



HAL
open science

Senses of time and maturity structuring participation in advanced mathematics

Cathy Smith

► **To cite this version:**

Cathy Smith. Senses of time and maturity structuring participation in advanced mathematics. Seventh ERME Topic Conference on Language in the Mathematics Classroom, Feb 2020, Montpellier, France. hal-02970626

HAL Id: hal-02970626

<https://hal.science/hal-02970626>

Submitted on 18 Oct 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Senses of time and maturity structuring participation in advanced mathematics

Cathy Smith

Open University, Milton Keynes, UK; cathy.smith@open.ac.uk

This paper examines how young people account for choosing advanced mathematical pathways, specifically how their language practices around time and maturity, inscribed in classroom and educational discourse, sustain, or not, their continued participation. It draws on a 2-year qualitative study of 24 young peoples' accounts of following advanced mathematical pathways within a widening participation programme. Working from a post-structural perspective, I identify distinct discourses –moving/improving and getting ahead - that structure the intelligibility of participation in the two pathways. I argue that tracing the alignments and tensions between these discourse offers potential to understand emergent practices in mathematics participation in terms of ongoing inclusions and exclusions that render individual student choices secure or fragile.

Keywords: Time; mathematics; aspiration; inclusion; social class.

Introduction

This paper starts from the perspective that language tools and rhythms contribute to the social structuring of time in educational settings, which in turn frame the educational choices of young people (Lingard & Thompson, 2017). Mathematics has been understood as culture-free and timeless, but is also pressed into service as the 'bright future' for individuals and nations. It is in this context that, in England, between 2005 and 2018, the government funded a national programme specifically to widen university-track 16-year-olds' participation in an enhanced mathematics pathway involving longer teaching hours, broader and deeper content (such as linear programming and complex numbers) and extra examinations. This pathway had entered a spiral of decline, available only in large, well-funded or fee-paying schools but still necessary for entry to elite university courses. It remains small: completed by 4.8% of academic-track students in 2018, while 27.4% complete standard mathematics. In England, 16-year-olds who have reached a threshold examination level can choose to study no more mathematics; thus the meanings that circulate in secondary classrooms about what it means to choose, or 'do', mathematics have material consequences. This study conceptualises the national programme as a serious attempt to reimagine the discursive structures of participation that reconstruct "knowing and thinking in/about mathematics" (Morgan, 2013) and patterns of exclusion. It draws on the accounts of 24 young people whose schools newly offered the enhanced pathway. These are analysed to trace the discourses that describe and construct these young people's choices and lived experiences, focusing on the senses of time and maturity that shape identities in relation to future and past selves. A full report of the research can be found in Smith (2020).

The research question driving this longitudinal, interview-based study was: What senses of time are circulated in students' accounts of choosing to study advanced mathematics pathways in a widening participation programme, and what discursive positions do they make available?

Theorising subject choice and time

I approach this argument and analysis using the Foucauldian concepts of discourse and positioning. Choosing mathematics is a discursive practice of the self, a way that power is circulated by producing knowing beings who judge their own and others' behaviour with respect to social norms (see, for example Smith, 2010). Discourses can be understood as webs of practices "that systematically form the objects of which they speak" (Foucault, 1972, p. 49). They are historically, linguistically and culturally contingent, but they present as unarguable regimes of meaning that gain currency through use. People are positioned relationally by discourse, by how they fit within webs of meaning, and they also understand themselves and position themselves through discourse. A sense of time frames people's explanations, purposes and imaginations, collectively and individually (Lingard & Thompson, 2017) and thus time was identified as a fruitful, and previously unexplored, focus through which to examine how discourses align locally to enable or prevent young people's participation in mathematics.

A post-structural method focuses on regularities in discursive practices, traces how these arise, how they align or interact, and the positions they make available. It thus shares a concern with Bourdieuan and cultural theory in how social patterns of aspiration are reproduced through individual behaviours. However, it focuses on the diffuse and productive functioning of power within particular situations, such as this national programme, and through specific social constructs, such as time, paying attention to alignments or tension between meanings that may include or exclude individuals. To ground this argument, I briefly outline macro- and micro-level discourses proposed by previous research in the three areas of: choosing mathematics, contemporary adolescence, and negotiating age imaginaries.

