiness, belonging or independence within discourses such as neoliberalism, I offer three things. First I establish validity for my own analysis. Drawing parallels with the discursive frameworks used by others helps to make explicit the methodological relationships (Brown and Dowling 1998) between my theoretical concepts (discourses, practices of the self) and empirical indicators (language, observed outcomes). Poststructural research cannot seek validity in an external frame of reference. It establishes its significance within the academic field by spelling its relation to previously published work; arguing its coherence; paying attention to detail, diversity and explication; and demonstrating its relevance to other ways of making sense of the context (Ramazanoglu and Holland 2002; Taylor 2001a).

Secondly, and continuing from this, I offer a policy contribution. Given the dominance of neoliberalism in post-compulsory education policy, largely unaffected by the change in UK government, my research can have an impact only if it can be interpreted as evidence within that policy framework (Wiseman 2010) and I have therefore sought to make the connections explicit while keeping a critical perspective. In Chapter 2 I drew on the literature to argue that contemporary education and employment are driven by a neoliberal self-entrepreneurial view of identity and education: the self progresses towards future success framed by self-governance, inclusion and the capacity for economic self-expression. In each of the empirical chapters I have shown how further mathematics sometimes works in tension and sometimes runs along with these neoliberal discourses, and this permits me to consider how further mathematics could develop in the future.

Thirdly, I make a methodological contribution to mathematics education research by demonstrating how a poststructural attention to discourse allows us to investigate participation within mathematics in relation to concerns beyond the strictly mathematical:

"in order to develop a conception of the learner who is an historically particular, social, embodied, and interested individual, at once both rational and irrational" (Walshaw 2004, p9). As just discussed, recent educational technologies prioritise individual choice, learning and self-expression, and so mathematics education research needs such methodologies to have relevance for contemporary institutional practices. More importantly, my study shows that students' accounts of participating in further mathematics are complex and bound up in their understandings of themselves as maturing individuals negotiating inscriptions of ethnicity, gender and class and how they belong to family, school and friendship collectives. A theoretical focus on learner-identities in mathematics is inadequate to account for these interconnections.

This research process of gathering coherence within complexity provided the structure of the four chapters analysing student data. It is in this area that I note a weakness of my research design which resulted in the fragmented collection of information about participants' social class, ethnicity and family/community setting. I initially felt nervous about asking personal questions about (for example) who students lived with and their family educational history, especially in group situations, and gathered information in a conversational ad hoc manner. I tried a more systematic approach through later email questionnaires but without complete success. I did not therefore have a systematic set of data on which to base comparisons. In some cases (eg with Steffi) it only became apparent later that students' family circumstances were so relevant to further mathematics. In future research I would ask participants' for such data at the outset, and thereby give them the opportunity to reflect on their positioning (Savage, Bagnall and Longhurst 2001). This was a limitation arising from my own class and ethnic positions, and also framed in the deceptive discourse that mathematics is less personal than, for example, gender (Adler and Lerman 2003; Mendick 2003).

In this conclusion I now discuss ideas that were raised across these chapters, and connect them to my analysis of document-based further mathematics discourses in Chapter 4. These are:

- The discourses of choosing mathematics and choosing further mathematics are not the same: further mathematics builds on and disrupts the dominant sense of mathematics as ensuring progress.

- The FMNetwork provides new routes for participation in advanced mathematics: it offers institutional and collective backing for students who want to improve or resist some ways they are positioned in school.
- There are tensions within the discourses of further mathematics that can lead students to exclude themselves: students who resist their school positioning are precarious in their power to 'write themselves differently'.

I then consider the implications for further mathematics itself, for participation in advanced mathematics, and for future research. In doing so I discuss what my research has to offer and its limitations.

9.1 The discourses of mathematics and further mathematics are not the same

Throughout this thesis it has been clear that choosing mathematics and choosing further mathematics both function as practices of adolescent selfhood extending beyond the classroom, but also that they function differently.

Choosing mathematics

In Chapter 5 I showed how choosing mathematics reinforces the modernist episteme of progress and the expectant time of staged adolescence. Modernity privileges knowledge that controls change in the present and future (Chandler 2011; George 1999; Mendick 2011; Sfard 2009), and the students could find such knowledge in their mathematics practices. They associated mathematics with safety, straightness and what I called a discourse of *moving/improving*. This discourse was then applied to themselves as individuals, predominantly in the form of an inheritance from their parents, their ethnicity or their recognized past ability. This discourse of safe, straight progress constructed participation in mathematics as something that endures within students and will guarantee future improvements, but nevertheless needs to be developed by appropriate educational technologies. In Chapter 6 I showed how mathematics produced students as engaged in such developmental work on the self: becoming able to manage the 'natural' opposition between work and happiness, indeed to transform it into the psychological rewards of self-entrepreneurism. This transformation supported the progressive discourse of *moving/improving*, so that accepting and adapting the imperative to work was taken as evidence of increasing maturity and alignment with the practical/financial realism of employability (Hesketh 2003).

I also showed in Chapter 6 that students predominantly used their accounts of work and happiness in school mathematics to orient themselves towards the future, and then, by securing that future, they could keep up happiness in the present. These discourses of controlling work and happiness relied on practices that established mathematics as dependable and allowing work with other students. Mathematics was dependable because it promised future attainment and economic rewards; and because it facilitated students in producing themselves as having epistemic and social authority in lessons. They felt able to chat, argue, collaborate and resist some aspects of teacher control because they were confident that they could – with a combination of self-motivation and peer explanations - make sense of mathematics. Both the resistance and the self-confidence helped again to produce them as maturing, self-governing individuals. In school mathematics working together was thus intertwined with dependable mathematics as a resource for steadily becoming mature, although always within the staged development of school progress.

Most students connected their sense of authentic belonging to the classroom collective with dependability and working together: together these constructed a confidence that they could rely on understanding mathematics with the help of friends (and sometimes teachers). In Chapters 7 and 8 I showed how students such as Jodie, Bob, Simon and (sometimes) Randall resisted the way they were positioned by the discourses of school mathematics and instead tried to 'go it alone' in further mathematics. Here again what they were resisting could be seen as the inevitability of mathematics: that certain positions in mathematics offered few possibilities for resistance or adaptation. Jodie, Bob and Randall reacted against the ways in which they could be judged as not belonging, and Simon reacted against his position of extreme belonging, because they understood these judgements as posing powerful threats of exclusion from other futures they envisaged.

Choosing further mathematics

How was this different for further mathematics? There were two key relationships in how students talked about choosing mathematics and further mathematics. Firstly they built on the discourse of *moving/improving* mathematics, and this happened particularly when they described their year 12 decision to start the further mathematics course. They saw further mathematics as offering impetus to the progress offered by mathematics. By choosing to 'do extra', further mathematics students could express themselves as extreme/typical examples in mathematics and also as the aspiring 'bright' students of neoliberalism, successfully framing the rewards of work as psychological as well as socioeconomic (Rose, 1990, 1999; du Gay 1996). Here they drew explicitly on the *inside/outside* and *gold-standard* discourses of the FMNetwork that I identified in Chapter 4. Being *inside* the mainstream curriculum allowed them to relate their choices of further mathematics to the shared understandings of progress used in national pre-university qualifications. Being outside enabled them to suggest extra qualities beyond that (often-criticised) scale. The *gold-standard* discourse added to their positioning by reinforcing a value system in which advanced mathematics indicates an enduring, objective measure of quality and qualities. This representation was durable: throughout the two years certain further mathematics students (such as Simon) were positioned as the archetypal student who were going to make good simply because of their (unexamined by others) disposition to study mathematics.

Secondly, further mathematics <u>disrupted</u> the discourse of steady mathematical and adolescent progress by suggesting you can 'get ahead'. Instead of progressing expectantly while learning mathematics you can make choices that project you nearer to independence and adulthood. Whether viewed as an acceleration or a calculated speculation, this supported students' decisions to participate in further mathematics. We saw this when students described further mathematics as new, hopeful, not safe but accessing university mathematics and ways of working. In this disruption, further mathematics students were frequently positioned as precocious, attempting to inhabit both childhood and adulthood. This position is familiar from the research of, for example, Burton (2004) and Mendick (2006; Mendick, Moreau and Epstein 2007) who examine stereotypes of 'born' or a-social mathematicians My study has shown that this position can also be productive and explain participation in further mathematics. Dissenting from the dominant temporalities and ascribing to alternative *uchronias* is a way of articulating oneself as an agentic knowing subject in contemporary discourses where time is so closely bound with the self (Nowotny 1994). Dissenting from the dominant discourse of mathematics as steady improvement contributes to the construction of further mathematics as autonomy; while rejecting the watched, expectant temporal technologies of adolescence constructs further mathematics as doing independence from school constraints. The claim for precocity adds to the discourse of 'going it alone' we saw in Chapter 7, and supports doing further mathematics as an exercise of neoliberal self-improving endeavour.

