

Funding decision and applicants' careers. A case study of an early career grant

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The paper analyses the funding decision of an early career program from Germany and the impact on further academic careers. The main results are: Gender does not play a role in funding decisions, but age is a factor: younger applicants have significant better chances. A higher journal impact promotes funding in Biology and Medicine. Grantees in the fields of chemistry, medicine and physics have a better chance of obtaining a professorship 15 years after applying than those who are not funded. In contrast, this is not a significant factor for career success in biology; instead, male applicants and a higher number of publications significantly increase the chances of being appointed.

1. Introduction

Two strands of research are linked in this study: On the one hand, research on grant decisions with a focus on gender differences or gender bias in research funding. On the other hand, research that examines the influence of grant success on further academic careers. Cruz Castro and Sanz Menéndez (2019) partly combines both in their literature review.

Research on grant decisions indicates that gender bias is decreasing or disappearing in more recent studies and data sets (Ceci and Williams 2023; Marsh, Jayasinghe, and Bond 2011). In addition, there has been an increase in work that not only examines success rates, but also investigates funding decisions in the context of past performance indicators (especially bibliometric indicators, cf. articles in Möller and van den Besselaar 2023). Bibliometric indicators are also increasingly being used in career research. A study of Sandström and Sandström (2023) on Swedish data shows that the number of grants has a statistically significant influence on the time to professorship. In a Dutch study a gender bias in favour of men obtaining a professorship were found, but the early career grants (Veni) do not have a significant impact on academic career success (Mom, van den Besselaar, and Möller 2022). In addition, some publications show that independence plays an important role in the career development of young researchers (Patsali, Pezzoni, and Visentin 2024). For early career grants, researcher independence is often a review criterion, e.g. in the German Emmy Noether program, but also in the ERC starting grant.

Using data from an early career grant in Germany, this paper examines (i) to what extent gender, age and bibliometric indicators influence the funding decision; (ii) whether the success of an early career grant leads to an advantage in later career and appointment to a professorship.

2. The case

The Emmy Noether Grant is a case of an early career grant in Germany. The goal of the grant is to enable grantees to achieve early independence in order to pursue their own research agenda. The DFG considers the Emmy Noether Program as a “turbo program for young researchers” (DFG 2006: 6, translation by TM). to obtain a professorship faster. Independence is a key review criterion: “Those who apply must show that they have conducted independent research after completing their doctorate and can build an independent scientific career” (DFG 2006: 7). The applicant must have “detached oneself from the professor's coattails”

(ibid.). The program (DFG 2021) is open to academics from all fields who have completed their doctorate with an outstanding result and submitted an excellent research proposal. They should have published demanding articles in internationally renowned journals and have already proven their scientific independence and substantial international research experience in the postdoctoral period (Böhmer, Hornbostel & Meuser, 2008: 18).

Until 2004, applicants were not allowed to be older than 32 at the time of application. Since 2005, the application had to be submitted four years after the doctorate, with the possibility of an extension due to childcare periods: For women two years per child, for men one year per child (2 years only with proof of childcare). The total length of the extension is limited to six years.

3. Data

The data refer to the funding decisions between 2000 and 2006 in biology, chemistry, physics, and medicine with a total of 495 Emmy Noether applicants. A descriptive overview of the applicants is given in Table 1.

Table 1. Descriptive statistics of applicants by gender and funding decision (proportions)

Biology	female	male
<i>Funded</i>	0.231 (15)	0.769 (50)
<i>not funded</i>	0.408 (20)	0.592 (29)
<i>Total</i>	0.307 (35)	0.693 (79)
Chemistry	female	male
<i>funded</i>	0.106 (5)	0.894 (42)
<i>not funded</i>	0.167 (7)	0.833 (35)
<i>Total</i>	0.135 (12)	0.865 (77)
Medicine	female	male
<i>Funded</i>	0.250 (17)	0.750 (51)
<i>not funded</i>	0.283 (28)	0.717 (71)
<i>Total</i>	0.269 (45)	0.731 (122)
Physics	female	male
<i>funded</i>	0.162 (12)	0.838 (62)
<i>not funded</i>	0.157 (8)	0.843 (43)
<i>Total</i>	0.160 (20)	0.840 (105)

In each field, more men than women submit a proposal and more men than women have received funding. Whether the proportion of women among the applicants corresponds to that of the respective fields cannot be determined based on the available data. Möller (2023) show that there are no differences in application activity between the genders in the German university system.

