INVESTIGATING PUPILS' IMAGES OF MATHEMATICIANS

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Abstract

This paper describes a research project that used a variation of the Draw-A-Scientist-Test (DAST) to investigate and compare the images of mathematicians held by lower secondary pupils (ages 12-13) in five countries. We report that with small cultural differences certain stereotypical images of mathematicians, and some surprising and disturbing images, were common to pupils in all of these countries. Further, we found that for pupils at this age, mathematicians are for all practical purposes invisible to pupils, and so the images they adopt to fill this void arise either from the media, or, in some cases, from negative experiences in mathematics classes.

1. Introduction

For the past decade there has been increased discussion and research about images of mathematics and mathematicians (Furinghetti, 1993; Henrion, 1997; Lim & Ernest, 1998; Rock & Shaw, 2000) as well as what has been referred to as the "mathematics image problem" (Howson & Kahane, 1990; Malkevitch, 1989; 1997). Research has shown that images of a particular field can affect who goes into that field (see Henrion, 1997), and where students may see mathematics as unattractive, and as populated with persons very different from themselves, they may be less likely to seriously consider entering it (NSF, 1998).

Lim and Ernest (1999) point out that it is only through ascertaining how popular or unpopular mathematics is, that measures can be created to change and improve its public image. And if, as Jaworski (1994, p. 218) seems to imply, learning mathematics is related to *being* a mathematician, what she calls "being mathematical within a mathematical community," then where pupils have images of mathematicians that are inaccurate it may hinder their study of mathematics.

The decision to investigate pupils' images of mathematicians came after seeing images produced from a class assignment given to her pupils by a colleague in

New York City, to: *Draw your perception of a mathematician*, one of which is reproduced in **Figure 1:**

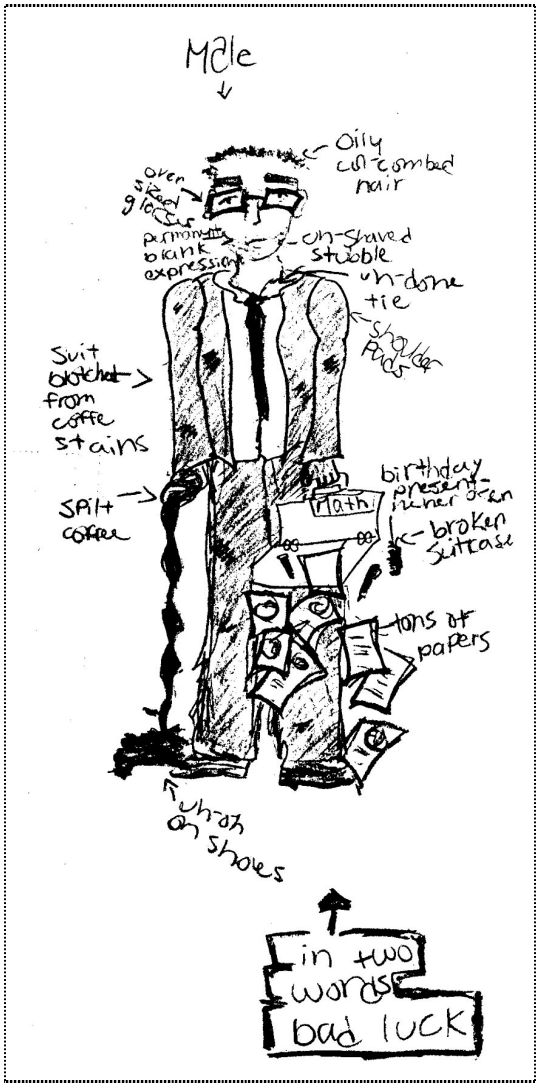

Figure 1 Female 7th Grade (UK Year 8) Pupil

We then learned of similar studies involving pupils' drawings of scientists, the *Draw-A-Scientist Test* (DAST), (see e.g., Chambers, 1983; Finson, Beaver & Cramond, 1995; Huber & Burton, 1995; Matthews and Davies, 1999; Barman, 1999), which showed that the images pupils held of scientists were increasingly stereotypical and increasingly male, by the time pupils leave the middle grades.

2. The Aims and Framework of the Research

We came to feel that images held by pupils aged 12-13 (Year 8 in the U. K. and Europe; 7th grade in the U. S.) might afford us some view of pupils at a sensitive age—one in which studies show negative attitudes begin to form (see Aiken, 1970; also Lucas, 1981) and we hoped to understand whether any of these images were held in common in the different countries involved in our survey. The 476

pupils involved in the study were from schools in the following countries: USA (n= 201), United Kingdom (n= 99), Finland (n= 94), Sweden (n= 49), Romania (n= 33).

3. Research Methodology and Methods

The study was primarily qualitative and interpretive in design, with purposeful sampling since in some cases we had to rely on colleagues in other countries to administer the survey tool.