Choosing further maths is also made precarious because of this precocity: in doing further mathematics you are out of your proper time and your development is both achieved and halted. In Chapters 5 and 8 we saw how the discourses of maturity and the normalising technologies of examinations mobilized against continued participation in further mathematics. The association of further mathematics with effortless success presents a similar dilemma: overcoming the opposition to work indicates adult achievements in working on the self, but the imperative not to work was also associated with illusion and childhood. This means there are flexible productive possibilities in not working (as for Michael) , but they can readily become threats. When work in further mathematics did not lead to a sense of secure understanding nor recognized examination results, then it exposed students such as Randall, Agent X and Tom to the feeling of having worked for an illusion. Unlike mathematics, choosing further mathematics could be construed as choosing an illusory future over the "realistic" expectant present and their socially-maturing teenage selves. Students who continued with it risked losing access to both mature adulthood and the natural, authentic pleasures of childhood.

After investigating these differences between the discourses of choosing mathematics and the discourses of choosing further mathematics, it is clear that there are ambivalences even in the basic relationship: further mathematics builds on mathematics, or disrupts it, or both. In the discourses of maturity/risk and work/happiness, further mathematics acts as a 'conversion point' that can turn good feelings into bad or vice versa (Ahmed, 2010). These ambivalences allow for possibilities and for tensions, and it is these currents that we see at play when students negotiate how they position themselves as individuals belonging to the collectives and imagined collectives of further mathematics, school mathematics, family and beyond. All of the students saw themselves engaged in the search for autonomy, which they associated with the discourse of the "independent learner" (Leathwood and Read 2009). As we saw in Chapter 8, students who trusted that school technologies would allow them to combine independence and success tended to continue mathematics but drop further mathematics. Students who distrusted or resisted school practices tended to continue further mathematics. Of course, as I have argued, there is no simple causality in these relationships: the discourses of school construct mathematics students as developing a natural staged autonomy, proving that they can 'do' the White, masculine, rational selves of mathematics education (Mendick 2006). The discourses of the FMNetwork can disrupt the educational progression and project students to more individualised choices of employment and university, suggesting they 'go it alone'.

9.2 The FMNetwork provided new routes for participation in advanced mathematics.

This thesis brings together ideas about choosing as identity work and what further mathematics 'is' in the FMNetwork. My poststructural approach allows me to analyse both these aspects through discourse: it is discourses that inscribe what choosing subjects means for individuals, and what further mathematics allows them to say about who they are and who they can be. Because poststructuralism has been more influential in generic rather than subject-specific education research, so existing literature has tended to frame choosing as a practice of the self inscribed in the pastoral, careers, personal and social development aspects of school (Ball, Maguire and Macrae 2000; Besley 2005; Reay 2004, 2008), while further mathematics is constructed in its curriculum, policy texts and connections to university mathematics (Hoyles, Newman and Noss 2001). I have argued throughout the thesis that these discourses are not produced separately. Instead, my data shows how further mathematics and practices of the self intermingle in schooling and the local contexts of FMNetwork classrooms. Discourses have effects, and one of my central lines of argument has been to show that the FMNetwork does provide new routes for participation in advanced mathematics because it offers institutional and collective backing for students who want to improve and/or resist some ways they are positioned in school.

One significant component of my thesis has been the longitudinal study in three sites. This offered the opportunity to examine subject choice in the context of the A-level subjects that students started, completed, sometimes wished they had (or had not) done or could have done. This means that my research complements larger studies based only on choice outcomes (Noyes 2009; Noyes and Sealey 2009; Royal Society 2011; Searle 2008b; Searle and Barmby 2006). None of the students I interviewed would have been able to start without the FMNetwork. When I first contacted the 22 further mathematics students during year 12, 21 were considering continuing (this was a factor in my choice of site and presumably their willingness to participate). By my last contact (six to twenty months later, depending on site and email permissions) 13 of them had continued for two years, 12 had accepted university offers for STEM subjects with a further six intending to apply (see Table 7.2). This is a good retention rate for STEM subjects: for comparison, the UPMAP project (Understanding Participation in post-16 Mathematics and Physics) found about half of the students in their sample who were qualified to study STEM degrees were actually doing so (Reiss et al. 2011). Of course my participants had already opted once to 'get ahead' through STEM when they started further mathematics, nevertheless most were choosing to repeat that choice. Moreover five of the ten who chose mathematics or mathematics-plus-another-subject at university had not studied a science A-level. It is students such as these, with a mixed, non-traditional selection of subjects, who are deemed less likely to continue (Bell, Malacova and Shannon 2003; Kitchen 1999; Reeves 2008). This is a significant group, comprising around 40% of mathematics/further mathematics A-level students in England in 2005, 2007 and 2009 (Royal Society 2011) but they are less studied because they are not qualified for science. This puts my research findings in context: although I have documented the complexities of choosing further mathematics, the clear outcome was that a diverse group of students were able to manage these complexities and continue a coherent trajectory in mathematics.

The second thread of this argument concerns how these new routes came about. Through the literature review, the analysis of further maths network texts and students' talk, I traced a range of ways in which students can find themselves belonging to further mathematics. It was no surprise to find the discourses of ability and inclination running through all the students' talk, as found in previous studies of mathematics participation (Hernandez-Martinez and Williams accepted; Mendick, Moreau and Epstein 2009; Solomon 2007a, 2009b). Here these discourses inscribed stories of belonging to further mathematics as a homecoming or natural progression, completing a cycle. We saw in Chapter 4 how this was supported by the gold-standard discourse of further mathematics that articulates mathematics as having a bright timeless quality. I also argued there that the FMNetwork presents itself as progressive by balancing discourses of quality with equity, critical comparisons with school measures of conformity. These come together in the *breadth-plus-depth* discourse that offers new routes for participation through shoring up *breadth*, but maintains legitimacy by reproducing *depth* as the non-examined, natural level where the 'elite' belong. Thus official discourses and students' talk reinforce each other in foregrounding a sense of searching-for and finding oneself in further mathematics.

However, although I found this was a widespread discourse, there were only two students (Paul and John) for whom it was not contested. For most students, finding oneself within the breadth of further mathematics was a discourse they could use to show themselves as working towards belonging, but in doing so they had to work – they were not achieving it as natural. In dealing with this dilemma, attraction could become a "lure", and homecoming became associated with escape or finding oneself in ways that were wider than mathematics.

In Chapters 7 and 8 I examined how six individual students were positioned at the intersections of multiple practices of the self, and how each negotiated their combinations in ways that were subtle and unique but did nevertheless show commonalities in what the discourses of further mathematics made possible. I want to draw out two of those commonalities here: how further mathematics relates to independence and families.

Independence

In Chapter 8 I presented my argument that doing further mathematics was best understood as a way of becoming independent. I supported this by examining the accounts of students who continued with further mathematics, and by exploring cases where tensions between the neoliberal requirements to achieve independence and experiences in further mathematics caused students to give up. In my data there are four related discourses that write further mathematics as a practice of independence:

- Further mathematics is positioned as outside school and yet possessing as much if not more legitimacy than school mathematics. Therefore it enables some students to resist school discourses which may exclude them.

- FMNetwork teaching practices allow students to learn for/about themselves. Providing textbooks, online resources and the expectation to persist with extended homework tasks are part of this practice. But students accorded more significance to teaching that focused on the mathematics and responded to what they did or did not understand, giving them skills for independent learning rather than simply demanding it.

- Students used further mathematics to claim epistemic and social authority. They described themselves moving between doing mathematics by themselves, with peers, in their mathematics classrooms and in the FMNetwork group. It was often acknowledged within their schools that they had unique or rare learning experiences. This was valued as an expertise in how school technologies should apply to them, and they were accorded relative (although not complete) freedom in choosing how to work and what examinations to sit.

- In return for being granted the freedoms of independence, students were positioned as responsible for their choices. This is the social contract of neoliberal individualisation. It also supports the distinction between safe, straight mathematics which is dependable in itself and for its students, and further mathematics which carries personal risk and hope.

Previous research has proposed that further mathematics provokes qualities of independence in students. In some cases (e.g Kitchen 1999; Newbould 1981) this was simply a 'commonsense' response to traditional school and assessment practices: since successful further mathematics students completed complex questions when on their own in examinations, and learned mathematics with less teacher support, then they were *de facto* more independent. The gradual retreat of further mathematics to the larger or selective schools who could maintain viable teaching groups meant that this picture of independent further mathematicians was dated. Similarly, since the 2004 A-level curriculum reforms, Mathematics and Further Maths A-levels have shared optional modules and had similar question structures. The difference in examination questions now rests primarily on the nature of the mathematical topics rather than on the style of the questions. This can indeed leave more decision-making to the students, so that in my data they described further mathematics questions as more "intuitive" and "connected" than in mathematics. They did not however feel that their developing intuition resulted from receiving less teacher input, but rather from skilled support in how to tackle difficult questions.

