End of Award Report:

Mathematical Images and Identities: Education, Entertainment, Social Justice

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> I was talking about my friend who was the maths geek. He came back this summer and he has got like the pi symbol and it's about an inch big tattooed on like the underside of his wrist. Everyone was telling me he had 'pi' and I was thinking, 'why has he got a pie tattooed on his wrist?' And I was thinking, 'what kind of pie would it be and why would you think let's have a pie?' And then everyone was like, 'what are you on about? Pi you know.' And I was like 'oh!' But he thinks it is like the best thing ever, so much so that he has had it now permanently tattooed on him. [laughter] You wouldn't go and get Marx, you know, 'I really like Marx let's have him tattooed,' or something like that, you know.

We start by juxtaposing this mathematical identity work from our data with a media image of 8-year-old Lisa Simpson thinking about pi and her father Homer Simpson thinking about pie (http://www.mathsci.appstate.edu/~sjg/simpsonsmath/). The link between the cartoon and the quotation from a social science undergraduate raises questions about the relationship between images and identities that are at the heart of this research. In many ways it is typical of how people position themselves relative to mathematics and mathematicians, in its distancing through easy use of 'geek' and multiple misunderstandings: that it is mathematical pi rather than edible pie; how anyone could relate to the symbol pi in that way; and even more, how someone could relate to a subject in that way; the comparison with Marx renders this obsessive and excessive. It is also typical in the way that people, whether they like and do mathematics or not, expect mathematics to be written on the body, though rarely so literally.

Background

This research's starting point was the tension between decreasing engagement in mathematics (Boaler, 2008) and increasing engagement with popular culture (Kenway & Bullen, 2001) and particularly the growing number of examples of popular culture involving mathematics. However, despite the acknowledged power of popular cultural representations and evidence of their impact on mathematics learners (Picker & Berry, 2000), there was little research on such representations and on how to map their effects (as detailed in the proposal, only a few textual and small-scale audience studies had been published). This project set out to explore how popular cultural images of mathematics and mathematicians impact on the relationships learners form with the subject. Because of the body of research evidence showing that mathematics participation and achievement are complexly related to 'race' (Kassem, 2001), class (Macrae & Maguire, 2002) and gender (Burton, 2004), we also looked at the ways that these representations and their effects are raced, classed and gendered.

We have been concerned to develop a theoretical approach that allows us to look at the intricate ways that people interact with cultural texts. As early as 1973 Hall cautioned "Though we know the television programme is not a behavioural input, like a tap on the knee-cap, it seems to have been almost impossible for researchers to conceptualise the communicative process without lapsing back into one or other variant of low-flying behaviourism" (1973:5). More recently Walkerdine (2007) attempted to avoid the polarisation of debates on media effects between those who claim a direct causal relationship between representations and behaviour and those who seek to deny all effects. We too sought to cut across the binaries within debates about the relationship between *images* and *identities*: for example, between: active makers of meaning and passive recipients of media messages, conscious and unconscious responses to texts, fantasy and reality. Thus, as the project developed, we talked less about 'impacts' of representations, as we had in the proposal, and more about their 'influences' and about the 'ways that people deploy cultural resources'.

In making sense of these 'influences', we analysed popular cultural texts as part of circuits of production of power/knowledge relations in society, looking at the constellations of meanings or discourses that are re/produced in and through them (Fiske, 1987). This involved seeing texts as inseparable from what people do with them or how they 'read' them. 'Reading' texts is part of our 'identity work', as we talk and act ourselves into being, establishing patterns of sameness and difference in relation to others (Epstein & Johnson, 1998, Mendick, 2006). Central to this approach is the idea that our notions of who-we-are are always storied: "Identity is not something which is formed outside and then we tell stories about it. It is that which is narrated in one's own self" (Hall, 1991:49). It is those constantly shifting stories, through which people construct themselves in relation to mathematics, and the part of popular culture in writing them that we have been exploring.

Objectives

1. To analyse representations of mathematics and mathematicians in popular culture.

2. To understand the influence of these representations on young people's relationship to mathematics.

3. To explore the differences between the responses of young people who do and do not choose to continue with mathematics post-16.

4. To investigate the social justice implications of the above.

5. To make recommendations for policy and practice in mathematics education.

These objectives are unchanged from the original proposal with the exception that 'influence' has replaced 'impact' for the reasons outlined above. These objectives have been achieved. Below we have structured our account of our findings in relation to objectives 1 to 4; objective 5 is covered in the activities and outputs and impacts sections.

Methods

We used a mixed methods approach, carrying out four forms of data collection: quantitative survey, textual, and qualitative semi-structured focus groups and individual interviews. For the survey, focus groups and individual interviews we worked with two participant groups:

- **Year 10 - 11 school students**: drawn from three mixed comprehensive schools: a rural South West school with a mainly White middle-class intake but a number of rural poor, a London school with a diverse intake in terms of social class and ethnicity, a Catholic school in a large South-England town with a mainly White intake but a mix of middle-class and working-class students.
- **University students**: drawn from three Russell group universities and three post-1992 universities. About half had chosen mathematics and about half had chosen social sciences/humanities subjects. Most were second or third year undergraduates. However, three of the final interviewees were postgraduates.

Survey

556 Year 10 students and 100 mathematics and humanities undergraduates completed the survey. We collected data on respondents': feelings about mathematics, use of popular culture, engagement with popular culture mathematics/mathematicians, families' relationships with mathematics, gender, social class, ethnicity and age. We analysed the results for the overall sample, by respondent group (Year 10, undergraduates) and by institution. Using a combination of cross-tabulations and chi-squared tests, we explored:

- Differences in relation to representations of mathematics/mathematicians between those who had continued or were intending to continue with mathematics and those who had/were not, and between those GCSE students seeing themselves as 'good at maths' and those who do not.
- Relationships between speaking about mathematics with family members and choosing the subject, seeing oneself as 'good at maths' and representations of mathematics/mathematicians.

Analysis by gender, 'race' and social class was transversal to the analysis when size of categories allowed.

Texts

We used data from an open survey question, asking for two examples of popular culture mathematics/mathematicians, to build up an archive of texts. For the 22 texts that came up more than twice, we constructed a textual description and coded this for discourses of mathematics, people doing mathematics and difference, and collected associated texts such as reviews, online feedback and fansite material. For a sample of 20 of the 60 texts that came up once or twice, we compiled summaries of the main discourses circulating in and through them in relation to mathematics. We then looked across the texts.

Focus groups

129 participants took part in 27 focus groups. In each school we did five groups (one all-female, one all-male, three mixed). These generally had 5-6 participants, but one had four and one seven. The 12 undergraduate groups were split equally between mathematics and social sciences/humanities, and between Russell group and post-1992 universities. The undergraduate groups generally had 3-6 participants; however, due to our struggles to persuade students to attend, one had only two people and another only one. These latter do not strictly qualify as 'focus groups' but we have included them in the analysis because we used the same schedule. In the focus groups we asked about participants': feelings about mathematics, images of mathematicians, responses to clips from *Stand and Deliver*, *Good Will Hunting*, the gremlins adverts and *Deal or No Deal*, engagements with sudokus and views on whether these are mathematics and on what makes something mathematics. We analysed these by coding them in NVivo and summarising our results in the following areas: *teachers and pedagogy*, *school/university maths*, *images of mathematicians*, *reasons for choosing and/or liking mathematics*, *responses to particular texts*, *what is mathematics?*

Individual interviews

We carried out 49 semi-structured individual interviews with 26 Year 11 students, 11 final year mathematics undergraduates and nine undergraduates and three postgraduates in social sciences/humanities. These were spread across our participating schools and universities. We asked participants for their ideas about the place of mathematics 100 years into the future and in a world where mathematicians appear regularly on television, about their relationships with mathematics and for any changes in these and any associated memories, to give the reasons for their educational and employment choices, to arrange a series of images of mathematical people in order of likeability, to arrange a series of images of mathematical artefacts in order of their 'maths-ness' and to discuss whether anyone can do mathematics. Our methodological approach, drawing on fantasy scenarios, memory and visual stimuli was innovative within mathematics education; consonant with our theoretical approach, it gave us a way of accessing the relationship between the mathematical and the popular, one which we knew from the focus groups is difficult to explore directly. We have carried out a thematic analysis of the interviews and are embedding an ongoing narrative analysis of selected interviews within this.

Results

Representations of mathematics and mathematicians in popular culture

Mathematics is simultaneously invisible and ubiquitous in popular culture. When asked in the survey to recall two examples of popular culture representations of mathematics/mathematicians, 25% of respondents left the first example blank and 49% left the second blank. As developed below, we argue that this signals not an absence of mathematical images but their invisibility. Only ten texts occurred more than five times (brackets: media, frequencies): BBC bitesize (website/TV, 117); *Countdown* (TV, 85); *A Beautiful Mind* (film, 58); sudoku (puzzle, 54); mymaths (website, 32); *Good Will Hunting* (film, 20); magazine quizzes, horoscopes, articles (magazines, 12); *The Curious Incident of the Dog in the Night-time* (book, 12); *Deal or No Deal* (TV, 7); *Pi* (film, 7). This list includes two 'edutainment' texts, bitesize and mymaths, that use popular forms to deliver the school curriculum (Buckingham, 2001). It also masks considerable differences between the two respondent groups; only one undergraduate selected bitesize, while only one Year 10 student selected *Pi*. For each of these texts, the feelings they provoked ranged across pleasure, enthusiasm, boredom and distaste; this range of readings and related identity work is something we return to in the next part on the influence of these texts. A remarkable 71 texts came up five or fewer times, 47 of these being noted by only one respondent each. Some we had anticipated but had expected to come up more often: including, *Rainman* (film), sport, *The Da Vinci Code* (book), Tetris (computer game). Others took us by surprise: including, *Mission Impossible* (film); Russ Noble (comedy); *Friends* (TV); Mambo Number 5 (music). Still others opened us up to whole new worlds: including, Dr Kawashima's Brain Training (NintendoDS game), DJ Shadow/Cut Chemist (music); Johnny Ball (theatre); wolfram (website). This multitude of diverse images led us to speak about the ubiquity and diffusiveness of mathematics in popular culture, from Doctor Who explaining happy numbers to Martha Jones and bemoaning the lack of recreational maths in the Earth's curricula (Harper, 2007) to policemen Fraser and Ray discussing Gödel's theorem whilst stranded in the ocean (Mendick, 2007a).

The discourses of mathematics and mathematicians in popular culture representations are clichéd. The intersecting discourses of mathematics we identified are:

- Reductive: mathematics as a set of techniques and often as simply numbers and their manipulation.
- Mystifying: mathematics as unexplained or presented in a pace and manner which make understanding difficult.
- Aesthetic: mathematics as beautiful, often linked to pattern and nature.
- Intellectual: mathematics as signifying the intelligence of characters or products.
- Absolute: mathematics as providing a secure route to a solution and/or a definite answer, albeit perhaps a meaningless one.
- Utilitarian: mathematics as necessary for everyday practices or more unusual but important ones such as winning wars and crime-fighting.

The discourses associated with mathematicians mark their bodies as different through physical inadequacies and mental health problems and through their exceptional abilities, suggesting that mathematics colonises their selves. Output 2 is a paper in which we analyse these representations in detail, drawing particularly on readings of *A Beautiful Mind*, *Good Will Hunting* and *Numb3rs*.