Discourse at a macro-level: choosing mathematics as a practice of the self

Within modern Western societies, choosing is constituted as a means by which individuals are enjoined to express themselves as agents with autonomy and subjectivity, and are held responsible for the processes and outcomes of those choices (Rose, 1999). Analyses of students' accounts have identified choosing mathematics as a practice of proving something *about* oneself in ways that are contingent on dominant discourses about the nature of mathematics as hard, competitive, rational, requiring natural aptitude and real understanding (Mendick, 2008; Stinson, 2013). These researchers show how students speak about their successes in "White male" mathematics as a counter to narratives of deficit or rejection that position them through race or gender. Such accounts of resistance are welcome, but their perceived rarity is part of what lends them discursive impact.

Discourse at a macro-level: adolescence as an emblem of modernity

Lesko (2001) argues that modernity privileges a *development-in-time* view of adolescents as always 'becoming', held between childhood and adulthood, at risk to themselves and others, and comprehensible in time without knowledge of their contexts. Lesko's argument rests on demonstrating how two main constructions of time are woven into the language that describes 20th century adolescence. Through *panoptical* time, adolescents are continually watched and measured normatively by age (for example, by schools' progress trackers); through *expectant* time they are positioned as not-yet-adults, unable to act until given social permission (e.g. everyone studies calculus aged 16). This means that for adolescents, time is necessarily involved with age and becoming mature.

Together, these temporalities construct knowledge about progressing towards a desirable end, a discourse that is valued in modernity but is not neutral since it recapitulates cultural stories about ‘progress towards’ Western civilisation.

Discourse at a micro-level: negotiating age imaginaries

Schools teach young people to express acceptable ambitions for employment even as they simultaneously consider contradictory dream jobs or realistic outcomes. The notion of “age imaginaries” (Alexander, 2014) acknowledges these concurrent constructions of young people’s future identities. Similarly to Lesko, Alexander suggests that time (and age) are central to modern youth, whose present conceptions of themselves are given meaning by the anticipation of consequence. Alexander’s research attends to what is mobilised in conversations as a marker of age differences – for example music choice or debt levels – and how transitions are organised. Whereas Lesko’s work emphasised the dominance of one temporal discourse, of adolescence as ‘becoming’, Alexander (2014) suggests that contemporary youth have a mercurial sense of temporality: that is, they imagine themselves in relation to multiple concurrent age-imaginaries that both follow and resist dominant discourses.

Study

The data comes from 31 interviews and 51 e-mail questionnaires with 24 students in three sites in England newly offering the enhanced mathematics pathway. The sites exemplified differing socio-geographic settings and teaching contexts: with the extra lessons scheduled in- or after-school, and either a full- or half-course offered. Almost all enhanced-course students at each site agreed to participate, a total of 10 girls and 14 boys. 13 participants completed an enhanced course, 9 stopped during their study and two had chosen not to take it. Using parents’ occupational classifications, 5 were working-class, 13 administrative/professional middle class and 3 unattributable.

The research data consisted of accounts of study experiences and choices, collected over two years using semi-structured interviews, half-termly emails, and observations of 2-6 mathematics lessons in each site. The students were interviewed by me either singly or in groups of 2-3, 18 during their first year after choosing their courses and 21 in the second year; with 15 interviewed twice. Interviews included direct questions about choosing subjects, how their class interacted in lessons, how they worked at home, and memories of learning mathematics. I also asked questions that involved talking about school and mathematics using unfamiliar adjectives. For example, students chose from a list of 12 adjectives to describe school subjects (such as *warm*, *talkative*, *straight*; derived by me from research into perceptions of mathematics, e.g. Gerofsky, 1997)), and explained their selections. I asked questions by email at significant transitional times, e.g. after receiving first module results, applying for and joining university, and to follow up any interesting responses in a reflective conversation. The longitudinal aspect allowed me to follow discursive patterns in the students’ accounts as they made study choices. Observations documented lesson practices in mathematics so that I could trace their interactions with student accounts. Language use around time was not systematically recorded during the observation, but language used to describe the two pathways was recorded, providing a check for the later claim of different discourses.