The second approach to explaining independence in further mathematics focuses broadly on "habits of mind" (Cuoco, Goldenberg and Mark 1997) engendered by mathematical experiences and pedagogy. Independence is seen as a stage of having developed these habits (Daskalogianni and Simpson 2002). They are often aligned with an idea of students' resilience, as when university tutors comment that further mathematics students' advantage comes from their 'stamina' not their wider content knowledge (Hoyles, Newman and Noss 2001). This association of resilience with independence positions the pursuit of successful, autonomous selfhood as always threatened and needing reinforcements from within. Recent research has examined resilience as a process of interaction between sociocultural context and individuals' developing agency, that can be strengthened by having a "leading identity" (Black 2010) requiring mathematics, or through reflective activities in which individuals become "consciously aware of their need to break with what is taken-for-granted" (Hernandez-Martinez and Williams accepted). My approach does not place such habits directly in the mind, but in discourse. It adds to this discussion by showing how the practices of further mathematics make it possible to pursue an identity of escape or accelerated progress if it can be positioned as neoliberal self-fulfillment (Lawler 1999; Lucey, Melody and Walkerdine 2003; Moreau, Mendick and

Epstein 2009; Reay 2004; Rose 1999). Secondly, they do require students to think about positioning themselves within ambiguous discourses (Ahmed 2008b; Butler 1990; Hall 1996b; Valentine 2007). Independence and success can be – and have to be - more broadly defined than seemed the case for mathematics.

Families

One of the things that has been striking in students' talk is how they can manage their claims to belong in further mathematics in relation to the ways they belong in a family collective, and how belonging to further mathematics can then function as a promising happy object in the same way that family does (Ahmed 2008a). I have shown throughout the thesis how students used relationships with family members, often but not always their fathers, to explain why they felt an affinity with mathematics. This complements recent research by the UPMAP project tracing the influence of 'key people' on participation in physics (Reiss et al. 2011): people whom the undergraduate identifies both with the subject and themselves. Here I have examined these notions of identification: showing how students could use the way that mathematics worked as a practice of the family collective, and translate that sense of natural belonging to an inherited sense of belonging in mathematics. This ties in with and is made possible by the mathematics discourses of staged development that align mathematics with secure progress and inclusion. It also fits with the finding that mathematics help students to feel chosen, reducing their agency and responsibility while increasing security (Mendick, Moreau and Epstein 2009).

For further mathematics, the discourses of 'getting ahead' and 'going it alone' had a main function of projecting students away from childhood. For example, Michael learnt from his father to work alone from a text book, and Helen learnt from her teacher how to feel confident in tackling further mathematics examination questions. But this discourse always brought with it the adaptation or resistance that participation was precocious, allowing the imperative of maturity to be subverted. Hence further mathematics provided routes by which students could progress while muddying the dichotomies of child/adult, dependent/independent. I showed this through the examples of Sukina and Charlotte in Chapter 5 who both used further mathematics to make claims for epistemic maturity and authority while rejecting social maturity that would take them out of their intersecting locations positioned by gender, class, ethnicity, by families, classroom collectives and friendship groups. In Chapter 7 we met Bob and Simon who tied their participation in further mathematics to their family ethnicity but who were also aiming to break new ground and challenge the family discourse of mathematics as a solitary endeavour.

9.3 Students who resist their school positioning are precarious in their power to 'write themselves differently'.

My study suggests that further mathematics was influential in providing students with a route inside/outside of school that they could frame as a space of escape, of access to privileged learning, and of recognition that they needed help in turning aspiration into achievement. I have suggested above that ambiguities in the discourses of further mathematics allow, and require, students to shape themselves (sometimes retrospectively) as resilient, independent students even while they struggle with the repercussions of examination failure. Similarly the ways they can/must frame how they belong to further mathematics lies in their pasts and who they 'are' and also in their futures and requires work on the self. We saw in Chapter 8 how some of these tensions added up to exclude three particular students, but my purpose throughout this study has not been to see individuals as types but to examine how the discourses themselves make it possible (or impossible) to choose or leave further mathematics. In Chapter 2 I considered how educational discourses constructed school-ability, gender, class and ethnicity, and here I return to these concerns.

Ability

The mathematics A-level students in my study all had reasons to think of themselves as able. A school history of 'always being in the top set' was a widely-understood justification for choosing further mathematics, so that having repeatedly 'been chosen' gave a legitimacy, almost an inevitability, to choosing for oneself to get/stay ahead. Other students told a history of feeling excluded from the top ability group and, as we saw in Jodie's case, further mathematics allowed such students to stake a claim that went beyond belonging in school mathematics into belonging with the imagined community of mathematically-empowered individuals. In this sense the FMNetwork discourse of broadening participation is reflected in the practices of students: it allows them to challenge the past as restrictive. There is another aspect of ability that we see when students encounter further mathematics, which is how much their "ability" relies on institutional technologies and how at A-level these technologies narrow to examinations and choosing responsibly to produce coherent belongings. Examinations are a normative technology of time, progress and risk that can verify your story of who you are, or else expose and confirm you as excluded. If you chose further mathematics and do well you are confirmed as special. If you fail in examinations you disrupt a significant practice of belonging and (since you cannot actually escape your own progress) you are positioned as deluded, out-of control and inauthentic. One of the things that is strongly present in my data is how students struggle to see themselves as successful once they have lost their powers to produce themselves as unquestionably able. My analysis suggests that the pursuit of independence and maturity takes over, and in further mathematics this can act inclusively as for Jodie and Bob, or exclusively as for Tom and AgentX.

Gender

Gender is central to the social constructions of identity, learning and adolescence (Davies 1989 | 2004; Skelton et al. 2009), and central to mathematics in the school curriculum and in Western culture (Mendick, Moreau and Epstein 2009; Walkerdine 1988, 1989). In Chapter 2 I discussed how the 'problem' of girls' choices in mathematics shapes thinking about the value of mathematics, about what equity should look like, and about gender. In my study there was no obviousness about participation and gender in further mathematics across the three sites. Moorden ended up with one young man in a group of four A2 students, Grants with one young woman, and Capital with small groups from single-sex and mixed schools. Overall more young men started further mathematics and more gave up. I discussed in Chapter 7 how two students were referenced by others in their groups as extreme/typical further mathematicians; one was male, and one female.

What was clear in both FMNetwork texts and the student talk was the discourse of proving oneself through choice that associates mathematics with masculinity, for boys and girls (Mendick 2003). We saw this in the alignment of further mathematics with accelerated progress, rationally-backed speculation and controlled adolescence. This plays out differently for young men and women. Rodd and Bartholomew (2006) suggest there is a discourse of specialness for young women doing mathematics that does not exist for young men, and this is partially supported in my data. For example we saw how Jodie constructs further mathematics as a space for 'going it alone' within which she constructs her significant friendships, her resistance to being positioned by male friends and teachers, and a new visibility as a hard-working neoliberal subject. But we also saw how the FMNetwork offers possibilities of distinction and specialness for young men through discourses of 'doing extra' and 'getting ahead', although these may turn out to be illusory (as for Tom) or unwantedly isolating (as for Simon). It seems therefore that a sense of specialness exists but is perhaps not easy to combine with adolescent masculinity. It seems likely that students learning further mathematics in school time would think differently about their specialness, and this could be an area for future research.

Ethnicity

We are lucky to have a growing body of literature in mathematics education that theorises gender without fixing what masculinities and femininities can mean. There are similar arguments for research that recognises the processes through which multiple ethnic and cultural positionings and identifications are ascribed, disclosed, un-closed and contested (Carter and Virdee 2008; O'Donnell and Sharpe 2000; Ramji 2008; Stevens et al. 2011) and these have been developed in mathematics for African-American and Latino/Latina students (Gutiérrez and Dixon-Román 2011; Martin 2006; Stinson 2010). My study can make some contributions to identifying such processes within mathematics. I have shown the dominance in choosing mathematics of the discourses of moving/improving and adolescent development. These discourses are historically and institutionally linked to western colonialism (Fraser and Gordon 1994; Lesko 2001; Martin 2010) but that awareness does not render them solely repressive: their circulation of power depends on how they produce meaning for all involved.