We also asked focus group participants to produce examples of popular culture mathematics/mathematicians. Because we asked people to imagine a mathematician we got examples of geeks (e.g. TV's *Saved by the Bell*), scientists (e.g. cinema's *Flubber*), and geniuses (e.g. cinema's *Phenomenon*); because we often began with conversations about everyday mathematics, we got examples of shopping, budgeting and gambling. All of these were absent from the survey. This dissonance between survey and focus group responses (repeated in the interviews) is further evidence that there is no simple absence of popular mathematical images; it shows that reading something as mathematical depends on your ideas about what mathematics is and that these ideas are always shifting and up for negotiation (the examples of sudokus and *Deal or No Deal* provoked heated focus group discussions about the nature of mathematics). Thus context is central to whether something can be read as mathematical and while it is productive to look in detail at texts it is vital to do this in conjunction with audience research and to use mixed methods for this. We also found evidence that the invisibility of the mathematical within the popular is maintained through the construction of these as two oppositional categories. A number of interview participants resisted the idea of a world where mathematicians appear on TV regularly, most commonly by arguing it was impossible or unimaginable or by saying that they and/or others would not watch TV there. This indicates the role of unconscious factors in maintaining a separation between the mathematical and the popular.

The influence of these representations on young people's relationship to mathematics

The influence of popular culture representations on learners is diffusive and rarely directly acknowledged. In the survey neither GCSE students nor undergraduates identified 'images of maths and mathematicians' as a major influence. Only 4.3% of GCSE students said it had affected their decision on continuing with mathematics post-GCSE (cf. 'career plans'-70.3%, 'being good at it'-57.9%, 'enjoying it'-44.4%) The figure for undergraduates was 10.7% (cf. 'being good at it'-67.9%, 'enjoying it'-66.1%, 'career plans'-39.3%). However, they are simultaneously aware of a generalised presence of mathematics within popular culture (while often, as noted above, struggling to come up with specific examples): for example, asked where they have heard about mathematics in popular culture, 87.8%, of GCSE students mentioned the internet, 82.1% TV and 74.4% puzzles; 96.3% of undergraduates mentioned books, 88.9% the internet, and 81.6% puzzles. Further, it is evident from the focus groups that people have strong images of mathematics and mathematicians that draw on constellations of meanings circulating within popular culture. The majority of Year 11 students and non-mathematics undergraduates had a view of mathematics dominated by number and calculation, with a strong division between everyday and esoteric mathematics and between mathematics and 'creative' subjects such as English, reiterating discourses identified in popular texts. Nearly all participants, mathematics students included, saw mathematicians as White, male, middle class and old, these are simultaneously positions of power and ones that draw on some common popular culture tropes of obsessiveness, geekiness, madness and social awkwardness. These discourses about mathematics and mathematicians are related through the idea that 'normal' people engage with everyday mathematics, while other and othered mathematicians engage with its esoteric forms. Participants showed a critical awareness that the images were clichés and often both used them and distanced themselves from them. However, they were unable to produce alternative ideas about mathematics and mathematicians because of the lack of these available within their experiences of school mathematics and popular culture. As one GCSE student put it: "If you have always seen it on the telly, you haven't

seen anything else of what that person or what that thing is then you're going to think that when you think of it."

Influences from popular culture interact in complex ways with influences from teachers, peers and family members. Teachers and experiences of school and university mathematics were not part of our original research questions. However, their strong presence in the data made us reflect on the relationship between 'school maths' and 'popular maths' as resources for building a relationship with the subject and between mathematics teachers and media images of people doing mathematics in processes of identification. The focus group talk demonstrated that popular maths is more open than school maths, there is more room for discussion and so more spaces for people to shift their ideas about what mathematics is and to find a way of relating to it; part of this is the way that emotion is visible within popular maths and less visible but very present in school maths. For example, interaction with sudokus (http://en.wikipedia.org/wiki/Sudoku) provoked one GCSE student to reflect:

> Before I came to like this meeting I just thought that maths was a like thing that has divide, times and plus and minus and all that stuff. … The question 'what is maths' I don't think it will ever be answered because it just goes on and there are so many different things and I think you have to spend like at least I don't know, more than a life time thinking about what maths is.

We found that particular people, be they teachers, peers, family members or characters in media texts, can serve to counter dominant clichés. This finding resonates with Meyrowitz's (1985:119) argument that for fictional characters, "although the relationship is mediated, it psychologically resembles face-to-face interaction."

The differences between the responses of young people who do and do not choose to continue with mathematics post-16

GCSE and undergraduate students who have a positive relationship with mathematics have a different relationship with mathematics and mathematicians in popular culture. As noted earlier, how people 'read' mathematical images is dependent on the resources they bring with them and, particularly, on their understanding of mathematics and their relationship with the subject. For example, undergraduates not studying mathematics tended to see Carol Vorderman (http://en.wikipedia.org/wiki/Carol_Vorderman) as the ultimate popular mathematician, whereas those who are tend not to identify with her, often stating that she is not a mathematician, is only good at mental arithmetic, and exploits her position for financial gain.

The 40, predominantly male, GCSE students seeing themselves as 'very good' at maths have a different relationship to mathematics within popular culture, being significantly more likely to play tetris and chess and do sudokus and cryptic crosswords. This relationship also applies to those who are most likely to continue with mathematics post-GCSE. Neither of these groups is more likely to have seen fictional accounts of mathematicians. The undergraduates are more likely to have seen such accounts. As noted above, popular culture can provide significant resources for developing identifications with the subject and some images come to take on particular significance for males choosing mathematics with characters representing something they want to be/come. Two examples are:

> *Jurassic Park's* Ian Malcolm's] the first cool mathematician, ever. … He was described as New Age mathematician. He wasn't a regular mathematician. I'm still not really sure what that means, I think it just meant he had more interest in chaos theory than was sort of accepted at the time. … I remember saying I wanted to become a New Age mathematician, whatever the hell that was. … I think it was quite interesting to have somebody that broke the image of what you expected a mathematician to be. [Mathematics undergraduate]

> It sounds a bit stupid but when I was little I watched this cartoon and there was a mathematician in it. … I suppose he was like, seen as really cool I suppose and like he went to work for NASA. So that sort of made me like maths I think. … I think he was only in one episode, it was called *Recess* I think. … on Saturday morning TV it was, many moons ago that was. [GCSE student]

There are processes of disidentification which happen in relation to geek images which make it difficult for some people to choose the subject. As discussed above, discourses of mathematicians as 'geeks' were common both with those who identify with mathematics and those who do not. Images of mathematicians Albert Einstein and John Nash were labelled as 'not normal', lacking social skills, and obsessive towards mathematics. Those not choosing mathematics tended to disidentify with these attributes and find them 'weird'; however, those choosing mathematics (at A-level or degree) were more likely to frame this obsession as 'skill' 'commitment' or 'devotion' and less likely to be frightened of connotations of mental illness. Thus, some mathematics undergraduates, more male than female, gave positive value to 'geek' status; however, several went to considerable lengths in the interviews and focus groups to claim 'normality'.

The social justice implications of the above: gender, class and 'race'

Relationships with mathematics are gendered, classed and raced. Consistent with other research we found that relationships with mathematics are ways in which social differences are re/produced (Burton, 2003). For example, responses to the survey question 'how good are you at maths?' were gendered, with male GCSE students over three times as likely to self-identify as 'very good' at maths (33 people or 10.7% of males; 7 people or 3.1% of females) and slightly more likely to say they are good at maths (38.6% compared with 35.4%) ($p=0.002$). This relationship was also classed though the differences are not statistically significant; 27 people or 8.3% of middle- and intermediate-class students, 4 people or 3.7% of working-class students self-identify as 'very good' at maths. Far fewer girls than boys were planning to continue with mathematics. Sample sizes did not allow an analysis of the survey data by ethnicity but the interview data demonstrates that family relationships with mathematics are central to young people's mathematical engagement and that these are both classed and raced. Further, there were race and class differences in the universities attended (Archer *et al.*, 2003).

Ideas of class, gender and ethnicity play out strongly but usually implicitly in the images of mathematics and mathematicians in popular culture and those invoked in the focus groups. Divisions between everyday/esoteric mathematics are classed and relate to the academic/vocational divide (Dowling, 1998) supported by school maths divisions (e.g. numeracy/mathematics, GCSE1/GCSE2); oppositions between mathematics and other subjects are gendered

(Mendick, 2005). As noted earlier, the images of mathematicians in popular culture texts and in focus group talk were dominated by middle-class White men (see output 2). Ideas of gender, class and ethnicity also play out in relation to whose bodies can be read as naturally able; in particular, there is an association of Asian bodies with mathematical ability that ties in with processes of other-ing (Said, 1995).

People's class, gender and ethnic positions play a part, but not deterministically, in the ways that they deploy mathematical images and in those to which they have access. There is insufficient space to unpick this but we offer two examples drawn from responses to images in the interviews:

- Female participants were more likely than male to object to mathematics being 'sexed up'. However, some saw it as a good way of promoting mathematics; as two female undergraduates put it, "who says you can't do maths in stockings?" and "why not use your sexuality when you can?"
- Three people identified the Alhambra as the most mathematical of six images, one of these was Muslim and drew on her knowledge and identification with Islamic art in making this connection, however, the other two, White British and Black Caribbean, drew on ideas of shape and pattern. Another participant expressed discomfort but admitted "if it was … a picture of a church, then that would probably be my favourite".

Using popular culture in the mathematics classroom can be a part of a pedagogy for social justice opening up mathematics to more people. Returning to the ubiquity and invisibility of the mathematical in popular culture, this can be understood as an instance of what Skovsmose (1994:42) calls the formatting power of mathematics. This names the way "that mathematics produces new inventions in reality, not only in the sense that new insights may change interpretations, but also in the sense that mathematics colonises part of reality and reorders it". The formatting power of mathematics gives us the paradox of relevance that "on the one hand, mathematics has a pervasive social influence and, on the other hand, students … are unable to recognise this relevance" (1994:82) and so supports the everyday/esoteric opposition. Skovsmose argues that we need to teach mathematical archaeologies that make mathematics visible through the process of "uncovering the mathematical roots of an activity" (1994:96) and highlighting the role of mathematics in structuring our understanding of the world. Our research shows that archaeologies of popular mathematics would be an important and accessible approach to these (Greenwald & Nestler, 2004a, b).

As noted earlier, our work suggests that there are pedagogic possibilities for using popular culture texts to make available more positive relationships with mathematics to a wider number of people. They create spaces for learners' own views and so give people alternatives to the current limited range of ways of relating to mathematics. The patterns of emotional investment and identification with characters and stories, makes these potential ways of doing mathematics differently.

Activities and outputs

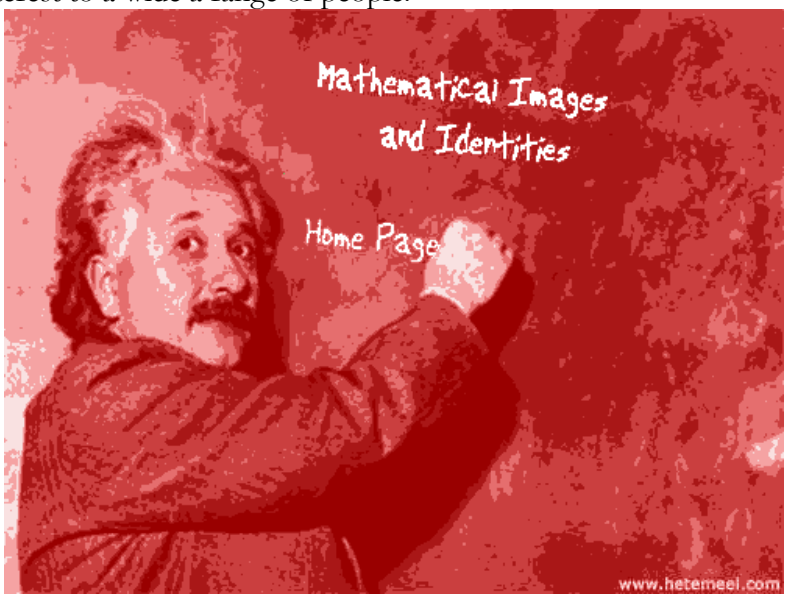
We have communicated the work within the following research communities:

- **Mathematics education**, building on Heather Mendick's strengths: Mendick et al. (2007), Mendick (2007b, c), planned: book chapter in *Mathematical Relationships*, Mathematics and Technology in the Body of Education conference keynote, International Commission on Mathematical Instruction conference paper.
- **Cultural studies**, building on Debbie Epstein's strengths: Epstein et al. (2007a), planned: *Social Semiotics* article.
- **Feminist research**, building on Marie-Pierre Moreau's strengths: Moreau et al. (2007a, b, forthcoming), planned: Centre for Law, Gender and Sexuality seminar paper, *Sociology* article.
- **Sociology of education**: Epstein et al. (2007b), planned: *Discourse* article.