Pupils were given a one page two-sided questionnaire that asked them to "*draw a mathematician at work*." There were also two open-ended prompts: the first asked pupils to explain and enumerate the circumstances under which one would need to hire a mathematician; the second prompt asked pupils to explain their drawings. We hoped with the first question, to ascertain what it is that pupils think mathematicians actually do. With the second prompt, we hoped pupils would give more information about the gender of their mathematician and perhaps reveal something further about their beliefs. The combination of pupils drawing and writing with interviews of some of the American pupils provided a triangulation of the data.

5. A Sampling of the Results

Pupils' written explanations for why a mathematician would be hired showed that they believe that mathematicians do applications similar to those they have seen in their own mathematics classes, including arithmetic computation, area and perimeter, and measurement. They also believe that a mathematician's work involves accounting, doing taxes and bills, and banking; work which they contend includes doing *hard sums* or *hard problems*; yet in interviews pupils could supply no specifics about what such problems entail. We came to conclude that for pupils of this age, mathematicians are invisible.

The drawings from the surveys showed many similarities among the different cultures. Upon examination, we identified seven sub themes among them:

Mathematics as coercion, in which pupils drew mathematicians as teachers who use intimidation, violence, or threats of violence on their pupils. This was a completely unexpected theme that emerged;

The foolish mathematician, in which mathematicians were depicted as lacking common sense, fashion sense, or computational abilities;

The overwrought mathematician, in which mathematicians were depicted as looking wild and being *overstrained*, to quote a pupil from Sweden;

The mathematician who can't teach, in which a classroom is drawn which the mathematician cannot control, or in which he doesn't know the material;

Disparagement of mathematicians who are depicted by pupils as being too clever or in some other way contemptible;

The Einstein effect; and

The mathematician with special powers, which may include wizardry and special potions.

We detail two of these sub themes: *mathematics as coercion,* and *the mathematician with special powers,* because they afford us a surprising view of pupils' images from their classroom experiences. And while some of the drawings could easily fall under more than one of the sub themes, the hope and intent was to highlight international commonalties amongst them.

5.1.1 Mathematics as Coercion

This sub theme can be seen in two drawings from Finland, and in drawings from Sweden, the United States and the United Kingdom. In each, the pupil has drawn a large authority figure intimidating someone smaller, sometimes with violence or threats of it. It is interesting that there was no drawing of this type from Romania, even as pupils' mathematics classes are very demanding.

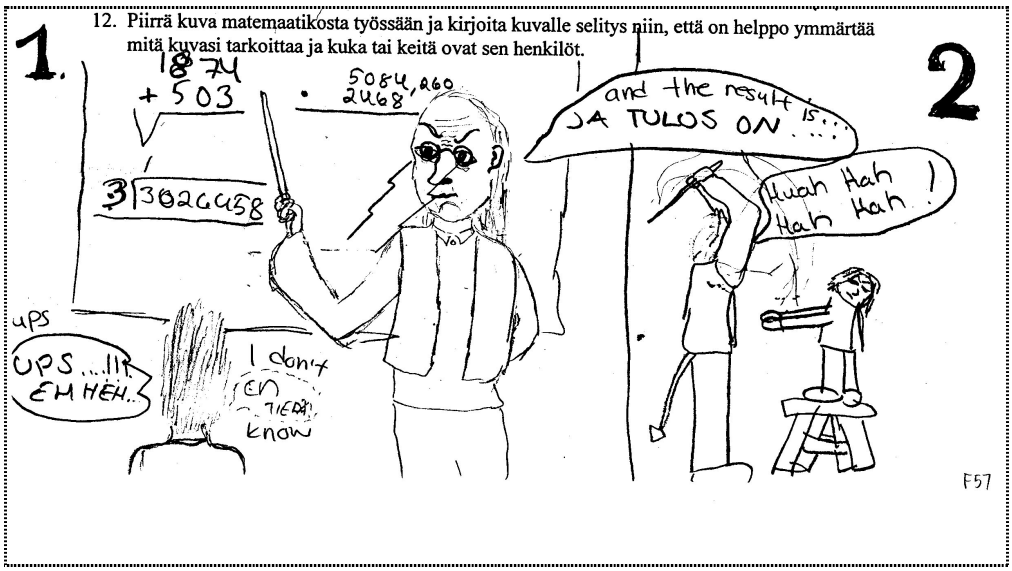

Figure 2 Finland—Female pupil

In the drawing in **Figure 2** from Finland, a Svengali-like figure prompts a trembling pupil in the first panel, then, in the second panel, a devil's tail peeks out from his coat as laughing maniacally, he beats the pupil for not knowing the answer to a simple arithmetic problem. The difference in their stature is accented by the pupil's having to stand on a stool.

