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# Do mathematicians' careers follow a common career path? - analysis of a questionnaire

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## 1. Introduction

Frequently when a mathematician reads a job advert or the conditions for a grant she is confronted with an age-limit. Although these adverts often include a statement along the lines of "Applicants over 40 may be considered under very exceptional circumstances" (see advert for the Royal Society's University Research Fellowships) the implication is that any mathematician worthy of the given job/grant should have already proved themselves by the stated age. As this age is often reasonably young, 30 or 35 say, it was felt by many members of EWM that such age-limits were restrictive and biased against mathematicians who, for one reason or another, had decided to take a few years out from their mathematical careers or decided to work part-time. It was also felt that the majority of such mathematicians would be female and therefore that these age-limits were particularly harmful to women. By the time of the 9th General Meeting of EWM a discussion along these lines had been running for some time on ewm-discuss (the email list of EWM devoted to such debates). It was therefore decided that a further discussion should be held on this topic at the General Meeting and that a questionnaire should be compiled to see whether these suspicions were based on reality.

The discussion was interesting, lively and wide-ranging (see Nadia Larsen's article (pages ?) for a detailed report) and the questionnaire put together at the time reflected the many topics covered during the discussion. However, when we were faced with distributing the questionnaire and analysing the results, we decided it would be preferable to reduce the scope of the questionnaire and to focus on what we thought was a critical assumption lying behind the idea of age-limits: that the career paths of mathematicians followed a common path and therefore by comparing two mathematicians of e.g. age 30, you could confidently compare the future success of the two mathematicians.

How many times as a mathematician have you heard members of the general public stating, as fact(!), that mathematicians burn-out young and that mathematicians do their best work by the time they're 30? Although there are classic cases where this is true, many participants in the discussion felt that this was really a myth and a harmful myth at that; harmful to mathematicians of both sexes, not just women mathematicians. This gave us additional motivation in trying to find out how mathematicians' careers really do evolve and whether such general statements can be made.

The questionnaire that follows is an adaptation of the one drawn up at the discussion and aims to tackle the particular issue of how mathematicians' careers develop. We were interested in all mathematicians, not only female, and we were not looking for particular problems faced by women mathematicians. The questionnaire was distributed via ewm-all (the email list of

EWM) and women were asked to pass the questionnaire on to male mathematicians of similar standing within their departments. Copies were also distributed at the British Mathematical Colloquium in Leeds, April 2000.

## 2. The Questionnaire

- 1) Are you female or male?
- 2) How old are you?
- 3)(a) How many years is it since you completed your Ph.D.?  
(b) Where did you complete your Ph.D.?
- 4) When did you publish your first mathematical paper?
- 5) What is your current position? Is it temporary or permanent, part-time or full-time?
- 6)(a) How many children do you have? If none go to question 7.  
(b) Did you take maternity/paternity leave for each child? If so, for how long?  
(c) At what age did you have your first child?
- 7)(a) Have you worked part-time?  
(b) If so for how long?  
(c) When was this?
- 8)(a) At what age did you write the published (accepted) paper of which you are most proud?  
(b) To date, when has been your most productive mathematical period?  
(c) Did the work on paper (a) occur during period (b)?
- 9)(a) Have you had any gaps in your publishing mathematical career?  
(b) If so, how long were these gaps and when were they?  
(c) In your opinion, what were the reasons for these gaps?
- 10) Comments:

### Remarks.

(i) It was thought that the country where a mathematician completed their Ph.D. would have a greater influence on their mathematical career than their country of origin, hence Question 3(b).

(ii) Although Question 3(a) asked for number of years since completion of Ph.D. this was then combined with Question 2 to find the age at which the respondent completed their Ph.D., thus Question 3(a) was probably the wrong question.

(iii) Although some respondents complained that Question 8(a) was too difficult to answer we felt it was an important indicator as to when a mathematician's career peaks.

### 3. Results

#### Gender and Ph.D. Origin

Country	Female	Male	Total
Argentina	1	0	1
Australia	0	1	1
Austria	1	0	1
Belgium	1	0	1
Bulgaria	1	0	1
Czech Republic	1	0	1
Denmark	2	2	4
France	4	5	9
Germany	16	12	28
Italy	1	0	1
Netherlands	1	1	2
Russia	1	0	1
Sweden	1	0	1
Switzerland	3	0	3
UK	11	10	21
USA	2	1	3
<b>Grand Total</b>	<b>47</b>	<b>32</b>	<b>79</b>

Table 1: Country where respondent completed their Ph.D. (re: Qns 1 & 3(b))

#### Age

Age	27 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 71
Frequency	5	31	16	22	3	2

Table 2: Ages of Respondents (re: Qn 2)

Mean Age of Respondents: 43	Female: 41	Male: 46
Median Age of Respondents: 41		
Mean Age when Completed Ph.D.: 28	Female: 29	Male: 27
Mean Age when Published First Paper: 28	Female: 28	Male: 27
Mean Age when Wrote Best Paper: 35	Female: 35	Male: 36

#### Children

No. of Children	Female	Male	Total
0	18	9	27
1	9	8	17
2	17	7	24
3	1	6	7
4	2	2	4

Table 3: Number of Children of Respondents (re: Qn 6(a))

Of the 52 respondents (29 female & 23 male) with children, 24 of the women had taken maternity leave and 2 of the men had taken paternity leave.