We have communicated our work in the following practice communities:

- **School mathematics teaching organisations**, including workshops for the Association of Teachers of Mathematics (ATM) and the Mathematical Association (MA), contributions to their journals and to the National Centre for Excellence in the Teaching of Mathematics (NCETM) website (www.ncetm.org.uk/Default.aspx?page=13&module=res&mode=100&resid=5625; www.ncetm.org.uk/Default.aspx?page=22&module=enc&mode=100&enclbl=Popular+culture).
- **Organisations concerned with the under-representation of women in science, technology and mathematics**, including: International Organisation of Women and Mathematics Education (IOWME) newsletter article, planned: UKRC conference presentation.

The project website and publicity leaflet cut across research and practice. The website (www.londonmet.ac.uk/mathsimages, submitted as output 1) is our most significant and widely available output. It includes details of findings, methodology and outputs along with a project blog. We paid attention to the website's accessibility and aesthetics to make it of interest to a wide a range of people.



Impacts

Our research has generated considerable interest within and beyond academia. We held an end of award event (photos below), attended by about 40 people including educational and social researchers, teacher trainers, mathematicians and policymakers.

In addition to coverage in the *Times Educational Supplement* and several invited papers, we have discussed our work with members of the DCSF, Women Promoting Mathematics Group, IOWME, NCETM, ATM, MA, UKRC and moremathsgrads. Two researchers have contacted us for permission to use our questionnaire. We have also been consulted by several people involved in producing popular forms of mathematics: Johnny Ball (stage shows), Marcus du Sautoy (BBC, Teachers TV), Ruth Alexander (Radio 4) and Rob Eastaway (Radio 4, stage shows). Thus, in the longer term, our work is likely to have influence on policy and practice in a range of areas and we are continuing to work with our user groups on this.

Future Research Priorities

Two current projects have developed directly from the research:

- **Mathematical Images and Gender Identities** (£24,470, UKRC, principal applicant: Heather Mendick, co-applicant: Marie-Pierre Moreau, 09/2007-12/2007): Research looking specifically at the gender aspects of the dataset allowing us to build on our analysis, to develop publications and to communicate policy implications.
- **The impact of the depiction of work in TV drama on young people's career aspirations and choices** (£38,037, British Academy, principal applicant: Heather Mendick, co-applicant: Katya Williams, 09/2007-06/2008): Research exploring questions about the influence of popular culture on young people's educational and employment choices generally and developing the theoretical and methodological work begun here.

We plan to produce a book that brings together insights from all three projects into the relationship between popular culture and educational choices and aspirations.

The research suggests many further areas for research. Heather Mendick and Marie-Pierre Moreau plan to develop an AHRC bid extending the textual analysis, looking not just at 'popular' texts but at the full range of images of mathematics and mathematicians and thinking about their different possibilities. It would be interesting to research the pedagogical possibilities of using popular culture with different groups of mathematics learners. Finally, the project's rich dataset speaks to many issues that are beyond our research questions (for example, learner/teacher relationships); archiving this will allow other researchers to use it to explore their own concerns.

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Walkerdine, V. (2007) *Children, gender, video games: towards a relational approach to multimedia* (Basingstoke, Palgrave Macmillan).

Methods

We carried out collection and analysis of four forms of data: a quantitative survey, a textual archive, qualitative semi-structured focus groups and qualitative semi-structured individual interviews. For the survey, focus groups and individual interviews we worked with two groups of participants:

- **Year 10 - 11 school students**: drawn from three mixed comprehensive schools - Franklin, a rural South West school with a mainly white middle-class intake but a number of rural poor, Shelley, a London school with a diverse intake in terms of social class and ethnicity and Saint Joan's, a school in a large town in the South with a mainly white intake but a mix of middle-class and working-class students.
- **University students**: drawn from one of three Russell group universities (Wollstonecraft, Meitner and Herschel) and three post-1992 universities (Gillespie, Charlton-Moore and James' Park). About half of these students had chosen to take mathematics and about half had taken subjects in the social sciences and humanities. Most of these students were in their second or third year of undergraduate study. However, we supplemented this with four postgraduates in the final interviews.

Details of each type of data collection and analysis follow.

Survey

We carried out a survey with the entire cohort of Year 10 at each school (total: 556) and with 100 undergraduates in mathematics and media studies. We collected data on respondents' feelings about mathematics, their use of popular culture, their engagement with images of mathematics and mathematicians in popular culture, their family's relationship with mathematics and their gender, social class, ethnicity and age. We analysed the data - for MM to complete, and check the figure of 100 for undergraduates.

Texts

We used data from an open question on the survey, asking for two specific examples of mathematics and/or mathematicians in popular culture, to build up an archive of these texts. We then analysed a sample of these looking in detail at those that came up more than twice. In each case we constructed a textual description and then coded this for discourses of mathematics, people doing mathematics and difference. We also collected associated texts such as published reviews, online feedback and material from fansites. For a sample of those texts that came up once or twice we compiled summaries of the main discourses circulating in and through them in relation to mathematics.

Focus groups

We carried out 27 focus groups with a total of 129 people. In each school we did five focus groups, one all female, one all male and three mixed. The school focus groups generally had five or six participants, but one had four and one seven. The 12 undergraduate focus groups were split into half in mathematics and half in social sciences and humanities, half of each of these were with students in Russell group universities and half with students in post-1992 universities. The undergraduate focus groups generally had between three and six participants, however, due to our struggles to persuade students to turn up, one had only two people and another had only one. These latter are not really 'focus groups' as such but we have included them in the analysis because we used the same schedule. In the focus groups we asked participants: about their feelings

about mathematics, about their image of a mathematician, for their specific responses to clips from *Stand and Deliver*, *Good Will Hunting*, the gremlins advertising campaign and *Deal or No Deal*, about their engagements with sudokus and whether they think these are mathematics and to consider what makes something mathematics. We analysed these by coding the responses in NVivo and then summarising our results in the following broad areas: *teachers and pedagogy*, *school/university maths*, *images of mathematicians*, *reasons for choosing and/or liking mathematics*, *responses to particular texts*, *what is mathematics?*

Individual interviews

We carried out 50 semi-structured individual interviews with 27 Year 11 students, 11 final year mathematics undergraduates and 12 undergraduate and postgraduate students in social sciences and humanities. These were spread evenly across the three schools and across Russell Group and post-1992 universities. In the interviews we asked participants for their ideas about the place of mathematics 100 years into the future and in a world where mathematicians appear regularly on television, about their relationships with mathematics and for any changes in this and for their memories associated with it, to give the reasons for their educational and employment choices and aspirations, to arrange a series of images of people and mathematics in order of likeability, to arrange a series of images of mathematical artefacts in order of their 'maths-ness' and to discuss whether anyone can do mathematics. Our methodological approach, drawing on fantasy scenarios, memory work and visual stimuli was innovative within mathematics education, and, consonant with our theoretical approach, it gave us a way of accessing the relationship between the mathematical and the popular, one which we knew from the focus groups is difficult to explore directly. We are carrying out an ongoing narrative analysis of selected interviews and embedding this in a thematic analysis – to update once we have got further into the analysis.

Mathematical images and identities questionnaire

This questionnaire is for some research we are doing on the impact of images of maths and mathematicians in popular culture on learners. By popular culture we mean activities related to mass communication. Our list of these includes TV, cinema, radio, internet, puzzles, computer games, other games, magazines, music and books. But you may be able to think of some more.

We are interested both in the views of those who enjoy maths and want to carry on with it and of those who don't. This questionnaire is the first stage of the research. We will also be doing focus groups and individual interviews next year.

This questionnaire will give us information to start our research. There are three parts:

- Part 1 contains questions about your relationship with maths
- Part 2 contains questions about maths and mathematicians in popular culture
- Part 3 contains questions about other aspects of your life

It should take up to 20 minutes to complete. Any information you supply will be treated completely confidentially.

Thanks for taking the time to fill this in. To say thank you, everyone who completes the questionnaire will be entered for a prize draw and the winner will receive a £20 token.

Heather Mendick, London Metropolitan University
Debbie Epstein, Cardiff University
Marie-Pierre Moreau, London Metropolitan University

The Economic and Social Research Council fund this research (project number: RES-000-23-1454) and it is being carried out by researchers at the Institute for Policy Studies in Education at London Metropolitan University and the School of Social Sciences at Cardiff University. If you would like more information about this project then please contact Heather Mendick, the project leader either by phone on 020 71332014 or by email at h.mendick@londonmet.ac.uk.

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Part 1: Your relationship with maths

1. Please indicate your feelings about the following statements: (*please tick one box per row*)

	Strongly agree	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
I enjoy maths	☐	☐	☐	☐	☐
I find maths useful in daily life	☐	☐	☐	☐	☐
I feel confident when I do maths	☐	☐	☐	☐	☐
I find maths difficult	☐	☐	☐	☐	☐
Sometimes I panic about maths	☐	☐	☐	☐	☐
Maths will be useful in my career	☐	☐	☐	☐	☐
Maths is an important subject	☐	☐	☐	☐	☐

2. Are you likely to go on with maths after GCSE

Yes, very likely ☐ Yes, perhaps ☐ No, definitely not ☐

Which of the following might help you decide whether to continue with maths after GCSE or not? (*please tick all that apply*)

Friends	☐	Family members	☐	Career plans	☐
Teachers	☐	Being good at it	☐	Enjoying it	☐
Images of maths and mathematicians			☐	Other. Please specify …….	☐

If you ticked the box marked ‘Images of maths and mathematicians’ above then where did these images come from? (*please tick all that apply*)

TV	☐	Computer games	☐	Magazines	☐
Cinema	☐	Other games	☐	Books	☐
Internet	☐	Puzzles	☐	Other. Please specify ……	☐

3. How good are you at maths?

Very good ☐ Good ☐ OK ☐ Bad ☐ Very bad ☐

How did you find this out?

How old were you at the time?

Part 2: Maths and mathematicians in popular culture

4. Have you seen or heard about maths in any of the following? *(please tick one box per row)*

	Yes	**No**
TV	☐	☐
Cinema	☐	☐
Radio	☐	☐
Internet	☐	☐
Puzzles	☐	☐
Computer games	☐	☐
Other games	☐	☐
Magazines	☐	☐
Books	☐	☐
Music	☐	☐
Other. Please specify: ……. …….	☐ ☐	☐ ☐

5. Have you seen anything about mathematicians in any of the following? *(please tick one box per row)*

	Yes, often	**Yes, sometimes**	**Yes, once or twice**	**No**
Films	☐	☐	☐	☐
TV programmes	☐	☐	☐	☐
Radio programmes	☐	☐	☐	☐
Internet websites	☐	☐	☐	☐
Magazine articles	☐	☐	☐	☐
Pop songs	☐	☐	☐	☐

6. Thinking about images of maths and mathematicians in popular culture, pick 2 you remember clearly and fill in the information about each in the boxes below.