Students in my study inscribed themselves with a secure, familial belonging in mathematics. The ethnicity of White students formed part of this discourse by its invisibility: their normative images of family drew on childhood and where relatives worked. Non-White backgrounds required/allowed students to accentuate their belonging by aligning further mathematics with their specifically-ethnic culture. Sometimes, they emphasised this culture as providing secure origins from which they could choose to inherit mathematics This was notably explicit for the three students who identified their own 'doing' of mathematics with what their parents brought 'from' China or Vietnam. Further mathematics was additionally aligned with the possibility of (positively) disrupting patterns of progress. This fuels the metaphors of melancholy migrants, inter-generational love and conflict that underpin prominent stories of ethnic-minority success and happiness (Ahmed 2008a). Several students in my study were resourceful in weaving these stories into learner identities that worked. I particularly recall how Sukina connected further mathematics with her friends and her science-teacher brother-in-law, and thereby found a route within the multiple meanings attached to being an aspirational, Muslim, caring, intellectual, young woman living in a space between Bangladesh and one part of London.

Class

It is discourses of advantage, disadvantage and class that run most strongly through the history of further mathematics, and get made over in the policy texts of the FMNetwork. Throughout this thesis I have built a layered analysis of further mathematics as a way of 'doing' independence. It is clear though that there are different ways to take up that independence: as expectant, straight progress from childhood/pupilhood towards adult and personal autonomy, as taking the risks of hoping for the future and the responsibilities of accounting for one's choices, and as resisting constraints as external and claiming expertise in one's own learning and progress. All these practices produce agency and high technological employability; it would be hard not to read as favourable an educational context which makes them possible. We saw in Chapter 7 how neoliberal self-entrepreneurism articulates subjects with a desire to escape constraints and inscribes them as empowered through self-knowing and hard work. However a major weakness of such a consensus position is that "it ignores differences in the power of social groups to enhance their employability at the expense of others" (Brown, Hesketh and Williams 2003, p133). This study has also shown such differences in further mathematics.

I started Chapter 5 with Clive and Steve whose initial choices of further mathematics as a way of 'doing extra' turned out to mobilise quite different perceptions of what mathematics was for. Clive, focussed on accruing high-status qualifications, was urged by teachers and middle-class parents to face the challenge of mathematics. Working-class Steve readily used the discourse of personal employability to convince his mother and teachers that he could spend his time better in vocational A-levels. The practices of the self in further mathematics that enhance self-governance and self-entrepreneurism are strategies of middle-class self-making (Archer, Hollingworth and Mendick 2010; Richards 2005; Sveinsson 2009), that construct working-class culture as an 'other' to the independent learner (Lucey, Melody and Walkerdine 2003; Moreau and Leathwood 2006). The binaries that oppose staged maturity to precocity, learning to earning, expected progress to illusions are all part of this construction of class as individual (Archer, Hollingworth and Mendick 2010; Skeggs 1997, 2004). My data has repeatedly shown how students can experience the ambiguities of further mathematics as exclusions gathering round inauthenticity. Randall was a notable example of student framing his attempt to study further mathematics as an illusion that distanced him from his 'true' status as a dependent pupil. Simultaneously he argued that success in further mathematics would distance him (and Mario) from his autonomous adult goal of 'being there'. These ways in which he and others struggle with further mathematics resonate with the same tensions that problematise working –class learning as having to change and let go of one's natural and autonomous self.

9.4 Implications for future participation and research

The FMNetwork came to an end in July 2009 but was replaced with the Further Mathematics Support Programme. One of the reasons given for this revision was the success of the network in promoting further mathematics so that the focus needed to change from providing tuition to supporting school groups (Stripp 2009). Both the schools in my study planned to bring further mathematics in-house. Yet what this study has shown is the clear differences between the discourses of school-based mathematics and network-based further mathematics. Thus the positioning of the FMNetwork as outside school and yet inside the school and UCAS systems was a significant factor in their practices. For the students it was a new space in which privileged or powerful identities could be "done" and "undone", creating new fluidities but also remaking exclusions (Valentine 2007, p14) Those students who presented their continued participation in further mathematics as most surprising were those who found a way to resist how schools had positioned them in the past, and who drew on further mathematics teaching and online resources to give them expertise in managing their own learning. When students continued to university they used their experience of multiple ways of working to engage resourcefully with new demands and to maintain their sense of self-inclusion through self-work. The particular discourses of belonging as becoming independent that were practices of the FMNetwork groups may not be supported in the same way in newly recruited school groups. It would therefore be interesting for future research to trace how they are adapted, closed off or perhaps enhanced for different students. There are also policy implications for the Support Programme. In this study we have seen the FMNetwork provide new beginnings, alternative support groups, and an authority that excuses examination failure and allows students to try again. I suggest the new FMSP should try to maintain the imagined community of further mathematicians as one which can mediate the relationship between students and schools in such ways. This will not be an obvious shift: the old relationship between the FMNetwork and schools was primarily institutional in its framing of mutual benefits, but the new relationship closely involves classroom teachers, their relationships and identity projects.

My study has also something to say about post-16 mathematics 'intervention' programs and curricula. First, the FMNetwork was extremely effective in matching their vision of an enrichment program with what schools expected from further mathematics in the past and what they wanted it to 'do' in the present and future. They balanced quality, conformity and accessibility in such a way that students – however long they continued further mathematics – consistently framed their experience as having benefits in its contribution to mathematics and work on themselves. The parallels between the discourses found in official texts and students' talk were significant; schools, students and FMtutors had the same expectations about individual lessons and administration, revision conferences and online resources (with the exception of synchronous online revision workshops which my students did not experience as valuable). This was brought about through a careful attention to what would 'work' in schools and in the curriculum. The FMNetwork is thus a good example of innovation that tackles an issue raised in the recent Wolf report on vocational qualifications (Wolf 2011): that qualifications gain value primarily from social practice not academic certification, and that value is easily 'distorted' if new programs fits poorly with existing institutional technologies. Secondly, the nature of post-16 mathematics A-level has itself been under question, with proposals to eliminate modular examinations or to group them into clearly-marked pathways (ACME 2010a, 2010b; DfE 2010; Royal Society 2011). My study confirms that there are complex connections between institutional practices and individual choices which have effects on participation. Very few students in my research set out to study further mathematics through to A2. It was an 'extra', the last priority when work got tight and always first in line to be dropped. The 'turning point' for many of the students who continued was one of the first modules they studied in year 12, discrete mathematics. Not only did most achieve relatively high grades on a restricted timetable, but they enjoyed the application to business and planning (much more than statistics which was seen as boring, fiddly number work). As we saw in Chapters 5, 6 and 7 a sense of mathematics as managing progress in the real world contributed to the discourses of maturity, realism and independence that students used for their own self-management. This suggests that maintaining entry-level applied mathematics within the further mathematics curriculum will be important to retention.

Exploring the discourses of further mathematics and selfhood have given me a fascinating five years of study. I end with lines by Gerald Manning Hopkins where he introduces the self as practice:

> As kingfishers catch fire, dragonflies draw flame;
> As tumbled over rim in roundy wells
> Stones ring; each tucked string tells, each bell's
> Bow swung finds tongue to fling out broad its name;
> Each mortal thing does one thing and the same:
> Deals out that being indoors each one dwells;
> Selves -goes itself; myself it speaks and spells,
> Crying What I do is me: for that I came.

Hopkins summons us to hear the compelling self-creation of subjectivity with an internal logic which for him (re-)articulates divinity. I wish I could match the energy of his poem in my argument that, through the complex inter-relations of practice, choosing further mathematics compels and creates certain possibilities of selfhood. I have traced the internal power that circulates when further mathematics articulates an independent, improving neoliberal self. I am heartened by the possibilities, albeit precarious, of other discourses that value mutual help and the present experience of working with mathematics.

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Appendices

Appendix 1 List of participants (alphabetical order)

These biographical details draw on biographical information asked for in interviews and an email. I decided not to pursue details if I did not get a full answer (which happened fairly frequently in joint interviews and emails) so it is not uniform. In identifying ethnicity and class I have combined specific responses given in some emails about ethnicity, parental occupations and education with relevant information given more anecdotally throughout the research. Specifically I have used parental occupations and the Office of National Statistics *Standard Occupational Classification 2000* to describe students as working-class or middle-class, and then further described students whose parents did not have a degree-level qualification as lower middle class. This educational criterion gave a distinction that tallied with my data regarding sociogeographic differences between sites and friendship groups within sites (Butler and Savage 1995), . I know the degree subjects eight students "went on to study" because they emailed during their first year at university; for another eight students I know the offers they held at the end of year 13;for year 12 interviewees I know only what they intended to apply for.

Overall then, my participants consisted of:

- 14 young men and 10 young women;
- 5 of these were working-class (W), 8 lower middle-class (LM), 8 from upper middle class (M) and 3 whose class was unattributable.
- 15 students were British/White, 2 were British/ Bangladeshi and there was one student in each of the following groups: British/Filipino, British/Mixed White and Asian, British Indian, British Chinese , British Vietnamese, Vietnamese and White Irish.