## Jobs

Job Type	Female	Male	Total
Full-time & Permanent	27	20	47
Full-time & Temporary	10	6	16
Part-time & Permanent	1	0	1
Part-time & Temporary	3	1	4
Retired	1	2	3
Between Jobs	1	0	1
Incomplete Answer	4	3	7

Table 4: Type of job of respondent (re: Qns: 1 & 5)

Worked Part-time	Female	Male	Total
Yes	21	5	26
No	26	27	53

Table 5: Whether respondent had worked part-time (re Qn: 7(a))

## Productive Periods

Coincided	Female	Male	Total
Yes	35	15	50
No	10	11	21
No answer	2	6	8

Table 6: Whether respondent's most productive mathematical period coincided with the writing of the paper of which they are most proud (re: Qn: 8)

## Gaps in Publishing Career

42 respondents (27 female & 15 male) said they had had gaps in their publishing career.

Reason	Female	Male	Total
Children/Family	16	5	21
Teaching	7	3	10
Administration/Managerial	4	5	9
New Research Area	5	2	7
Personal Problems	4	3	7
Unfriendly Environment	3	2	5
Disruptive Moves	2	0	2
Writing Books	0	2	2
No Progress on Difficult Problem	0	2	2

Table 7: Frequency of reasons given by respondents for gaps in their publishing career (re: Qn 9(c))

## 4. Discussion

Over half of the respondents completed their Ph.D.s in either Germany or the UK. However since these two countries have very different academic systems, a typical British student completing their Ph.D. several years before the average German student (in our sample the median age for a British student completing their Ph.D. is 25 in comparison with 28 for a German student and 29 for the rest), the sample should not be biased too heavily by a particular mathematical culture.

In our sample the average age of a female respondent is 5 years younger than that of the male respondent. To investigate whether this difference was significant, a 2-sample t-test assuming unequal variances was performed which did not quite reach a 5% significance level ( $p = 0.051$ ). However, we claim from personal experience (departments we have worked in, conferences attended, etc.), that the average female mathematician is younger than the average male mathematician, but it is not possible to check this assumption without collecting large scale data. Whether the ages of our respondents accurately reflects that of the mathematical population is unclear to us, but it seems likely that our sample is on the young side.

Further to the calculation of the mean age of the respondent when they wrote their best paper, we checked to see if this age was related to the age of the respondent. This turned out to be the case. However, even after allowing for the current age of the respondent the age when they wrote their best paper was still very similar for men and women and still around 35. We can maybe conclude that men and women's mathematical careers peak at similar times, and that this is relatively young, although maybe not as young as is generally believed. This is also supported by the response to Question 8(c). Most respondents said that their most productive period coincided with the writing of their best paper and for those when this was not the case the two times were generally pretty close together. This also implies that mathematicians' best work is the culmination of an intense period of research as opposed to a 'flash in the dark' - maybe common knowledge to the mathematician, if not to the general public.

That 16% of the male respondents had worked part-time in comparison to 45% of the women (a statistically significant difference,  $p = 0.004$ ) confirmed the idea that women tend to have a much more disrupted career path than men. This was also supported by the fact that of the 29 women and 23 men with children, 24 women took maternity leave in comparison with only 2 of the men taking paternity leave.

Family and, in particular, the care of young children came up as the main reason for gaps in respondents publishing careers. Perhaps not surprisingly, this reason affected a higher proportion of female respondents than male (female: 16/47, male: 5/32). That duties other than research, such as teaching and managerial responsibilities, can often create gaps in people's publishing careers is also not surprising. In fact whether research is our primary aim was also questioned, one (male) respondent commented "there are more ways to contribute to mathematics than writing lemmas". Gaps can also be due to unhappy circumstances. It appears that mathematicians need to be in a friendly environment and have a happy personal life to succeed in research. But the reasons for gaps are not all negative: people switch research areas, take time out to write books and concentrate on difficult problems which do not always lend themselves to solutions. So maybe gaps themselves should not always be viewed in a negative light and instead thought of as a necessary time-out in people's careers.

It is often claimed that, due to the additional pressures having children puts on their careers, female academics have on average fewer children than their male counterparts. In

our sample the female respondents had a mean number of children of 1.1 in comparison to 1.5 for that of the male respondents. However, this could be due to the fact that the majority of our female respondents are not past child-bearing age and at an average age of 41 years are 5 years younger than our average male respondent.

## 5. Conclusions

We should treat the conclusions we draw from this survey with caution. First we note that our sample size of only 79 is too small to draw any strong conclusions. Secondly, we note that our distribution of the questionnaire is very likely to introduce a bias as we relied on people volunteering to fill it in. We have no way of monitoring those who chose not to. In fact our sample is probably too female to be truly representative of the mathematical population. However, we shall make some additional comments.

Although it seems clear from our results that the career path of a female mathematician is much more disrupted than that of her male colleague this does not seem to have a significant impact on when she judges herself to have peaked as a mathematician. However, it might help to explain why she has a slightly higher tendency to have gaps in her career (27/47 women claimed to have gaps in comparison with 15/32 men). Further, although we seem drawn to conclude that there is a similarity in mathematicians' career paths, we should also note that our sample consists of mathematicians who have remained and therefore succeeded in academia (although one respondent worked in industry) and therefore conformed to our own stereotype of a successful mathematician.

With regard to the issue of sample size we note that the questionnaire is due to appear in the September 2000 issue of the Association for Women in Mathematics (AWM) newsletter and a similar questionnaire has appeared in the *Notiziario* of the Italian Mathematical Society. We look forward to analysing this additional data which will enhance our sample size as well as providing interesting comparisons. Thus, we hope in the future to be able to draw more reliable conclusions about the career paths of mathematicians.