Example 1: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

Example 2: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

7. Please indicate how often you do each of the following? *(please tick one box for each row)*

	Every day	**Every week**	**Every month**	**Less than every month**	**Never**
Watch TV	☐	☐	☐	☐	☐
Go to the cinema	☐	☐	☐	☐	☐
Listen to the radio	☐	☐	☐	☐	☐
Surf the internet	☐	☐	☐	☐	☐
Play computer games	☐	☐	☐	☐	☐
Play card games	☐	☐	☐	☐	☐
Play board games	☐	☐	☐	☐	☐
Do puzzles	☐	☐	☐	☐	☐

8. How often do you do each of the following *(please tick one box for each row)*

	Often	**Sometimes**	**Once**	**Never**
Watched the TV series *Numb3rs*	☐	☐	☐	☐
Done a *Sudoku* puzzle	☐	☐	☐	☐
Done a *cryptic crossword*	☐	☐	☐	☐
Played the computer game *tetris*	☐	☐	☐	☐
Played the board game *chess*	☐	☐	☐	☐
Played the board game *Othello*	☐	☐	☐	☐
Read *New Scientist*	☐	☐	☐	☐

9. Have you ever seen any of these films:

	Yes, more than once	**Yes, once**	**No**
A Beautiful Mind	☐	☐	☐
Pi	☐	☐	☐
Proof	☐	☐	☐
Good Will Hunting	☐	☐	☐

Part 3: Background information

10. What would you like to do in the 2 or 3 years after you leave school?

11. What careers might you end up doing?

12. Which of these family members have you ever spoken to about mathematics? (*please tick one box per row*)

	Yes	No	Not applicable
Mother	☐	☐	☐
Father	☐	☐	☐
Sister	☐	☐	☐
Brother	☐	☐	☐
Daughter	☐	☐	☐
Son	☐	☐	☐
Partner	☐	☐	☐
Other relative. Please specify: ……..	☐	☐	☐

13. Please indicate the highest level of qualification held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify: ……..	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

14. Please indicate the highest level of qualification in maths held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify: ……..	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

15. Please indicate which of the following best describes/described the occupation(s) of your parent(s)/carer(s). Give the current occupation if still working; otherwise give the last known occupation *(please give one answer for each column).*

	Mother/carer	**Father/carer**
Managers and senior officials *(e.g. managers in construction, marketing, finance, health service)*	☐	☐
Professional occupations *(e.g. scientist, health professional, engineering professional, teacher, accountant, librarian)*	☐	☐
Associate professional and technical occupations *(e.g. engineering or IT technician, nurse, community worker, police officer, sales representative)*	☐	☐
Administrative and secretarial occupations *(e.g. clerk, administrative officer, secretary, office assistant)*	☐	☐
Skilled trades occupations *(e.g. farmer, decorator, electrician, painter, chef)*	☐	☐
Personal service occupations *(e.g. nursing assistant, childminder, travel agent, hairdresser, caretaker)*	☐	☐
Sales and customer service occupations *(e.g. sales and retail assistant, call centre operator)*	☐	☐
Process, plant and machine operatives *(e.g. food and drink process operative, assembler, construction operative, van driver, taxi driver, sewing machinist)*	☐	☐
Elementary occupations *(e.g. farm worker, courier, hotel porter, construction labourer, catering assistant, bar staff, security guard)*	☐	☐
Not in work	☐	☐
Other. Please specify: …….	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

16. Write a sentence or two below about what your mother/carer does in their everyday life

Does this involve maths?

Yes ☐ No ☐

Do you think your mother/carer enjoys or enjoyed maths?

Yes ☐ No ☐

17. Write a sentence or two below about what your father/carer does in their everyday life

Does this involve maths?

Yes ☐ No ☐

Do you think your father/carer enjoys or enjoyed maths?

Yes ☐ No ☐

18. Which of the following best describes your ethnic background?

WHITE:

White British ☐
White Irish ☐
Any other White background ☐

MIXED:

White and Black Caribbean ☐
White and Black African ☐
White and Asian ☐
Any other Mixed background ☐

ASIAN OR ASIAN BRITISH:

Indian ☐
Pakistani ☐
Bangladeshi ☐
Any other Asian background ☐

BLACK OR BLACK BRITISH:

Caribbean ☐
African ☐
Any other Black background ☐

CHINESE OR OTHER ETHNIC GROUP:

Chinese ☐
Other ☐ If you ticked Other, please specify: ……

19. Are you male or female?

Female ☐ Male ☐

……

20. Please give your name and a daytime telephone number and / or email address where we could contact if you want to enter the prize draw for a £20 token

Name: …… Phone number: ……

Email address: …….

We are planning to conduct focus groups with a small number of undergraduates in Autumn 2006. Would you be happy to participate?

Yes ☐ *(check you've filled in your contact details above)* No ☐

Mathematical images and identities questionnaire

This questionnaire is for some research we are doing on the impact of images of maths and mathematicians in popular culture on learners. By popular culture we mean activities related to mass communication. Our list of these includes TV, cinema, radio, internet, puzzles, computer games, other games, magazines, music and books. But you may be able to think of some more.

We are interested both in the views of those who have chosen to study maths at university and of those who have chosen not to do so. The Economic and Social Research Council fund this research (project number: RES-000-23-1454) and it is being carried out by researchers at the Institute for Policy Studies in Education at London Metropolitan University and the School of Social Sciences at Cardiff University. This questionnaire is the first stage of the research. We will also be doing focus groups and individual interviews next year.

This questionnaire will give us information to start our research. There are three parts:

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- Part 3 contains questions about other aspects of your life

It should take up to 20 minutes to complete. Any information you supply will be treated completely confidentially.

If you would like more information about this project then please contact Heather Mendick, the project leader either by email at h.mendick@londonmet.ac.uk or by phone on 020 71332014.

Thanks for taking the time to fill this in. To say thank you, everyone who completes the questionnaire will be entered for a prize draw and the winner will receive a £20 book token.

Heather Mendick, London Metropolitan University
Debbie Epstein, Cardiff University
Marie-Pierre Moreau, London Metropolitan University

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Part 1: Your relationship with maths

Please answer each question below by clicking on the relevant boxes or writing in comments as appropriate (grey areas will expand when you type in them).

1. Please indicate your feelings about the following statements: (*please tick one box per row*)

	Strongly agree	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
I enjoy maths	☐	☐	☐	☐	☐
I find maths useful in daily life	☐	☐	☐	☐	☐
I feel confident when I do maths	☐	☐	☐	☐	☐
I find maths difficult	☐	☐	☐	☐	☐
Sometimes I panic about maths	☐	☐	☐	☐	☐
Maths will be useful in my career	☐	☐	☐	☐	☐
Maths is an important subject	☐	☐	☐	☐	☐

2. Which of the following affected your choice to study or not to study maths at university? (*please tick all that apply*)

Friends	☐	Family members	☐	Career plans	☐
Teachers	☐	Being good at it	☐	Enjoying it	☐
Images of maths and mathematicians			☐	Other. Please specify	☐

If you ticked the box marked 'Images of maths and mathematicians' above then where did these images come from? (*please tick all that apply*)

TV	☐	Computer games	☐	Magazines	☐
Cinema	☐	Other games	☐	Books	☐
Internet	☐	Puzzles	☐	Other. Please specify	☐

3. How good are you at maths?

Very good ☐ Good ☐ OK ☐ Bad ☐ Very bad ☐

How did you find this out?

How old were you at the time?

Part 2: Maths and mathematicians in popular culture

4. Have you seen or heard about maths in any of the following? *(please tick one box per row)*

	Yes	**No**
TV	☐	☐
Cinema	☐	☐
Radio	☐	☐
Internet	☐	☐
Puzzles	☐	☐
Computer games	☐	☐
Other games	☐	☐
Magazines	☐	☐
Books	☐	☐
Music	☐	☐
Other. Please specify:	☐ ☐	☐ ☐

5. Have you seen anything about mathematicians in any of the following? *(please tick one box per row)*

	Yes, often	**Yes, sometimes**	**Yes, once or twice**	**No**
Films	☐	☐	☐	☐
TV programmes	☐	☐	☐	☐
Radio programmes	☐	☐	☐	☐
Internet websites	☐	☐	☐	☐
Magazine articles	☐	☐	☐	☐
Pop songs	☐	☐	☐	☐

6. Thinking about images of maths and mathematicians in popular culture, pick 2 you remember clearly and fill in the information about each in the boxes below.

Example 1: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

Example 2: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

7. Please indicate how often you do each of the following? *(please tick one box for each row)*

	Every day	**Every week**	**Every month**	**Less than every month**	**Never**
Watch TV	☐	☐	☐	☐	☐
Go to the cinema	☐	☐	☐	☐	☐
Listen to the radio	☐	☐	☐	☐	☐
Surf the internet	☐	☐	☐	☐	☐
Play computer games	☐	☐	☐	☐	☐
Play card games	☐	☐	☐	☐	☐
Play board games	☐	☐	☐	☐	☐
Do puzzles	☐	☐	☐	☐	☐

8. How often do you do each of the following *(please tick one box for each row)*

	Often	**Sometimes**	**Once**	**Never**
Watched the TV series *Numb3rs*	☐	☐	☐	☐
Done a *Sudoku* puzzle	☐	☐	☐	☐
Done a cryptic *crossword*	☐	☐	☐	☐
Played the computer game *tetris*	☐	☐	☐	☐
Played the board game *chess*	☐	☐	☐	☐
Played the board game *Othello*	☐	☐	☐	☐
Read *New Scientist*	☐	☐	☐	☐

9. Have you ever seen any of these films? *(please tick one box for each row)*

	Yes, more than once	**Yes, once**	**No**
A Beautiful Mind	☐	☐	☐
Pi	☐	☐	☐
Proof	☐	☐	☐
Good Will Hunting	☐	☐	☐

Part 3: Background information

10. What degree course are you doing?

11. What career would you like to pursue?

12. Which of these family members have you ever spoken to about mathematics? (*please tick one box per row*)

	Yes	No	Not applicable
Mother	☐	☐	☐
Father	☐	☐	☐
Sister	☐	☐	☐
Brother	☐	☐	☐
Daughter	☐	☐	☐
Son	☐	☐	☐
Partner	☐	☐	☐
Other relative. Please specify:	☐	☐	☐

13. Please indicate the highest level of qualification held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify:	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

14. Please indicate the highest level of qualification in maths held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify:	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

15. Please indicate which of the following best describes/described the occupation(s) of your parent(s)/carer(s). Give the current occupation if still working; otherwise give the last known occupation *(please give one answer for each column).*

	Mother/carer	**Father/carer**
Managers and senior officials *(e.g. managers in construction, marketing, finance, health service)*	☐	☐
Professional occupations *(e.g. scientist, health professional, engineering professional, teacher, accountant, librarian)*	☐	☐
Associate professional and technical occupations *(e.g. engineering or IT technician, nurse, community worker, police officer, sales representative)*	☐	☐
Administrative and secretarial occupations *(e.g. clerk, administrative officer, secretary, office assistant)*	☐	☐
Skilled trades occupations *(e.g. farmer, decorator, electrician, painter, chef)*	☐	☐
Personal service occupations *(e.g. nursing assistant, childminder, travel agent, hairdresser, caretaker)*	☐	☐
Sales and customer service occupations *(e.g. sales and retail assistant, call centre operator)*	☐	☐
Process, plant and machine operatives *(e.g. food and drink process operative, assembler, construction operative, van driver, taxi driver, sewing machinist)*	☐	☐
Elementary occupations *(e.g. farm worker, courier, hotel porter, construction labourer, catering assistant, bar staff, security guard)*	☐	☐
Not in work	☐	☐
Other. Please specify:	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

16. Write a sentence or two below about what your mother/carer does in their everyday life (include their job title if applicable)

Does this involve maths?

Yes ☐ No ☐

Do you think your mother/carer enjoys or enjoyed maths?