The students:

007 from Capital is a working-class British/Filipino boy studying Mathematics, Chemistry and Economics (A2), Further Maths (AS). His parents work as hospital porter and midwife, and he is resitting year 12 to improve last year's grades. He intends to study civil engineering.

from Grants is a lower middle class British/White boy studying Mathematics, Geography, Physics (A2) and Further Maths (AS). His parents work as an engineer and a housing assistant. He is an ambitious student and went on to study civil engineering.

from Capital is a British/Bangladeshi boy studying Mathematics, Physics, Accounting (A2) and Further Maths (AS). He did not tell me his parents' occupations but his brother works as a pharmacist. He found that he hadn't chosen the right subjects for medicine or finance, and had an offer to study environmental engineering.

from Moorden is a middle-class British/White girl studying Mathematics, Further Maths, Physics, Psychology (A2) and Classical Civilisation (AS). Her parents work as a police officer and social worker. She went on to study mathematics and engineering mathematics.

from Moorden is a middle-class British/White girl studying Mathematics, Further Maths, Philosophy and Psychology (A2) and Sociology (AS). Her parents work as a marketing director and teacher. She went on to study mathematics and business.

from Moorden is a middle-class British/White boy studying Mathematics, Economics, Geography and History A2) and Further Maths (AS). His parents work as a chief executive and teaching assistant. He had an offer to study economics.

from Moorden is a middle-class British/White girl studying Mathematics, Music and Biology (A2) and Design Technology (AS) but she did not have time for Further Maths. Her parents work in computing and teaching. She had an offer to study music.

from Moorden is a middle-class British/White girl studying English, Performing Arts, and Classical civilisation (A2) and Mathematics (AS). She started Further Maths AS level and stopped after the January module. She did not tell me her parents' occupations but her grandfather was a mathematician. She had an offer to study English.

from Moorden is a lower middle-class British/Mixed White and Asian girl studying Mathematics, Biology and Psychology (A2) and Chemistry (AS) but not Further Maths. Her mother does secretarial work. She intends to study Business or Accounting.

is the only girl at Grants studying Further Maths (A2). She also studies Mathematics and History (A2), and Psychology (AS). She is lower middle-class and

British/White and her parents work as a police officer and school administrator. She went on to study mathematics.

from Moorden is a working-class British/White girl studying Mathematics, Further Maths, Business, Psychology (A2) and Health Care (AS). Her parents are care-workers for the elderly. She had an offer to study mathematics with management studies

from Capital is a working-class White Irish boy studying Mathematics, English Language and Economics (A2). He started Further Maths and stopped after one module in June of Y12. His parents are not employed; his father lives away from the family but encouraged Joe with his mathematics. He intends to study economics and mathematics.

from Capital is a British/Chinese boy aiming to study Mathematics, Accounting, Physics and Economics (A2) and Further Maths (AS). Although "most Chinese people are good at maths," his parents do not work with it because they came to England. He intends to study economics and mathematics.

from Capital is a middle-class Vietnamese girl studying Mathematics, Physics and Economics (A2) and Further Maths (AS). Her school teacher is helping her study more modules to get Further Maths A2 if possible. Her parents own a business in Vietnam and she lives on her own in England. She intends to study mathematics and management science.

from Grants is a lower-middle-class British/White boy studying Mathematics, Further Maths, Physics, Chemistry (A2) and Design Technology (AS). His parents work in engineering, secretarial/ insurance. He went on to study acoustic engineering.

from Capital is a working-class British/Vietnamese boy studying Mathematics (A2). He is retaking Y12 to improve his grades in ICT and Economics (AS) but continuing with Mathematics. Although he started Further Maths AS, he stopped for the resit year. His father is a bus driver who "has a passion for" mathematics. Michael intends to finish A2s and another AS and study economics and mathematics.

from Moorden is a middle-class British/White boy studying Mathematics, Further Maths Physics, Computing (A2) and Psychology (AS). His parents work as a telemetry engineer and teaching assistant. He went on to study computer science.

from Grants is a lower middle-class British/White boy studying Mathematics, Further Maths, Physics, Chemistry (A2) and Design Technology (AS). His parents work in engineering. He aims to work in music. He was the only participant not applying for university.

from Grants is a British/White boy studying Mathematics, Psychology and Physics (A2) and Further Maths (AS). His father "sort of" works with mathematics but without a degree. At the end of Y12 he intended to study mathematics but in Y13 he told me he found A-levels more difficult, and did not take part in further emails or interview.

from Grants is a middle-class British Indian boy studying Mathematics, Further Maths, Physics, Chemistry (A2). His parents are professionals. He went on to study computer science.

from Moorden is a lower middle-class British/White girl studying Mathematics, Art, Biology (A2), Further Maths and Physics (AS). She continued Further Maths for one more module in Y13. Her mother and grandfather work in accountancy. After a gap year studying floristry, she had an offer to study Marine Biology.

from Moorden is a working-class British/White boy studying Business Studies, Economics and Law (A2), Mathematics and Further Maths (AS). His mother and brother work in accounts. He had an offer to study business management.

from Capital is a middle-class British/Bangladeshi girl studying Mathematics, Biology Chemistry (A2), Further Maths and Psychology (AS). Her brothers are in business and she is inspired by her brother-in-law who is a science teacher. She had an offer to study pure mathematics, and was angry to find that some courses required Further Maths A2.

from Grants is a lower middle-class British/White boy studying Mathematics, Physics and Geography (A2), and Further Maths (AS). His parents work as a postman and IT manager. He went on to study computer science.

Students by Gender, Ethnicity and Class

	Gender	Ethnicity	Class
	M	British Filipino	W
	M	British White	LM
	M	British Bangladeshi	Unattributed
	F	British White	M
	F	British White	M
	M	British White	M
	F	British White	M
	F	British White	M
	F	British Mixed White/Asian	LM
	F	British White	LM
	F	British White	W
	M	White Irish	W
	M	British Chinese	Unattributed
	F	Vietnamese	M
	M	British White	LM
	M	British Vietnamese	W
	M	British White	M
	M	British White	LM
	M	British White	Unattributed
	M	British Indian	M
	F	British White	LM
	M	British White	W
	F	British Bangladeshi	LM
	M	British White	LM

Student participation in interviews and emails

	Y12 interview	Y13 interview	Number of emails
	-	Alone	1
	With and	With	3
	-	Alone	-
	Alone	Alone then with	5
	With	Alone	4
	Alone	Alone	1
	Alone	Alone	2
	With	Alone	3
	With	-	1
	With and	Alone	1
	Alone	With then alone	4
	-	Alone	-
	Alone	-	-
	-	Alone	1
	With &	With	3
	-	Alone	-
	Alone	Alone	4
	With &	With	2
	With and	-	-
	Alone	Alone	4
	Alone	Alone	3
	With	Alone	3
	-	Alone	-
	With and	With	3

Appendix 2 Documents used

I selected these documents as representing further mathematics and the FMNetwork to a range of audiences. All of them are public documents: published, distributed or made available on the web. (The FMNetwork is now called the Further Mathematics Support Programme (FMSP) so much of its documentation is slightly renamed). I selected the documents in four main areas (see headings): in the first two, the authors can be considered as writing *for* the FMNetwork; in the second two, authors *outside* the FMNetwork relate it to wider discourses of mathematics.

FMNetwork internal and public promotional

Here I selected three documents in which the FMNetwork made a case for its inception, aimed to involve others who recognised a mathematics 'problem', and build up a momentum for reform.

Why study FM? (no date). Leaflet and webpage www.furthermaths.org.uk/student_area/whystudyfm.php. [accessed 17/3/11].

This is the recruitment leaflet that the FMNetwork distributed to schools and students from the beginning of the project. It sets out the "good reasons" for students to take Further Maths, and how they can benefit from studying with the FMNetwork.

Newly completed network provides access to Further Mathematics throughout England. Further Mathematics Network Press Release, 7 September 2006. Available from www.fmnetwork.org.uk/press_releases.php. [accessed 17/3/11].

This press-release presents the newly-established FMNetwork as a ground-breaking DfES intervention to reverse the decline and narrowness of Further Maths, using favourable quotes from schools, universities and government advisors.

A-Level Further Mathematics Celebrates Further Increases. Further Mathematics Network Press Release, 13 August 2007. Available from www.fmnetwork.org.uk/files/PR07-8_Further_Mathematics_Network_A_levels.doc [accessed 17/3/11].

This media-release explicitly associates the FMNetwork with "impressive" increases in Further Maths A-level numbers, and encourages more universities to make it an entry requirement.

Explaining the FMNetwork to undergraduate mathematics educators

Here I selected three documents written by staff associated with the FMNetwork for lecturers in mathematics-related higher education. In them, Stripp and Porkess summarise the problem of declining mathematics numbers and inform their readers that the FMNetwork is addressing their concerns.

Stripp, C. 2004. The changes to AS/A level Further Mathematics for September 2004. *Mathematics, Statistics and Operation Research Connections* 4 (3):15-16.