Analysis involved coding the student accounts to locate language related to time or age (underlined in the following extracts), and examining whether/ how this language was associated with narratives of choosing and participation (Robson & Bailey, 2009). The codes and subcodes relevant to this paper were Time (as a resource/ age-related/ memories/ futurity), Maths and Further Maths (i.e., the names of the two pathways). Transcripts were initially coded for Time by searching for utterances (in interviews) or written answers (in emails) that included: time-specific words (e.g. before, always, future) or markers (at school, at university); verbs in association with time (e.g. spend, waste, have); age-specific words (e.g. child, mature); juxtaposing different times in reported actions (remembering, planning) or in explanations (e.g. I used to ..., now I ...; It will carry on ...). Coding for the pathways sought descriptions or explanations that were clearly ascribed to one pathway or the other, with subcodes for explicit comparisons (similarities; differences). Coded text was reviewed to ask, first, how, and in what contexts, students used these senses of time and age to position themselves and others as choosing and doing mathematics; and, secondly, whether there were alignments or tensions between these uses. This resulted in identifying concurrent discursive patterns that structure relationships between ‘what can be said’ and the power effects of saying it.

Results

My argument in this paper is that the senses of time and maturity mobilised when mathematics students account for their participation result in different discourses for the standard and enhanced mathematics pathways. The following sections show how these two discourses– that I named *moving/improving* and *getting ahead* – are each constructed through language patterns that combine into understandings of mathematics and selfhood. These were patterns that occurred across the students’ talk; the quotations below are chosen to illustrate the language use while providing context.

Standard mathematics as moving/improving

This discourse was constructed through three patterns that align the futures for individuals with the temporalities of mathematics. The first pattern, *Securing progress in modernity*, occurs in students’ explanations that their present choices are shaped as responses to their state of expectancy and of how mathematics projects itself as foreseeable security. In this pattern, students responded to the question ‘What do you think is most important to you in choosing your subjects?’ by invoking the future, for example:

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 easier ones. (Clive)

Clive foresees a continuing process of being scrutinised, part of the *panoptical time* associated with adolescence. Within this process, he positions himself as knowledgeable about the relevant technologies of “my application forms” and the exchange value resulting from future employers’ respect for mathematics. In a later interview he described family conversations about school and university choices as “finding the right course where at the end of it you have got a job set in stone, ready for you”. Security was an aspiration and, for him, an expectation. Language such as his “set in stone”, and others’ “build and progress” illustrates how participants reproduced mathematics as central to a predictable modernity, and themselves as sharing in that security through their choice.

The second discursive pattern, *Doing mathematics as moving on*, aligns the futurity of mathematics with a sense that individuals learning mathematics are in continuous movement. It appears, for example, in describing being persistent through mathematics “Once I get started, if I can’t actually work it out then I’ll keep on going till I’ve worked it out” (Steve). It also appeared in responses to the adjectives task., where the two most commonly chosen for mathematics were ‘safe’ and ‘straight’, and students’ explanations positioned mathematics as of guaranteeing movement in time:

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. (Joe)

This pattern is marked by a combination of linearity and repetition that conveys an *enduring* sense of time. There is ambiguity over who/what is progressing – ‘you’/ ‘I’ and/or mathematics/‘it’ - and repetitions that bring the person close to the subject, associating the future power of mathematics with the individual. The continuity of past going to present and future is emphasised, with echoes of Lesko’s (2001) discourse of expectant development in “you are always progressing slightly”, and in looking ahead to the endpoint of “hard” adulthood.

The third pattern, *Inheriting mathematics*, combines enduring and cyclical temporalities to position mathematics as inherited. This aligns with a dominant discourse that mathematical ability is ‘natural’ and timeless rather than achieved (Foyn, Solomon, & Braathe, 2018; Mendick, 2008). Students themselves summarised this concisely in one of the reasons most gave for choosing advanced mathematics: that they had always been good at it. When asked for memories or images of themselves doing mathematics, many gave examples of events involving parents. This emphasised mathematics as a natural and enduring inheritance heightened through family stories:

My dad always has this story [laughs] when I was about 5 [...] And Dad finds this story so funny. He just sort of “oh we knew back then she was going to do maths.” (Charly)

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?’” (Joe)

In such stories, a child-like experience of ‘doing mathematics’ is understood as relevant to a present sense of belonging and a promised future, connecting the age imaginaries. These memories position participants within the family but also as agentic. Mathematics is inherited *and* it prepares them for the challenges of adulthood. Thus this discursive pattern positions mathematics within the dominant *expectant* time of adolescence – progressing without arriving - and layers this with concurrent, connected imaginaries (Alexander, 2014) of childhood and future.