In two drawings, from Finland and Sweden (see **Figure 3**), there are rifles pointed at smaller figures. In **Figure 3**, a pupil is also being asked to do simple arithmetic. The pupil wrote about his drawing: *He is a strong mathematician. If you answer wrong he* [will] *KILL you.*

It is jarring to see images of guns and violence from countries whose societies are not known for this type of behaviour, within schools or without. Similar drawings from the United States, which however has a regrettable history of violence in its schools, nevertheless contained intimidation but in a different form, with no such threats of violence coming from a teacher.

Figure 3 Sweden—male pupil

The drawings from the U.S. and U.K. also contain large authority-figures. In the American drawing the girl who drew it wrote: *A white Caucasian male saying complicated things to a class of small children (only 1 child represented)*. And in the drawing from the U.K., a menacing-looking the teacher is drawn on a stage ordering punishment, evincing what Nolan and Francis (1992, p.46) call a teacher centred conception of teaching in which the teacher "occupies the centre stage of the educational drama."

In these drawings again, the differences in statures between the authority-figures and the pupils is notable. And it is worth noting, too, that pupils have chosen to draw *small children* although the pupils creating these drawings are no longer small children, but in their early teens. It is possible that for the pupils creating this type of drawing, the experiences that have produced such images come from a time when they were much younger and felt more keenly their own lack of power. But these images are now carried into the present, with the result that the image of mathematics represented in each of these drawings is that of a bewildering and intimidating subject, placing pupils in a situation over which they have no control; of being excluded from the world the teacher inhabits—the teacher on a *stage* is one example of this remove—of sitting powerlessly in a class while a large adult says *complicated things.*

Davis & Hersh (1981, p. 282) have illuminated the origin of this perception of powerlessness in the minds of students:

> Mathematical presentations, whether in books or in the classrooms, are often perceived as authoritarian…Ideally, mathematical instruction says, 'Come, let us reason together.' But what comes from the mouth of the lecturer is often, 'Look, I tell you this is the way it is.' This is proof by coercion.

The theme of power is a large one in children's literature, often including secret and supernatural powers. It may also be a large factor in what is being referred to as "the Harry Potter phenomenon" (Jacobs, 2000), on both sides of the Atlantic, for as one reviewer of the fourth Rowling book (Acocella, 2000, p.77) observed: "The subject of the Harry Potter series is power, an important matter for children, since they have so little of it." In interviews, Rowling (see, e.g., Fraser, 2000, pp. 5-6; 8) has spoken about her experience of feeling intimidated in mathematics class at school.

The large size of the teachers in these drawings would seem to indicate pupils' perceptions of having more often had to deal with conformity and authority than sense-making in the classroom.

5.1.2 The Mathematician With Special Powers

The drawings in this theme contained references to special powers, from a Superman-like *S* on the chest of a mathematician drawn by a Romanian pupil to a figure creating a *maths potion*, drawn by a pupil in the U.K., to a series of wizards who appeared less than benign.

The very idea of a *maths potion* or super power implies that something extraordinary is necessary in order to do mathematics. And it is also related to the general invisibility of the mathematical process, for with the process hidden, mathematical facility looks more like a power than an ability, which anyone has the possibility to learn.

And although these are not the same wizards as in Harry Potter—the books had not caught on at the time of this survey as they have since—comments on the meaning of the magic in relation to the books are still, we believe, relevant. For as Jacobs (2000) indicates, anything that is "sufficiently inscrutable" might as well be the product of wizardry.

6. Implications for Pedagogy and Conclusions

Along with our finding that for pupils of this age, mathematicians are essentially invisible, is the conclusion that pupils appear to rely on stereotypical images from the media to provide images of mathematicians when asked.

We could not have anticipated how much pupils' drawings would provide a window onto their experiences in their mathematics classes. We believe that the drawings created by the pupils contain valuable insights with significant implications for teachers, their training, and their practise.

Pupils appeared to use experiences of having been intimidated in mathematics classes (*You should know this!)* and their criticisms of teachers for doing this, at times to depict mathematicians in their drawings in a vengeful manner, something with which they were aided by images of mathematicians in the media. How pupils can be made to feel in a classroom by teachers, appears centrally in many of the drawings, from feeling intimidated at not knowing something, to being dazzled by a teacher's polish and ability, to exploiting a teacher's inability to control a classroom, and I think seeing all these possibilities portrayed in the drawings can spur rich discussions and significantly raise teachers' consciousnesses.

The projection of supernatural powers onto mathematicians appeared in drawings by pupils in each country. When Arthur C. Clarke (in Jacobs, 2000) observed that, "Any smoothly functioning technology gives the appearance of magic," he could as easily been commenting on what pupils perceive as a "smoothly functioning" ease many teachers exhibit with mathematics, a facility that to many pupils also looks like magic.

The dominant image of a mathematician that emerged from this study is that of a white, middle aged, balding or wild-haired man. This points to both a gender and a racial gap in pupils' images of mathematicians, which is consistent with those findings of the DAST.

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