This journal has a readership amongst university staff interested in new insights on teaching mathematics. Stripp informs them of changes that "give grounds for optimism" and asks for help in promoting the pilot Further Maths programme.

Porkess, R. 2006. *Unwinding the Vicious Circle.* Paper read at IMA international conference on Mathematical Education of Engineers, at Loughborough, April 2006.

This talk analyses the multiple causes of mathematics decline and proposes the FMNetwork as a logical solution. The 'vicious circle' has been influential, with versions appearing in later reports (e.g. self-perpetuating cycle of decline).

Stripp, C. 2007. The Further Mathematics Network. *Mathematics, Statistics and Operation Research Connections* 7 (2).

This follow-up article to Stripp's earlier contribution (above) sets out the mission statement and national structure of the FMNetwork, and implications for universities.

FMNetwork evaluations

These four documents from researchers at Durham University report the findings from independent evaluation of the FMNetwork pilot and programme. They set out criteria for judging institutional success and in doing so position the FMNetwork according to wider discourses of mathematics education policy.

Barmby, P. and R. Coe. 2004. Evaluating the MEI 'Enabling Access to Further Mathematics' Project. *Teaching Mathematics and its Applications* 23 (3):119-132.

This was published in a small journal popular with university mathematics educators at the time of extending the project.

Searle, J. & Barmby, P. (2006) *Evaluation of the MEI Further Mathematics Network: Initial Report.* Curriculum, Evaluation and Management Centre, Durham University.

Searle, J. 2008. *Evaluation of the MEI Further Mathematics Network: Interim Report 2.* Durham: CEM Centre, Durham University.

These are reports designed for an already-interested audience including the FMNetwork and its funders.

Searle, J. 2008. *Evaluation of the Further Mathematics Network.* Power point slides of a paper read at Improving Educational Outcomes Conference, at Durham University.

This describes some of the evaluation findings as work in progress, showing some of the criteria that did not end up in the final report.

National mathematics policy documents

I selected four key documents that appeared contemporaneously with the FMNetwork and addressed the 'mathematics problem' and used these to investigate how the discourses of the FMNetwork are similar or different to those of government policy.

Matthews, A. and Pepper, D. (2005) *Evaluation of participation in A-level mathematics. Interim Report.* QCA, pp 1-11, 73-4.

Matthews, A. and Pepper, D. (2007) *Evaluation of participation in GCE mathematics: Final report.* QCA. pp 1-22, 68-69

Two influential reports on A-level Mathematics which include Further Maths as a subsidiary interest. I have looked closely at the Introduction/Summary section from each, and the sections that report findings for further mathematics.

more_maths_grads. *More Mathematics Graduates* Press release, 23 April 2007 Available from http://mmg.scenta.co.uk/_db/_documents/070423_mmg_launch.pdf.

I attended the launch of this national project whose remit to promote mathematics has similarities with the FMNetwork. It seemed fruitful to compare their press-releases.

QCA (2007) *Offering further mathematics as part of the A level curriculum.* Qualification and Curriculum Authority.

A rare QCA document about teaching/structuring further mathematics that describes the FMNetwork amongst other ways to promote and offer further mathematics.

Appendix 3 Observation design

I chose to gather information from observation for two reasons: to obtain accounts produced by students and teachers about identities, arising in the natural context of mathematics and further mathematics lessons, and to provide background information and shared knowledge of classroom practices to enable me to conduct interviews and analyse the data. At Grants and Moorden, I decided to observe mathematics lessons for a full week, in mid–term so that teaching was uninterrupted, visiting each of the relevant A-level teachers at least once. As the schools had different Mathematics A-level groups, usually with two teachers each, it was impossible to observe every student's full mathematics week, and ad hoc observations continued over a period of time. Clearly this selection of lessons to observe offers a spread across the school, the students and teachers, but little in the way of generalisability. For further mathematics, I observed an initial sequence of three consecutive lessons in each school, with occasional observations of the weekly lessons over the research period, preceding other contacts such as email and face-to-face interviews. At Capital I was only able to observe one lesson in each year.

I recorded information from the observations using field notes, as their exploratory nature did not suggest pre-formed categories of interest. Instead, the situation was one in which "the researcher enters the setting with a range of questions, interests, orientations"(Brown and Dowling 1998, p50). In taking field notes, there is inevitably a selection of material to record and an organisation in the manner of recording it that requires ongoing consideration of the underlying principles by which this is done. For my field notes I made an initial choice to include:

- Information relating to students, time, place and a description of setting
- Outlines of the mathematical tasks introduced by the teacher, the questions asked, approaches and variations discussed;
- A record of connections between mathematics and further mathematics verbalised by teachers or students, or noted in the lesson tasks;
- Descriptions of the approaches to learning in that classroom – noting episodes of teacher/ peer talk, written mathematical activity, group, pair or individual goal setting, who provides and critiques the mathematics.

- Records of comments made by teachers or students about the process of learning or doing mathematics;
- Descriptions of how identities were offered or taken up by the students and teachers, particularly common models such as 'exam candidate', 'hard-working girl', 'isolated mathematician'.
- Records of any emotions or power relations expressed by the teachers or students.
- Records of using common gendered binaries in their reasoning e.g. hard/easy; calculation/reasoning.

Notes in all these areas were collected under four broad headings, Classroom setup, Pedagogy, Identities and Emotions/Connections, and annotated to show the chronology of the lesson. Despite the ambitious scope of the categories of information to be collected, the nature of the lessons, with usually one person talking at a time and regular periods when individuals practised mathematical techniques, meant that it was usually possible to decide and record the information considered to be relevant.

Appendix4 Interviews

Appendix 4.1 Year 12 Schedule Further Maths Students

Introduction	Research context – choice, experiences, feelings opinions Confidentiality – storage and use Consent – taping Withdrawal
Name What were your A-level choices?	Choose research name
How did you come to choose those subjects?	What was the first one you chose? Which is/was your favourite? When did you think about doing Maths A level? Did you think about maybe doing Further Maths? Do you think your friends or family influenced your choice? Or your teachers?
I have got twelve words here – varied descriptive words. *warm green repelling painful* *new fluid straight talkative* *safe stale cloudy hopeful*	Can you choose three that definitely apply to Maths, and three that definitely don't - and tell me why? What about three for your favourite subject? And for Further Maths? Why are they different?
Can you describe how your class usually interacts in maths lessons?	Who is your best friend in maths? Are there people who don't work well together? How do you feel about your share of teacher time?
Can you describe to me how you worke on a recent topic in maths or F maths? *E.g. integration , complex numbers, fixed poin iteration*	What happened in class with your teacher? How did you get on with it when you were working by yourself? What are good practices for you in learning maths? What are bad practices? Are they different in different subjects?
Do you have any strong memories or images of you working on maths?	How does working on maths now compare?
Got a set of photos of various situations in study and employment. Are there any that appeal to you in terms of your future, say in 3-5 years time?	What subjects will you have continued to A2? Will you be using maths at all?
*What do you feel about learning from your maths textbook?	How is it different working in Maths and Further Maths?
*How important to you is your teacher when you are learning?	Do your different maths teachers expect different things from you? *Maybe in lessons? For homework?*
*Do you think that being "good" at maths is the same as being good in maths exams?	Do you have a sense of how good you are at maths? Does it matter to you how well you do in exams?
End	Thanks. Check on consent. Email Questions to follow?

Starred questions were optional that I omitted if time was short and/or if the student had already talked about similar issues.

Appendix 4.2 Year 13 Schedule A Further Maths students

Introduction	Research context. Confidentiality – storage and use. Consent – taping. Withdrawal
Subjects? Target grades? AS grades?	
What are you planning to do next year?	Subject? Where? Or what? How did you make that decision? What kind of advice did you take on those choices? How certain are you about the choice?
Did you feel that the A levels you chose made a difference when applying?	
What kind of work environment are you looking forward to at university?	How do you think it will be different to school?
I have got twelve words here – varied descriptive words. *independent flighty lazy natural competitive mature crazy intuitive disciplined skilful quick realistic*	Can you choose three that definitely apply to you as a student, and three that don't? Are there any lessons that particularly bring out those qualities? What qualities will be useful in later life?
Looking back at year 12/13, when have do you felt happiest doing your school work? When have you felt most miserable?	
C3/C4 A-level question: How would your teachers tell you to approach this question?	Just talk through what you'd try and what you think would happen.
Can you tell me about any differences in your learning styles or skills between now and year 12?	Describe how the class works
How would you describe the people who do maths with the FMNetwork?	Tutors? At revision days? Other students? Are you a typical maths student?
*What effect does it have that the FMN is a national programme?	Online resources? Revision online and meeting days?
*What advice would you give someone in year 11 who had chosen further maths or maths for A-level?	How much work is it? How should you organise your work?
*Do you feel that your different A levels fit together well? Have they been connected?	Can you give me an example of any time when something you learnt in mathematics helped with further maths? Or Physics?
*What do you think is most influential in learning maths – the school, the teacher, or the student?	Responsibility?
What do you think you will you be doing around 5 years time?	What kind of maths might you be using in the future?
End	Thanks. Check on consent Email Qs– uni?