Enhanced mathematics as getting ahead

The *Getting ahead* discourse, arose from the combination of three different patterns that make use of a sense of time associated with speculation and risk, where the present is used to compete for the rewards of the future. In the adjective task, students described the enhanced pathway as *not* safe, but hopeful. The first pattern, *Doing extra*, indicates the value of activities that run alongside what is seen as normative development and positions students as consuming time in a way future employers will like. Doing extra is not a guarantee in the way that straight mathematics is; rather, it concerns appearance and impressions:

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

‘Doing extra’ thus presents as an age imaginary of an adolescence supplemented with some aspects of adulthood – hard work, awareness of the adult gaze - and expecting rewards from this alignment. The second pattern, *A head start*, treats time subtly differently: it accelerates the normal linear progress of mathematics towards adulthood. Many students reported hearing from family, friends or teachers that the enhanced mathematics pathway resembled university work. In choosing it they expressed themselves as willing to secure a “head start” and project themselves into the future.

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)

There is rationality and pleasure in this reasoning and in emphasising the fast pace of university mathematics that she has adopted early. Enhanced mathematics is thus constructed as accelerating the dependable, staged progress of standard mathematics, and moving students more quickly towards an imagined next stage. This can function as an enabling discourse that provides doxic ways for students in these state-school sites to claim a privileged position. Nevertheless, it can very easily be threatened, as Sukina found when she visited a prestigious university admissions event and found that the half-course offered by the school was not accepted. Although a “gap year” is part of the adolescent story for middle-class students, and for this tutor, it was unthinkable for Sukina. The age-imaginaries offered by the admissions tutor were incompatible with the ways that Sukina and her British-Bangladeshi family were negotiating new imaginaries of young adulthood that combined familiar narratives, material resources and degree-level study.

In the third pattern, *Bright lights and im/maturity*, students on the enhanced course were commonly described by others, and described themselves, as missing the adolescent “play” appropriate to their age. Seen positively, this positioned them as accelerating to adulthood. However, this dominant discourse was also used, in reverse, to reason against enhanced study. Students critiqued the demands of the national programme for after-school learning: “really we shouldn't have been made to do that anyway, should we, at this age? We're still in A-levels”. In a late interview, Tom and AgentX looked back and contested the discourses that led to their original choice. Although Tom described still feeling “the lure” of enhanced mathematics, he framed his decision to stop as developing maturity, a matter of understanding his own limitations, managing school planning technologies, and “sacrific[ing] one thing to be better at other things”. They were humorously vocal in questioning the maturity of others on the enhanced pathway, condoning aspirations only for young or clever students.

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.

Despite allowing these exceptions, their use of the theatrical “bright lights” metaphor suggests that for most students claiming such cleverness may in fact be a self-deceiving and naïve performance, distanced from authentic adolescent development.

Discussion

This analysis suggests how students incorporate senses of time and age in forming discourses of doing mathematics. One mathematics pathway is positioned via senses of enduring, cyclical and inherited time, offering security as a relevant force in a technological but uncertain world. Students associate these qualities with mathematics; but the moving/improving discourse does more: it enables them to claim them for themselves through the practices of choosing. The sense of enduring time positions students within the developmental view of adolescence, subject to panoptical and expectant temporalities (Lesko, 2001). Childhood and family were also evoked in this discourse of choosing mathematics, giving a sense of time as inheritance that adds continuity to students’ projects of the self in mathematics. Mathematics is a doxic choice for students with prior achievement, but this discursive pattern locates it as arising also from family practices and sustains a sense of selfhood as authentic and persisting through time. The temporality of inheritance layers and threads age imaginaries together rather than keeping them apart, mirroring Alexander’s (2014) finding that young people conjure life trajectories where imminent and distant futures are mixed.