Yes ☐ No ☐

17. Write a sentence or two below about what your father/carer does in their everyday life (include their job title if applicable)

Does this involve maths?

Yes ☐ No ☐

Do you think your father/carer enjoys or enjoyed maths?

Yes ☐ No ☐

18. Which of the following best describes your ethnic background?

WHITE:

White British ☐
White Irish ☐
Any other White background ☐

MIXED:

White and Black Caribbean ☐
White and Black African ☐
White and Asian ☐
Any other Mixed background ☐

ASIAN OR ASIAN BRITISH:

Indian ☐
Pakistani ☐
Bangladeshi ☐
Any other Asian background ☐

BLACK OR BLACK BRITISH:

Caribbean ☐
African ☐
Any other Black background ☐

CHINESE OR OTHER ETHNIC GROUP:

Chinese ☐
Other ☐ If you ticked Other, please specify:

19a. Are you male or female?

Female ☐ Male ☐

19b. How old are you?

21-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56+ ☐

……

20. Please give your name and a daytime telephone number and / or email address where we could contact if you want to enter the prize draw for a £20 token

Name: Phone number:

Email address:

We are planning to conduct focus groups with a small number of undergraduates in Autumn 2006. Would you be happy to participate?

Yes ☐ *(check you've filled in your contact details above)* No ☐

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This questionnaire is for some research we are doing on the impact of images of maths and mathematicians in popular culture on learners. By popular culture we mean activities related to mass communication. Our list of these includes TV, cinema, radio, internet, puzzles, computer games, other games, magazines, music and books. But you may be able to think of some more.

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- Part 2 contains questions about maths and mathematicians in popular culture
- Part 3 contains questions about other aspects of your life

It should take up to 20 minutes to complete. Any information you supply will be treated completely confidentially.

If you would like more information about this project then please contact Heather Mendick, the project leader either by email at h.mendick@londonmet.ac.uk or by phone on 020 71332014.

Thanks for taking the time to fill this in. To say thank you, everyone who completes the questionnaire will be entered for a prize draw and the winner will receive a £20 book token.

Heather Mendick, London Metropolitan University
Debbie Epstein, Cardiff University
Marie-Pierre Moreau, London Metropolitan University

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Part 1: Your relationship with maths

1. Please indicate your feelings about the following statements: (*please tick one box per row*)

	Strongly agree	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
I enjoy maths	☐	☐	☐	☐	☐
I find maths useful in daily life	☐	☐	☐	☐	☐
I feel confident when I do maths	☐	☐	☐	☐	☐
I find maths difficult	☐	☐	☐	☐	☐
Sometimes I panic about maths	☐	☐	☐	☐	☐
Maths will be useful in my career	☐	☐	☐	☐	☐
Maths is an important subject	☐	☐	☐	☐	☐

2. Which of the following affected your choice to study or not to study maths at university? (*please tick all that apply*)

Friends	☐	Family members	☐	Career plans	☐
Teachers	☐	Being good at it	☐	Enjoying it	☐
Images of maths and mathematicians			☐	Other. Please specify …….	☐

If you ticked the box marked 'Images of maths and mathematicians' above then where did these images come from? (*please tick all that apply*)

TV	☐	Computer games	☐	Magazines	☐
Cinema	☐	Other games	☐	Books	☐
Internet	☐	Puzzles	☐	Other. Please specify …….	☐

3. How good are you at maths?

Very good ☐ Good ☐ OK ☐ Bad ☐ Very bad ☐

How did you find this out?

How old were you at the time?

Part 2: Maths and mathematicians in popular culture

4. Have you seen or heard about maths in any of the following? *(please tick one box per row)*

	Yes	**No**
TV	☐	☐
Cinema	☐	☐
Radio	☐	☐
Internet	☐	☐
Puzzles	☐	☐
Computer games	☐	☐
Other games	☐	☐
Magazines	☐	☐
Books	☐	☐
Music	☐	☐
Other. Please specify: ……. …….	☐ ☐	☐ ☐

5. Have you seen anything about mathematicians in any of the following? *(please tick one box per row)*

	Yes, often	**Yes, sometimes**	**Yes, once or twice**	**No**
Films	☐	☐	☐	☐
TV programmes	☐	☐	☐	☐
Radio programmes	☐	☐	☐	☐
Internet websites	☐	☐	☐	☐
Magazine articles	☐	☐	☐	☐
Pop songs	☐	☐	☐	☐

6. Thinking about images of maths and mathematicians in popular culture, pick 2 you remember clearly and fill in the information about each in the boxes below.

Example 1: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

Example 2: Name and where you saw it:
Describe the main things that you remember about it:
What were your opinions and feelings about it?

7. Please indicate how often you do each of the following? *(please tick one box for each row)*

	Every day	**Every week**	**Every month**	**Less than every month**	**Never**
Watch TV	☐	☐	☐	☐	☐
Go to the cinema	☐	☐	☐	☐	☐
Listen to the radio	☐	☐	☐	☐	☐
Surf the internet	☐	☐	☐	☐	☐
Play computer games	☐	☐	☐	☐	☐
Play card games	☐	☐	☐	☐	☐
Play board games	☐	☐	☐	☐	☐
Do puzzles	☐	☐	☐	☐	☐

8. How often do you do each of the following *(please tick one box for each row)*

	Often	**Sometimes**	**Once**	**Never**
Watched the TV series *Numb3rs*	☐	☐	☐	☐
Done a *Sudoku* puzzle	☐	☐	☐	☐
Done a *cryptic crossword*	☐	☐	☐	☐
Played the computer game *tetris*	☐	☐	☐	☐
Played the board game *chess*	☐	☐	☐	☐
Played the board game *Othello*	☐	☐	☐	☐
Read *New Scientist*	☐	☐	☐	☐

9. Have you ever seen any of these films? *(please tick one box for each row)*

	Yes, more than once	**Yes, once**	**No**
A Beautiful Mind	☐	☐	☐
Pi	☐	☐	☐
Proof	☐	☐	☐
Good Will Hunting	☐	☐	☐

Part 3: Background information

10. What degree course are you doing?

11. What career would you like to pursue?

12. Which of these family members have you ever spoken to about mathematics? (*please tick one box per row*)

	Yes	No	Not applicable
Mother	☐	☐	☐
Father	☐	☐	☐
Sister	☐	☐	☐
Brother	☐	☐	☐
Daughter	☐	☐	☐
Son	☐	☐	☐
Partner	☐	☐	☐
Other relative. Please specify: …….	☐	☐	☐

13. Please indicate the highest level of qualification held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify: ……	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

14. Please indicate the highest level of qualification in maths held by your parent(s)/carer(s). *(please tick only one box for each column)*

	Mother/carer	**Father/carer**
Postgraduate or professional qualification	☐	☐
Degree or equivalent	☐	☐
A-levels or equivalent	☐	☐
GCSEs or equivalent	☐	☐
None	☐	☐
Other. Please specify: ……	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

15. Please indicate which of the following best describes/described the occupation(s) of your parent(s)/carer(s). Give the current occupation if still working; otherwise give the last known occupation *(please give one answer for each column).*

	Mother/carer	**Father/carer**
Managers and senior officials *(e.g. managers in construction, marketing, finance, health service)*	☐	☐
Professional occupations *(e.g. scientist, health professional, engineering professional, teacher, accountant, librarian)*	☐	☐
Associate professional and technical occupations *(e.g. engineering or IT technician, nurse, community worker, police officer, sales representative)*	☐	☐
Administrative and secretarial occupations *(e.g. clerk, administrative officer, secretary, office assistant)*	☐	☐
Skilled trades occupations *(e.g. farmer, decorator, electrician, painter, chef)*	☐	☐
Personal service occupations *(e.g. nursing assistant, childminder, travel agent, hairdresser, caretaker)*	☐	☐
Sales and customer service occupations *(e.g. sales and retail assistant, call centre operator)*	☐	☐
Process, plant and machine operatives *(e.g. food and drink process operative, assembler, construction operative, van driver, taxi driver, sewing machinist)*	☐	☐
Elementary occupations *(e.g. farm worker, courier, hotel porter, construction labourer, catering assistant, bar staff, security guard)*	☐	☐
Not in work	☐	☐
Other. Please specify: ……	☐	☐
Do not know	☐	☐
Not applicable	☐	☐

16. Write a sentence or two below about what your mother/carer does in their everyday life (include their job title if applicable)

Does this involve maths?

Yes ☐ No ☐

Do you think your mother/carer enjoys or enjoyed maths?

Yes ☐ No ☐

17. Write a sentence or two below about what your father/carer does in their everyday life (include their job title if applicable)

Does this involve maths?

Yes ☐ No ☐

Do you think your father/carer enjoys or enjoyed maths?

Yes ☐ No ☐

18. Which of the following best describes your ethnic background?

WHITE:

White British ☐
White Irish ☐
Any other White background ☐

MIXED:

White and Black Caribbean ☐
White and Black African ☐
White and Asian ☐
Any other Mixed background ☐

ASIAN OR ASIAN BRITISH:

Indian ☐
Pakistani ☐
Bangladeshi ☐
Any other Asian background ☐

BLACK OR BLACK BRITISH:

Caribbean ☐
African ☐
Any other Black background ☐

CHINESE OR OTHER ETHNIC GROUP:

Chinese ☐
Other ☐ If you ticked Other, please specify: ……..

19a. Are you male or female?

Female ☐ Male ☐

19b. How old are you?

21-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56+ ☐

……

20. Please give your name and a daytime telephone number and / or email address where we could contact if you want to enter the prize draw for a £20 token

Name: …… Phone number: ……

Email address: …….

We are planning to conduct focus groups with a small number of undergraduates in Autumn 2006. Would you be happy to participate?

Yes ☐ *(check you've filled in your contact details above)* No ☐

Scenario1: Imagine the world one hundred years into the future…
What do you think the world is like?
Do people learn and do maths?
Probe: What kind of people? What are they like? What kind of maths? What is it used for? How do people learn maths? Are there schools and teachers?
Would you like to live there? Why/Why not?
Probe: dystopian/utopian visions

Scenario 2: Imagine a world where mathematicians appear on TV regularly…
What do you think this world is like?
What are the mathematicians like?
Probe: Who are they? (gender, ethnicity etc.)
What do they do on TV?
Would you like to live there? Why/Why not?
Probe: dystopian/utopian visions