Starred questions were optional that I omitted if time was short and/or if the student had already talked about similar issues.

Appendix 4.3 *Year 13 Schedule B* *Maths students*

Introduction	Research context. Confidentiality – storage and use. Consent – taping. Withdrawal
Subjects? Target grades? AS grades?	
What are you planning to do next year?	Subject? Where? Or? How did you make that decision? What kind of advice did you take on those choices? How certain are you about the choice?
Did you feel that the A levels you chose made a difference when applying?	
What kind of work environment are you looking forward to at university?	How do you think it will be different to school?
I have got twelve words here – varied descriptive words. *independent flighty lazy natural competitive mature crazy intuitive disciplined skilful quick realistic*	Can you choose three that definitely apply to you as a student, and three that don't? Are there any lessons that particularly bring out those qualities? What qualities will be useful in later life?
Looking back at year 12/13, when have do you felt happiest doing your school work? When have you felt most miserable?	
C3/C4 A-level question: How would your teachers tell you to approach this question?	Just talk through what you'd try and what you think would happen.
Can you tell me about any differences in your learning styles or skills between now and year 12?	Describe how the class works
How would you describe the people who do maths with the FMNetwork?	Are you a typical maths student?
*What advice would you give someone in year 11 who had chosen further maths or maths for A-level?	How much work is it? How should you organise your work?
*Do you feel that your different A levels fit together well? Have they been connected?	AS only: can you give me an example of any time when something you learnt in Further Maths helped with mathematics? Or Physics?
*What do you think is most influential in learning maths – the school, the teacher, or the student?	Responsibility?
What do you think you will you be doing around 5 years time?	What kind of maths might you be using in the future?
End	Thanks. Check on consent Email Qs– uni?

Starred questions were optional that I omitted if time was short and/or if the student had already talked about similar issues.

Appendix 4.4 Year 13 Schedule AS-only Further Maths

Main Questions	Optional Prompts
Introduction	Research context – choice, experiences, feelings, opinions Confidentiality – storage and use. Consent – taping. Withdrawal. Choose research name
What were your A-level choices? How did you come to choose those subjects?	What was the first one you chose? Which is/was your favourite? When did you think about doing Maths A level? When did you think about doing Further Maths? Do you think your friends or family influenced your choice? Or your teachers?
I have got twelve words here – varied descriptive words. *warm green repelling painful* *new fluid straight talkative* *safe stale cloudy hopeful*	Can you choose three that definitely apply to Maths, and three that definitely don't - and tell me why? What about three for your favourite subject? And for Further Maths? Why are they different?
Can you describe how your class usually interacts in maths lessons?	Who is your best friend in maths? Are there people who don't work well together? How do you feel about your use of teacher time?
Does it make any difference that you've done Further Maths in your normal Maths lessons?	
Can you describe to me how you worked on a recent topic in FMaths? *E.g. integration , complex numbers, fixed point iteration*	What happened in class with your teacher? How did you get on with it when you were working by yourself? What are good practices for you in learning maths? What are bad practices? Textbook? Are they different in different subjects?
How would you describe the people who do maths with the FM network?	Tutors? At revision days? Other students? Are you a typical maths student?
*What effect does it have that the FMN is a national programme?	Online resources? Revision online and meeting days?
*What do you think is most influential in learning maths – the school, the teacher, or the student?	Responsibility?
What do you think you will you be doing in around 5 years time?	If uni, do you feel that the A levels you chose made a difference? What kind of maths might you be using in the future?
End	Thanks Check on consent

Starred questions were optional that I omitted if time was short and/or if the student had already talked about similar issues.

Appendix 4.5 Adjectives task

Design and rationale

In the 'adjectives task' I asked students to choose three words from a bank of adjectives that they thought applied to mathematics and three that did not, and then to talk through their choices. This was repeated for further mathematics and/or their favourite subject. The themes that I tried to include through my choice of words picked up on metaphors for mathematics and leaning and beliefs about participation. The first theme was to echo metaphors for learning that I had observed the school teachers use, such as 'following a journey', 'saying', 'seeing' for understanding and learning (Cameron 2003). So the adjectives *straight* and *fluid* suggest movement, *talkative* suggests speech; while *green* and *cloudy* were chosen to be visual terms. (As an example of the personal nature of evocations, one student explained that *green* meant 'go' and suggested a pleasurable journey in mathematics). The second theme picked up on the feelings of 'not belonging' (Solomon 2005) and 'exposure' (Nardi and Steward 2003; Rodd 2002) prevalent in accounts of studying mathematics at university. I chose *warm, repelling, safe, painful, talkative, hopeful* to evoke emotions and sensations associated with acceptance and rejection in social groups.

Similarly, research has found that mathematics students described their emotions concerning the subject as 'frustration' (Rodd 2002), 'cooling down/off' (Daskalogianni and Simpson 2002). They also used metaphors related to death and dis/solution (Early 1992), uncertainty and unfinished problems. Gerofsky (1997, np) describes how anxieties and desires are articulated by students: "desire in traditional mathematics education seems to be for an immediate closing down of messy living spaces, foreclosure on the unknown". I chose *cloudy, fluid, warm, painful, stale, straight, new, safe, hopeful* as words that echo these fears, but also the associated possibilities for new beginnings. Finally, the discussions were taking place in the context of educational choice in which choice is thematised as largely concerned with comfort, utility and rationalism (Blenkinsop et al. 2006; QCA 2007; SHM 2006). I welcomed the associations with futurity, direction and self-care of *hopeful, repelling, new, straight and safe*. I avoided *useful* as too obviously associated with choosing and mathematics.

All these words were chosen by some students for some subjects. *Safe* was the most popular word, as described in §5.1.1. *Talkative* tended to be used in the same way by students within a teaching group – they agreed that their mathematics lessons were either talkative or not, and this was a good introduction to describing lessons. *Green* was rarely selected in relation to any subject, although it provoked the odd interesting comment in passing that mathematics had nothing to do with green issues or nature.

In Year 13 interviews I used a variation of this task with twelve adjectives that applied (or not) to them as learners. I asked students which lessons brought out those qualities, and which would be useful in later life.

independent	*flighty*	*lazy*	*natural*	*disciplined*	*skilful*
competitive	*mature*	*crazy*	*intuitive*	*quick*	*realistic*

Results

This table shows how often each adjective was selected during the tasks. Not all students gave three responses, and some groups/pairs students gave joint responses, some individual responses. The numbers are therefore indicative, which is why I have used a word cloud to compare them in the thesis. Here I have marked the common responses in bold, and underlined the adjectives where there is a difference between mathematics and further mathematics.

	***MATHS* (17 responses)**		***FURTHER MATHS* (15 responses)**	
	DO	***DON'T***	***DO***	***DON'T***
warm	4	2	3	1
green	0	3	0	2
repelling	1	**8**	1	3
<u>painful</u>	3	**10**	6	2
new	6	2	**10**	2
fluid	4	2	4	4
<u>straight</u>	**9**	2	2	6
talkative	6	6	4	5
<u>safe</u>	**10**	4	1	**10**
stale	0	5	3	5
<u>cloudy</u>	5	6	**7**	2
hopeful	6	0	**7**	3

For the adjective task that required students to describe themselves as learners, 17 students gave these responses:

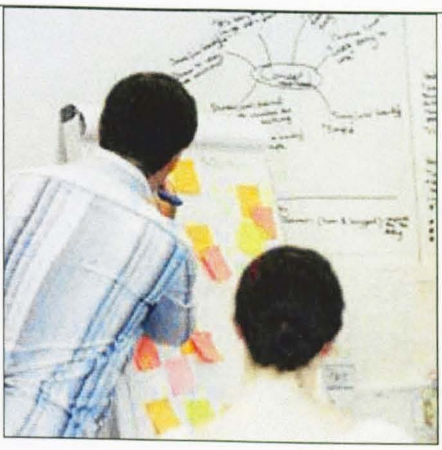
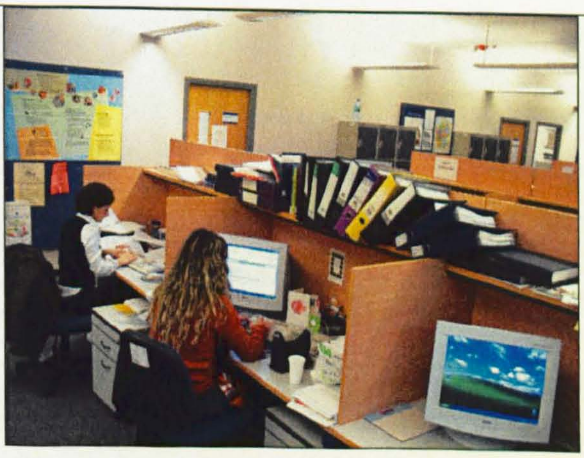
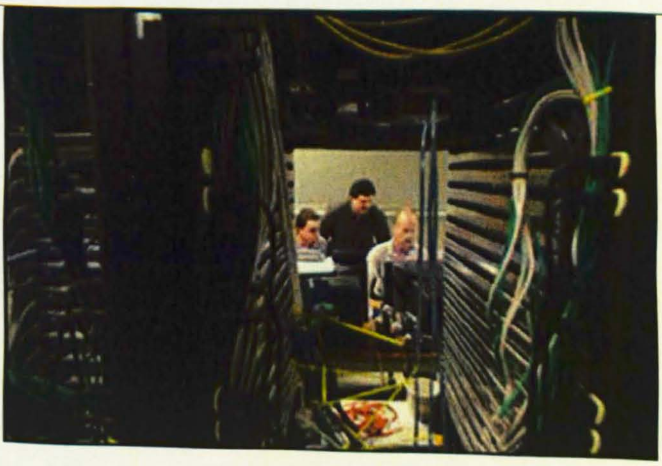
	ME AS A LEARNER		*USEFUL IN LATER LIFE*	
	DO APPLY	*DON'T*	*YES*	*NOT*
independent	12	4	9	1
flighty	7	1	-	1
lazy	4	9	-	1
natural	1	2	-	
disciplined	2	11	3	2
skilful	-	1	-	
competitive	8	5	3	1
mature	3	2	3	1
crazy	-	6	-	
Intuitive	1	2	-	
quick	3	4	3	
Realistic	10	1	3	1

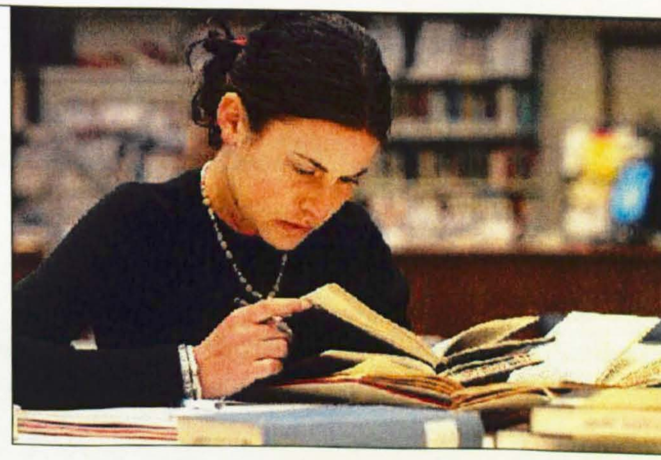
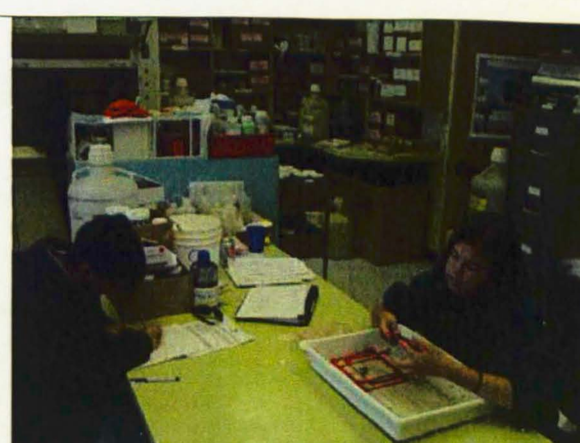
Appendix 4.6 Design and rationale for Photographs task

The photographs in this task were chosen after analysing the further mathematics documents. The FMNetwork website (www.fmnetwork.org.uk) uses a range of photographs of further mathematics students and career mathematicians. Presenters at the More Maths Grads launch and FMNetwork revision days also showed eye-catching images and associated them to mathematics. These were aspirational images associated with beauty, mystique, travel, access to impressive buildings, technology and institutions, and with a social picture of race and gender inclusion, leadership and teamwork. So the design element of this task was to introduce some of these visual discursive practices of further mathematics but bring them into interactions where students described their own choice-making.

To create this resource I searched for copyright-free photographs on the internet that matched my specifications. I chose photographs for the images because of their implications of access, authenticity and realism. I decided to mute the dominant effects of aspirational photography by finding images that matched in their topics but not the quality of production, and by including other, more mundane situations that students might be familiar with. I was asking participants to identify themselves in imagined futures so I avoided images that put objects centre-stage in favour of individuals and groups of people in action. However I chose photos where people manipulated props to match the metaphor of control noted from the FMNetwork document analysis, and to offer complexities and possibilities in the student comments. I paid particular attention to how the photographs portrayed group relationships in terms of people's age, gender and ethnicity, aiming for photos that were varied and inclusive while not overtly challenging or stereotypical. Finally I avoided full-face portraits because I wanted to signal that these images were of roles not characters.

The final selection depicted (to me):

A	A woman and man adding to communal post-it notes in front of a poster-sized spider diagram.	
B	A man at his desk using telephone and four computer screens with a view over colleagues and a cityscape.	
C	Two women in adjacent personalised, desk-spaces working with computers and piles of folders in a colourful office.	
D	Three men at two computers, revealed behind complex wiring.	

E	Four young presenters pointing to graphs on a data projector screen in a darkened auditorium.	
F	Six colleagues in lively discussion of shared documents around a small circular table in a town office.	
G	A young woman reading books in a blurred book-lined library/office.	
H	A young man and woman writing and manipulating equipment in a room full of boxes, tubs and shelves.	

Appendix 5 Example of Email Questionnaire

Questionnaires were sent as word forms so participants could type only in the highlighted boxes.

Questionnaire for ---------

October 2007

I hope you have had a good beginning to year 13. Thanks for filling in my questionnaire again.

Some boxes have single questions that I am looking for an answer to, while in other boxes I have put a few related questions and I am interested in anything you have to say in that general area. The questions do overlap slightly. Please answer in every box, but if you have written a longer answer somewhere then don't feel you have to repeat yourself.

Cathy

Which of these AS levels have you continued to A2?	
Psychology	
Sociology	
Philosophy and Ethics	
Mathematics	
Further Mathematics	

How does choosing A2s compare to when you chose AS levels?
Did you consider not continuing with maths or further maths? Can you describe the kind of experiences last year that have influenced your feelings about continuing?
What factors came into your thinking when you chose the A level subjects to continue?
When did you decide?

What happens in a typical further maths lesson this term? How are you feeling about your learning? How does it compare to your normal maths or last year?
Please describe any differences in how your maths class works with each other and the teachers now that you are in A2?
Personally, do you feel differently about maths and your other A level subjects now that you are experiencing them in A2?
What are you thinking about in terms of plans for next year? How do you feel about having to make them? Have your ideas changed at all from when we spoke in April?

Thanks again. If you have any queries about this, then please do email me.

To know more about my research, check http://www.litlington.org.uk/cas/

Cathy Smith

Appendix 6 Talks, Papers and Awards from this thesis

Talks

"Not knowing and not being too safe": happiness, work and further mathematics. Invited lecture to the day conference of the British Society for Research in Learning Mathematics, Leeds University, 11 June 2011.

"Sometimes I Think Wow I'm Doing Further Maths...": Tensions Between Aspiring And Belonging. Sixth International Mathematics Education and Society Conference, Freie Universitat Berlin, 25 March 2010. Published in refereed proceedings (Smith, 2010b)

Choosing more mathematics: happiness through work? British Educational Research Association Conference, Manchester, 4 September 2009.

Choosing more mathematics: working for happiness? Cambridge Colloquium in Mathematics Education, Cambridge University, 11 May 2009.

Choosing more mathematics: happiness through work? British Society for Research into Learning Mathematics Conference, Kings' College, London, 15 November 2008. *Informal Proceedings* 28 (3):114-119.

Who wants to be a Mathematician: further mathematics A-level as identity work? Birmingham Science Education Research Group meeting, London, 3 May 2008

Who wants to be a Mathematician? London Metropolitan University research student seminar, London, 21 Nov 2007

Publications

Smith, C. 2011. 'Sometimes I think Wow I'm doing Further Maths…': balancing tensions between aspirations and belonging. In *Mapping Equity and Quality in Mathematics Education*, ed. B. Atweh, M. Graven, W. Secada and P. Valero. New York: Springer.

Smith, C. 2010. Choosing more mathematics: happiness through work? *Research in Mathematics Education* 12 (2):99-116.

Award

Janet Duffin Award for 2010; awarded by editorial board of *Research in Mathematics Education* for my paper (Smith 2010 above).