The discourse associated with the enhanced mathematics pathway was produced via a different sense of time, that of getting ahead. Students construct participation as not merely oriented towards their future study and career intentions but starting to access them now. This discourse provides a way of proving themselves within the school environment and justifies their thinking in terms of neoliberal dreamscapes in which they achieve more than others expected of them. They are positioned as already accessing an age imaginary that secures unexpected privilege – and the novelty of the pathway in these sites reinforced this sense. Nevertheless the discourse of getting ahead is precarious. It is readily intelligible by students but so are ways of resisting it, and of positioning oneself and others as not authentic participants. Notably, maturity was constructed as disciplining oneself to educational technologies of the present and resisting aspiration. In this positioning, participation in the programme excludes the normative understanding of schooling as developing adolescent maturity; students teeter instead between being a child and an adult. Lesko (2001) argues that precocious individuals (young drivers, parents) are understood as dangerous in the dominant discourse of development because they raise concerns that subordinate positions will become entwined with dominant ones. This wider cultural concern about precocity renders student choices fragile. Some students use the tension productively to perform new forms of aspiration. They challenge stereotypes about who can do mathematics by giving accounts of exceptional progress. However, these are easily threatened by calls to become appropriately mature and by encounters with inflexible institutional temporalities.

Finally, I consider what this means for advising students about studying mathematics. Overwhelmingly, these students relied on mathematics for security in the performative world of school classrooms and examinations; they felt hopeful but less safe accepting that mathematics requires risks. Knowing that you will do well in mathematics tests, and then actually doing well, was a strategy for simultaneously and publicly controlling time and success. Despite their attainment,

losing the opportunity to produce this narrative of self-governance evoked the same reactions as with the majority of students who had already rejected the subject aged 16. This suggests the importance of creating a discourse that supports cognitive risks in the mathematics classroom and provides ways of valuing learning for what it makes possible in the present as well as the examination-mediated promise of future selves.

References

- Alexander, P. (2014). Learning to act your age: “Age imaginaries” and media consumption in an English secondary school. In D. Buckingham, S. Bragg, & M.J. Kehily (Eds.), *Youth cultures in the age of global media* (pp. 136–149). London, UK: Palgrave Macmillan.
- Foucault, M. (1972). *The archaeology of knowledge* (A.M. Sheridan Smith, Trans.). London, UK: Routledge.
- Foyn, T., Solomon, Y., & Braathe, H.J. (2018). Clever girls’ stories: The girl they call a nerd. *Educational Studies in Mathematics*, 98, 77–93.
- Gerofsky, S. (1997). “Why does a letter always arrive at its destination?”: Opening up living space between problem and solutions in math education. *Chreods*, 12, 32–36.
- Lesko, N. (2001). *Act your age! A cultural construction of adolescence*. New York, NY, USA: Routledge Falmer.
- Lingard, B., & Thompson, G. (2017). Doing time in the sociology of education. *British Journal of Sociology of Education*, 38(1), 1–12.
- Mendick, H. (2008). Subtracting difference: Troubling transitions from GCSE to AS-level mathematics. *British Education Research Journal*, 34(6), 711–732.
- Morgan, C. (2013). Language and mathematics: A field without boundaries. In B. Ubuz, C. Haser, & M.A. Mariotti (Eds.), *Proceedings of the eighth congress of the European Society for Research in Mathematics Education (CERME8)* (pp. 50–67). Ankara, Turkey: Middle East Technical University and ERME.
- Robson, J., & Bailey, B. (2009). “Bowling from the heart”: An investigation into discourses of professionalism and the work of caring for students in further education. *British Education Research Journal*, 35(1), 99–117.
- Rose, N. (1999). *Powers of freedom: Reframing political thought*. Cambridge, UK: Cambridge University Press.
- Smith, C. (2010). Choosing more mathematics: Happiness through work? *Research in Mathematics Education*, 12(2), 99–115.
- Smith, C. (2020). Discourses of time and maturity structuring participation in mathematics and further mathematics. *British Journal of Sociology of Education*, 41, 160–177.
- Stinson, D. (2013). Negotiating the “white male math myth”: African American male students and success in school mathematics. *Journal for Research in Mathematics Education*, 44, 69–99.