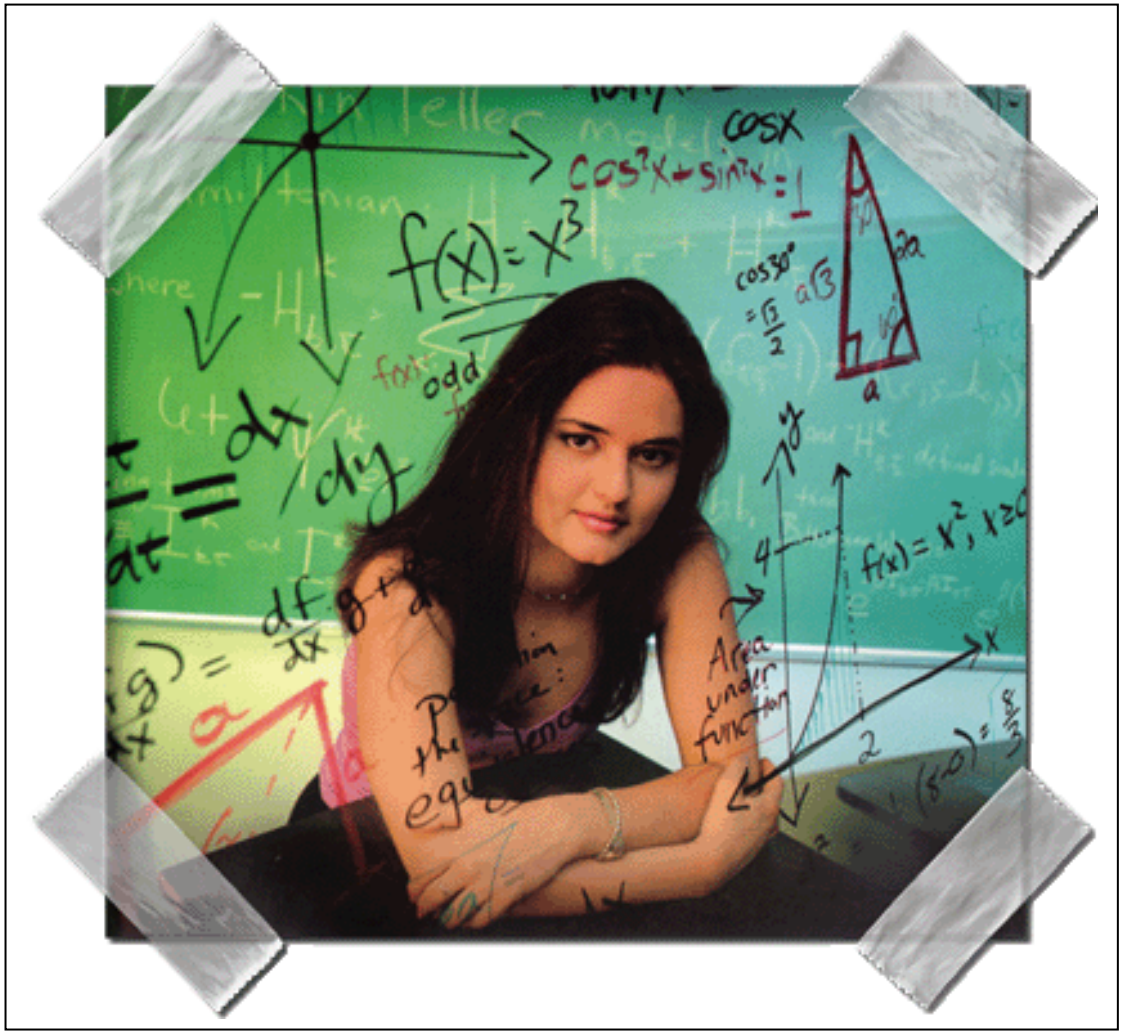
We chose people to interview to balance those who like maths and those who don't so can we talk a bit more about that…
GCSE/maths undergrad: How are you finding maths now? Is it better or worse than when you did the questionnaire/focus group? Why?
Non-maths undergrad: Tell us something more about your feelings about maths? Do you ever wish you'd learnt more maths? (Probe: current course and life)

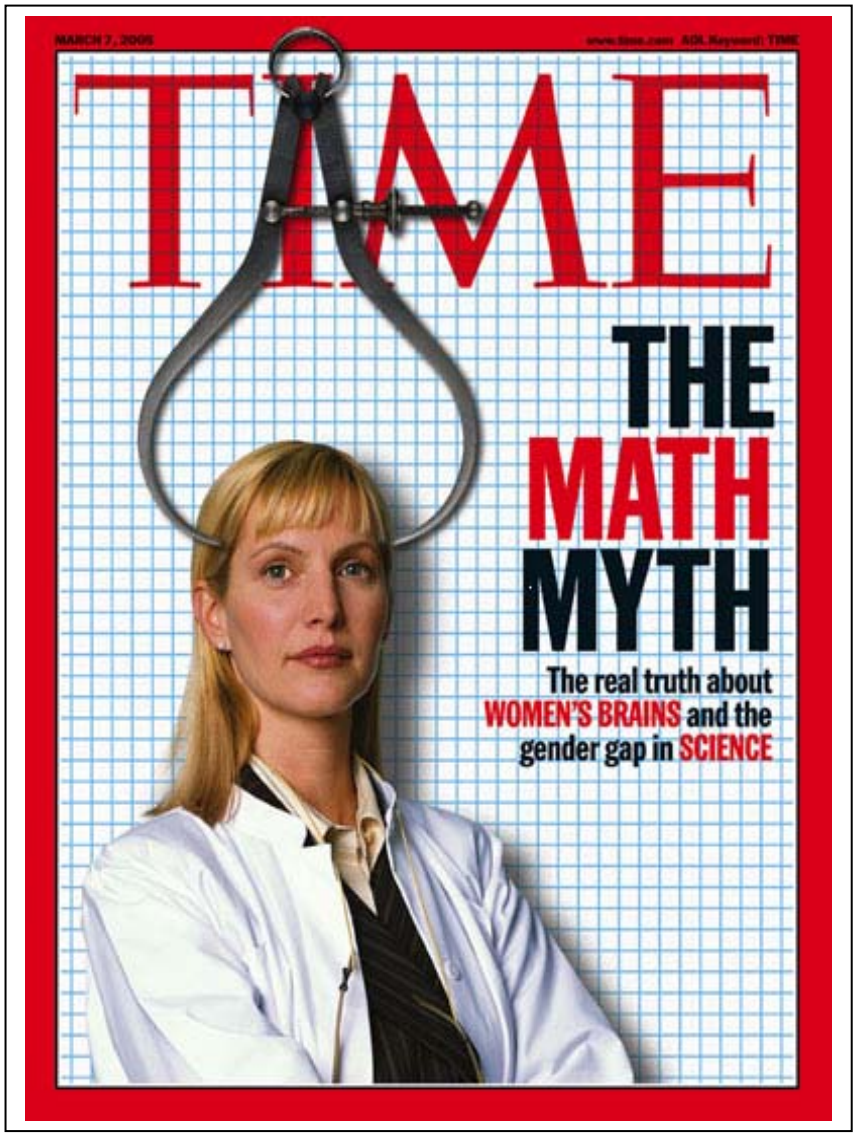
What are you planning on doing next year?
How do you feel about that? (confident, nervous etc.)
What about longer-term?
Are you likely to need maths in some form? (For those ending maths here: Might you come back to learning maths at some point?)
Can you tell us how you made your choice (post 16 or post-uni)?
Probe: role of family, role of teachers, role of popular culture

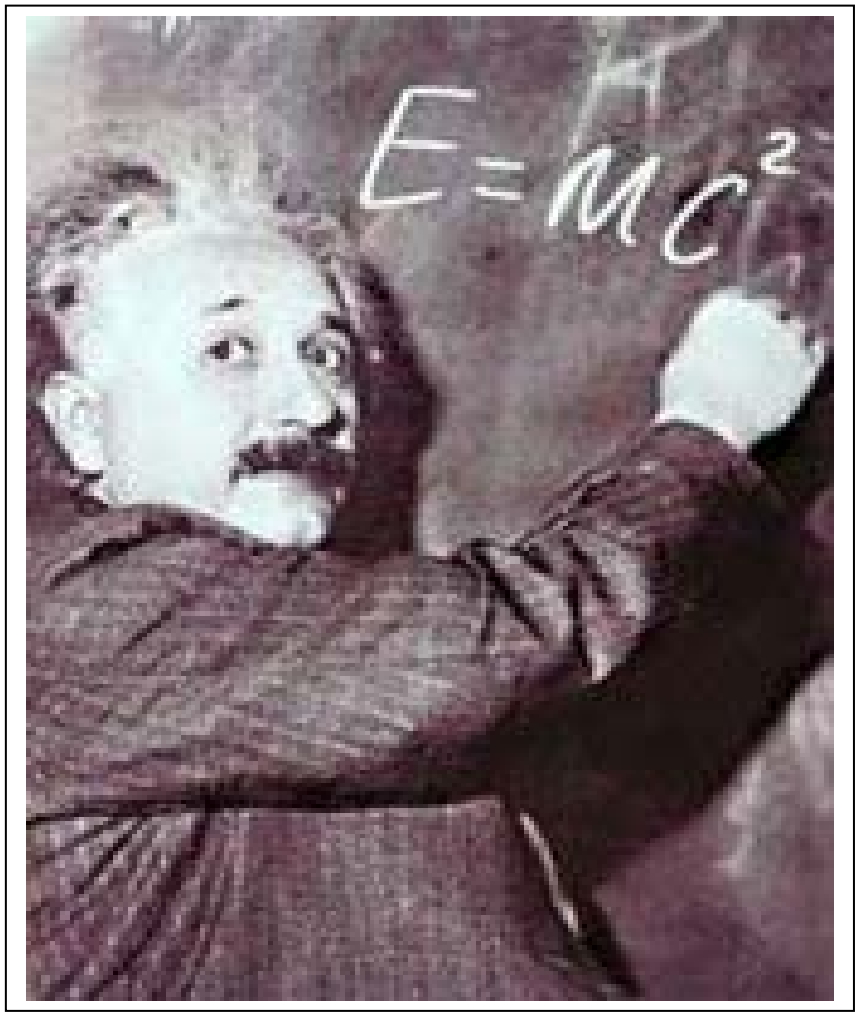
Show: People and maths images
Simpson's pi/pie; Einstein; Beautiful Mind; Time cover; Carol Vorderman; Danica MacKellar
Put these in order of how much you like them? (or into sets of like/not like)
Probe to explain as they do it
Who of these do you think can do maths?

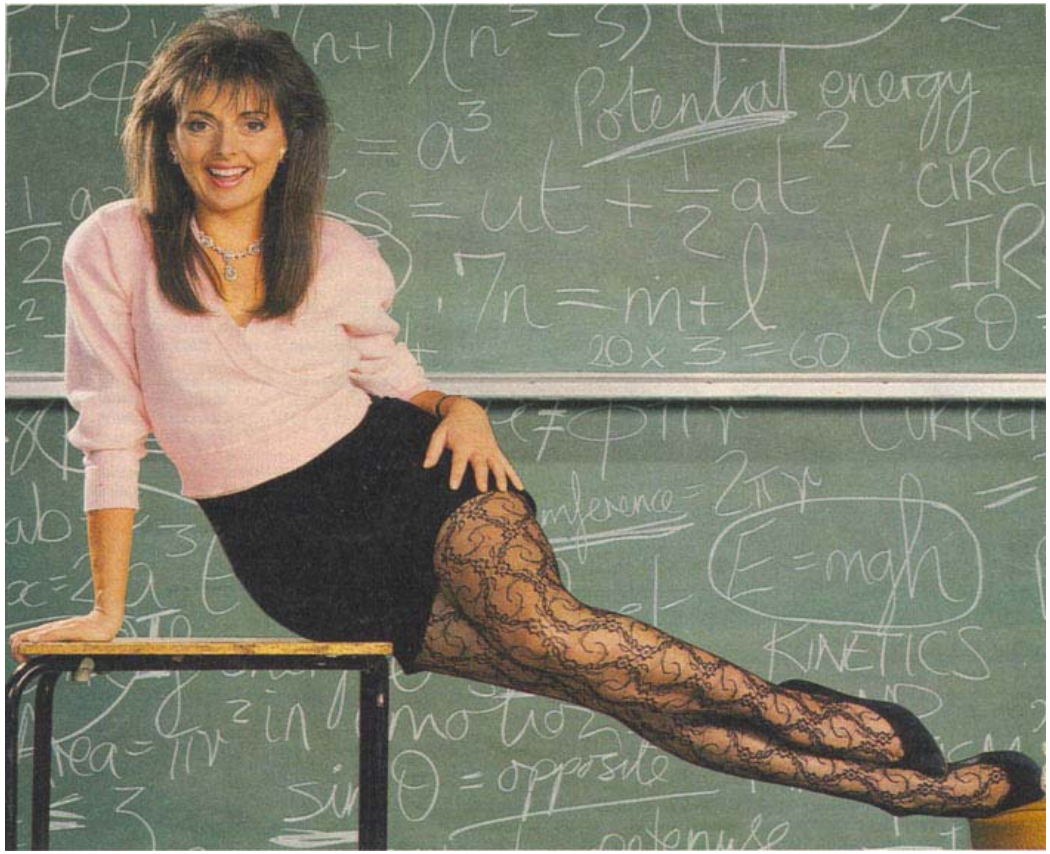
Show: Maths images
Good Will Hunting Board; Mandelbrot Set; Romanescu; Alhambra type image; Sudoku cube; Art using equations
Put these in order of how much these involve maths? (or into sets of maths/not maths)
Probe to explain as they do it
What do they make you think about? Which ones do you like?

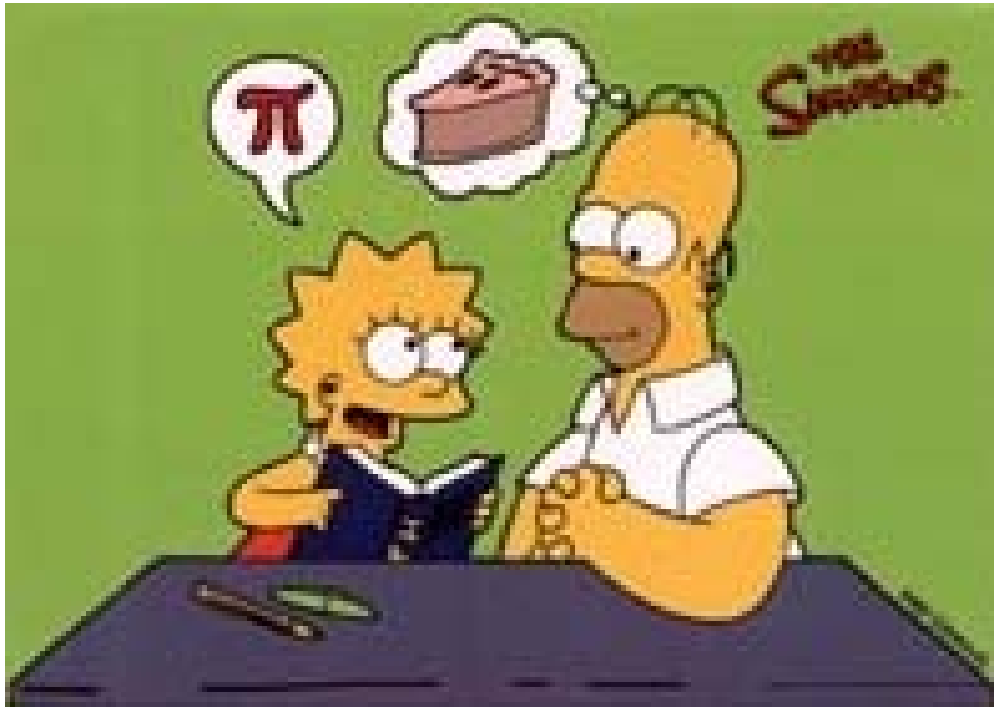
Thinking about your relationship with maths, can you tell us a story of something that happened to you, a key memory that involved maths…
Do you think everyone can do maths? Does it seem to make a difference (in your class) whether people are boys or girls? What about class, ethnicity…?

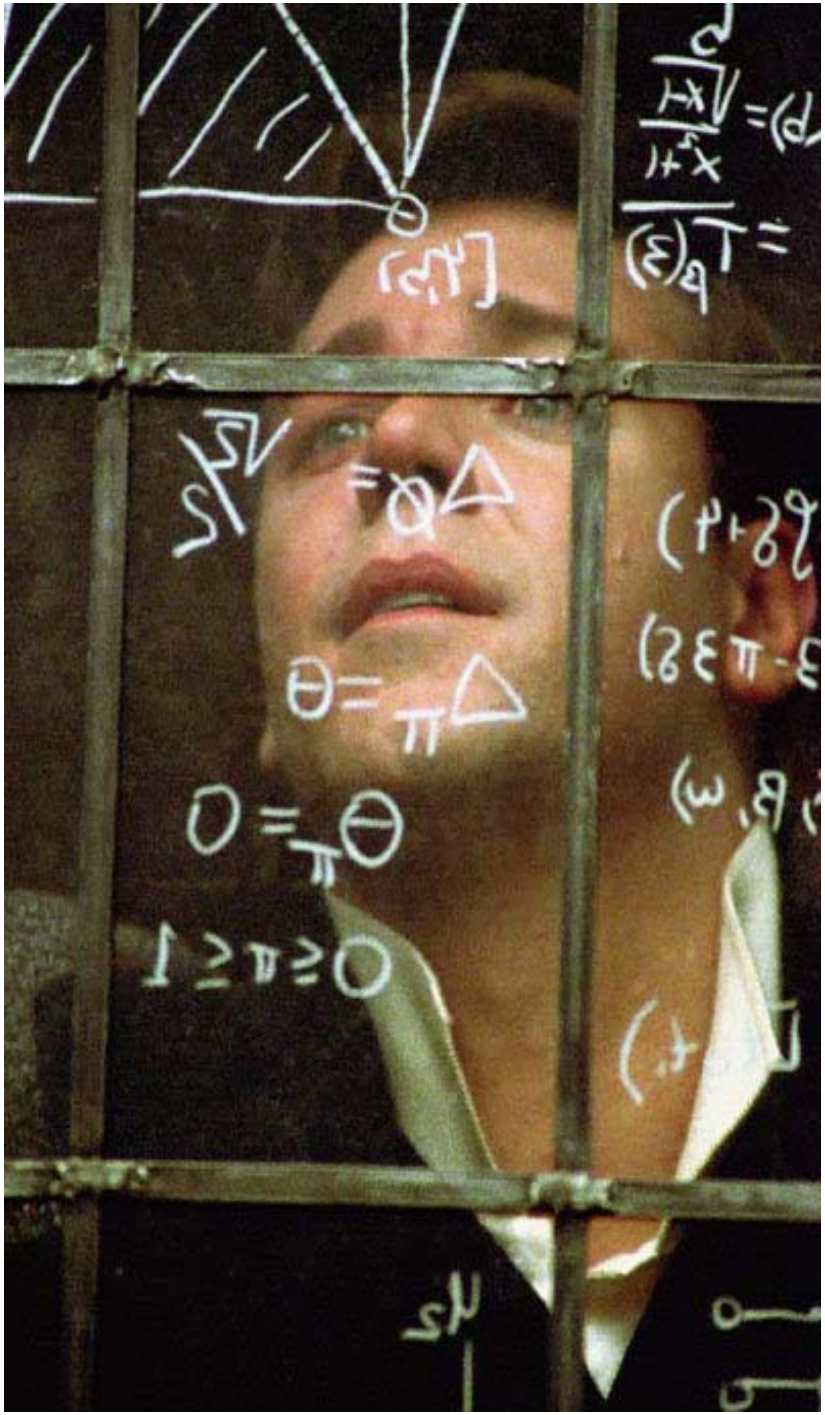

cosx
$\cos^2 x + \sin^2 x = 1$
$f(x) = x^3$
odd
$\frac{dx}{dt} = \frac{dy}{dt}$
$\frac{df}{dx}$
Area under function
$f(x) = x^2, x \geq 0$
$\cos 30° = \frac{\sqrt{3}}{2}$
a√3
2a
a

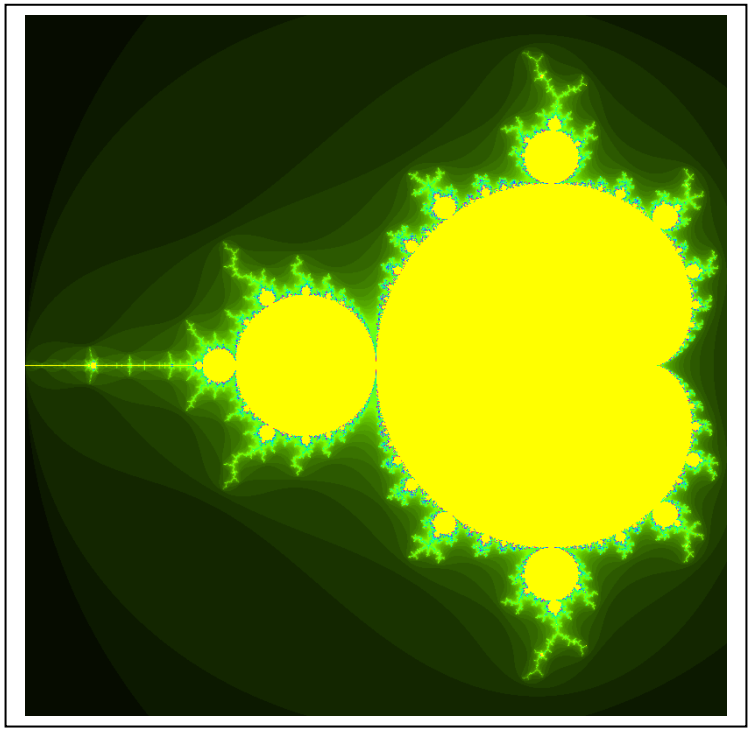

MARCH 7, 2005
TIME
THE MATH MYTH
The real truth about WOMEN'S BRAINS and the gender gap in SCIENCE

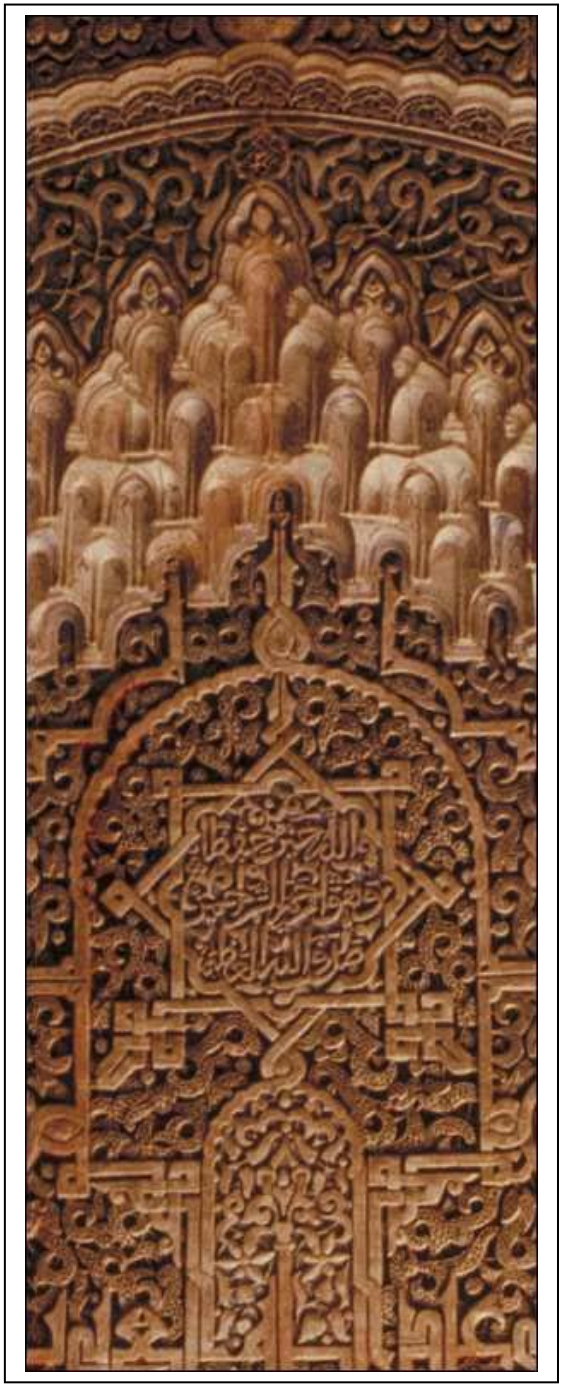

E=MC²

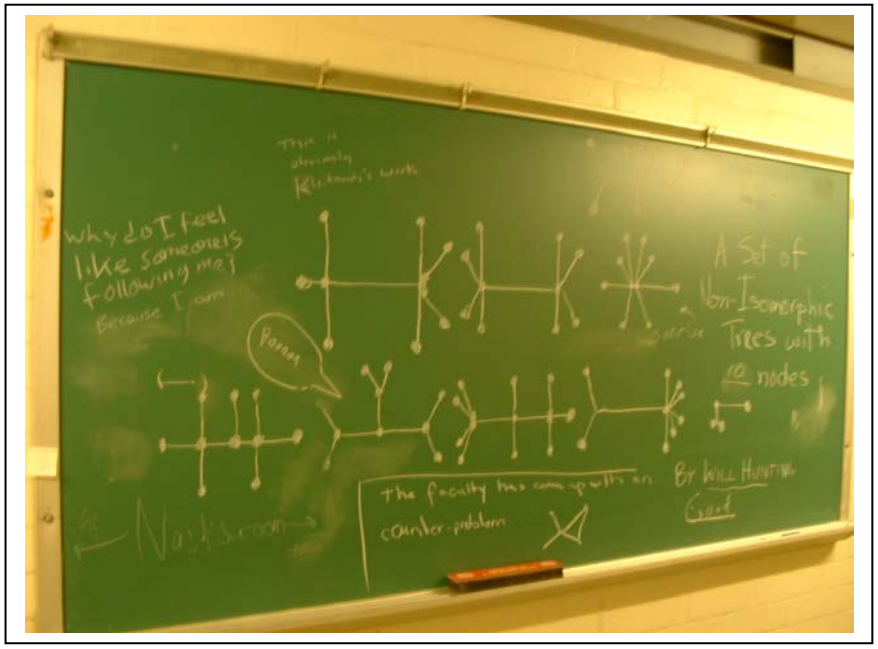

Potential energy
V=IR
KINETICS


π
The Simpsons



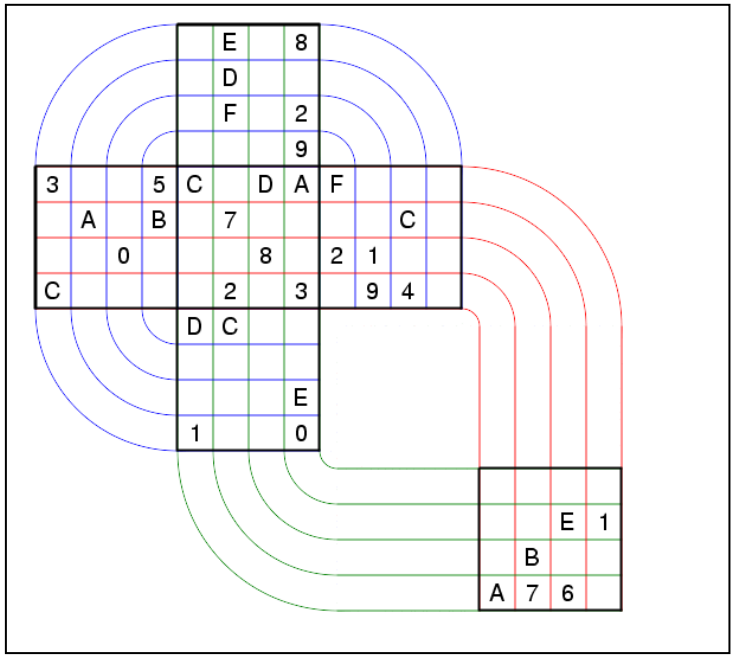





Why do I feel like someone is following me?
Because I am
Poisson
A Set of Non-Isomorphic Trees with 10 nodes
The faculty has computers on counter-problem
By Will Hunting Grad

1+1=3

For large values of 1



45-60 minutes with 3-6 people

Getting started (about 15 minutes)
Remind about the project, confidentiality, recording
Going round introducing us and themselves and choosing pseudonyms

Prompt questions
Say something about how you feel about maths
Let's describe a mathematician
Areas for probing
Feelings about maths
    reasons for difference in who can do maths and who likes maths, are these the same? School maths/other maths
Reasons for these
Images they hold of maths/mathematicians
    personality, body image, clothing, what do they like/do, family, friends

Discourses of people doing maths (about 20 minutes)
Example text compilation, scenes from: Stand and Deliver/Good Will Hunting/Gremlins advert/Deal or No Deal

Prompt questions
What do you think about these characters? What are they like?
Do you have anything in common with them? Your friends? Your family?
Do you like them? Why? Why not?
What kind of people (creatures) do you think they are?
Do you know anyone who they remind you of?
Would you like to be like them? Why? Why not?
Would you invite them to your house/go for a drink with them if they were real? Why? Why not?
What other examples do you remember of people doing maths in pop culture?
Areas for probing
Private/public
Emotion
Issues of difference: sexuality, masculinity, race?
Madness (obsession and paranoia)
Genius

Discourses of maths (about 15 minutes)

Prompt questions
How do you know when something is maths?
Example text: Sudoku: Is this maths?
Can you tell us about any other examples of maths in popular culture?
What do you think makes them maths?
Areas for probing
What is (seen as) maths
    numbers, puzzles, formulae, patterns, shapes

Notes on the clips used

Stand and Deliver: the scene when Jaime Escalante slices an apple to get his groups attention and to introduce them to work on fractions, decimals and percentages. The clip starts with the boy in glasses staring straight ahead and ends with Jaime Escalante setting the class some questions (so before the 'difficult' students enter). We see him dressed as a chef slicing an apple with a very sharp knife. Bits of apple fly off in all directions. He asks members of the group how much they have got. A young woman with big 80s hair does not know what he means, another says a half, which gets the response "good, excuse my German accent". A girl at the back says "missing 25 percent" but too quietly to be heard, he walks up to her and leans down to hear her response and replies "is it true intelligent people make better lovers". Finally, he asks a boy who has eaten his portion of apple, his comment "I've got a core" gets the response "you owe me 100 percent, I'll see you in the People's Court".

Good Will Hunting: In the MIT Hallway we see Will looking into the camera and then pull back t o see him writing on a blackboard, with janitorial equipment next to him. Lambeau and Tom come out of lecture theatre. They see Will and Lambeau calls out: "What're you doing?" Will replies: "Sorry." He walks away rapidly. Lambeau follows him calling out: "That's people's work, you can't graffiti here. Don't you walk away from me!" Will: "Hey, fuck you!" Lambeau: "Oh, you're a clever one. What's your name?" Will disappears. Lambeau returns to Tom at the board. He looks at what Will has written and says: "Oh my god." Tom says: "It looks right."

Gremlins adverts: we showed two. These are the 'bad dad' advert and the 'bubblegum' advert. You can download them from: http://www.dfes.gov.uk/get-on/downloads-2k5.shtml

Deal or No Deal: this features a 22 year old mixed-heritage woman who is has this game board:

1p	£1	£500		
£5000	£20000	£50000	£75000	£750000

We hear Noel Edmonds building up to the banker's phone call and then the call, and the offer of 22000 (before this offer Noel walks very far away from her and talks direct to camera, "she's going to have a problem with this"). She doesn't know what to do, it's her favourite number. She asks to hear what her friends (her fellow contestants) have to say. We hear nearly all the right wing say deal, then Noel goes last to Trevor who Noel labels "the voice of reason". He says if it was any number then he'd say "you're going travelling, deal" but 22 is her favourite number and he has a feeling about this so "no deal". The audience applaud and we ended the clip there.

Dear Parent(s)/Carer(s)

We are a team of researchers from London Metropolitan and Cardiff Universities, carrying out a research project on young people's identities, choices about whether or not to pursue mathematics and the part that popular culture plays in these decisions. Research shows that the image that maths has does not represent something appealing to most young people or something which they feel is compatible with their 'identities'.

This project will look at the ways that popular cultural images of maths and mathematicians (for example, on television or film, puzzles in newspapers and magazines and so on) impact on the relationships that young people form with the subject. In contrast with maths, popular culture has a growing influence on young people. We do not know much, at present, about how these images impact on young people's identities or subject choices and this project will investigate this.

The project will begin with a questionnaire survey of Year 10 pupils in a number of schools, including your child's school, during the summer term 2006. Before they are asked to complete the questionnaire, the young people will be given a full explanation of the purposes of the research and told that they may opt out of completing it if they wish. The questionnaire also asks the pupils to give us their names and brief contact details (email or phone number) if they would be willing to participate in focus group discussions and/or interviews later in the project.

We are writing to ask your permission for your child to:

a) Participate in the survey by completing the questionnaire we have devised. This will take place in school time in the summer term 2006.
b) Participate in focus group discussions and/or individual interviews during the autumn term 2006 and possibly the spring term 2007.

We will try to arrange these different aspects of the research so that they take place during school time in such a way as to cause minimum disruption to the school and the pupils. It is, however, possible that some of the interviews will have to take place after school. If that is the case, we will contact you in plenty of time beforehand. Interviews and focus groups will take place on school premises, conducted by an experienced researcher and will be recorded. Recordings will be stored in electronic format but will not be identifiable except by code. All personal details will be kept anonymous, pupils will be given pseudonyms, and the names of the schools will be changed so that the confidentiality of the young participants will be ensured. All the researchers have full Criminal Records Bureau checks.

A fact sheet about the project is attached. Please contact either Dr Heather Mendick, h.mendick@londonmet.ac.uk or Professor Debbie Epstein, epsteind@cf.ac.uk should you require any further details about the project.

Please could you return the attached permission slip to the research team via your child's school.

Dr Heather Mendick (Principal Investigator), Professor Debbie Epstein, Ms Marie-Pierre Moreau

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Maths Images and Identities Research Project

Name of child in Year 10 .....

Name of Parent .....

I do not wish my child to participate in the following research activities (delete as appropriate):

a) completing a written questionnaire

b) participating in a focus group discussion, to be recorded and transcribed

c) participating in an individual interview, to be recorded and transcribed.

Signed .....

Date .....

NB: PLEASE NOTE THAT WE WILL ASSUME THAT YOU ARE WILLING TO ALLOW YOUR CHILD TO PARTICIPATE IN THIS RESEARCH IF WE HAVE NOT HAD A RESPONSE BY the23rd of MAY

Dear Student,

We are a team of researchers from London Metropolitan and Cardiff Universities, carrying out a research project on people's identities and their choices about whether or not to pursue mathematics and the part that popular culture plays in these decisions. Research shows that the image that maths has does not represent something appealing to most people or something which they feel is compatible with their 'identities'.

This project will look at the ways that popular cultural images of maths and mathematicians (for example, on television or film, puzzles in newspapers and magazines and so on) impact on the relationships that young people form with the subject. In contrast with maths, popular culture has a growing influence. We do not know much, at present, about how these images impact on people's identities or subject choices and this project will investigate this.

We are conducting interviews and focus groups to learn more on how these affect choices and attitudes towards maths and we would appreciate it if you could spare some time to talk about your views. The focus groups will be conducted by an experienced researcher and will be recorded. Recordings will be stored in electronic format but will not be identifiable except by code. All personal details will be kept anonymous, participants will be given pseudonyms, and the names will be changed so that the confidentiality of all participants will be ensured.

A fact sheet about the project is attached. Please contact either Dr Heather Mendick, h.mendick@londonmet.ac.uk or Professor Debbie Epstein, epsteind@cf.ac.uk should you require any further details about the project.

Dr Heather Mendick (Principal Investigator), Professor Debbie Epstein, Ms Marie-Pierre Moreau

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Maths Images and Identities Research Project

I consent to taking part in a focus group for the above project. I understand that Interviews and focus groups will be recorded and that the recordings will be stored in electronic format. These will not be identifiable except by code and all personal details will be kept anonymous, so that the confidentiality of all participants will be ensured.

Signed: .....

Name: .....