A comparison of the gender proportions of applicants and grantees indicates that there are only slight differences in chemistry, physics, and medicine. The funding share of women in biology deviates the most from the gender share of the applicants. This aspect will be investigated in the finding section.

4. Variables

An important aspect of this paper is to assess funding decisions and career success in the light of applicants' past performance. Bibliometric indicators are used for this purpose. Applicants'

publications¹ are collected through Scopus via the Scopus author ID. The Scopus author ID is relatively well suited to identify publications of a person (Aman 2018; Kawashima & Tomizawa 2015). Misassignment of publications to an author ID rarely occurs. However, it often happens that a researcher has several Scopus author IDs, usually a main ID that covers most of the publications and one or more additional IDs. One reason for this is that publications that deviate from the main research direction are more likely to be assigned to a new ID instead of causing an error by misassignment. This fact was considered when searching for the author ID, as we merge all Scopus author IDs of an applicant.

All bibliometric indicators were calculated fractionalized (divided by the number of authors). The values of the author-fractionalized publications are added up year by year. These summed values are stored in two pub(lications) variables: (i) up to the year of the funding decision and (ii) up to 15 years after the funding decision. The same procedure is performed for the impact indicators (citation window up to 5-years). The field normalized citation rate (FNCR, on the level of the Scopus subject categories) was used to measure the impact.

The FNCR is more sensitive to individual highly cited publications than percentile-based indicators, such as the excellence rate or the PP top 10%. In previous studies, we have used both indicators depending on what should be investigated. We chose FNCR to model the grant decision and the further career development as individual highly cited publications can strongly affect the selection decision and the professorial appointment. In addition, we included a journal impact indicator in the analysis as reviewers may not always be aware of the citations of individual publications. While this is also true for impact indicators at the journal level, there is at least an implicit knowledge of what is a good and not so good journal. The journal FNCR indicator in our model represents both this implicit and explicit knowledge of reviewers about the journal rankings in each discipline.

To answer the question of career success, a web search was carried out and it was checked whether the respective persons had obtained a professorship. The following table provides an overview of the variables.

Table 2. Variables.

Variable	Description
granted	grant decision: funded or not funded
professorship	professor up to 15 years after the funding decision
gender	female or male
age	biological age
pub	total number of publications, fractional counting
fncr	field normalized citation rate (FNCR), fractional counting
journal_fnrcr	Journal impact measured by a journal based fnrcr, fractional counting

¹ Only the following publication types were considered for the analysis: articles, reviews, and conference papers in journals and conference proceedings.

5. Findings

The models are presented below, differentiated according to the respective research fields. A field-specific analysis is important considering differences in publication practices, which cannot be completely excluded by fractional and field-normalized calculations. The dependent variable in the first finding section is grant decision (funded / not funded). In the second section career success (appointment to a professorship: yes / no). The independent variables are gender, age, pub(lications), fncr, and journal_fncr. The bibliometric indicators were summed up to the time of the funding decision and 15 years after the funding decision.

5.1. Grant decision models

Gender-specific differences became apparent in the description of the data (Table 1). For this reason, logistic regression models with different independent variables were calculated. Due to limited space, only the models for biology are presented.

Table 3. Logistic regression models of the funding decision in biology

Biology: Logistic Regression Models - estimates & (std. errors) in odds ratios			
	(1)	(2)	(3)
(Intercept)	0.750 (0.256)	4623097851.214 (23449372004.676) ***	17211198100.617 (91845320949.030) ***
gendermale	2.299 (0.951) *	1.907 (0.929)	1.274 (0.669)
age		0.507 (0.077) ***	0.479 (0.078) ***
pub			0.789 (0.137)
fncr			0.950 (0.074)
journal_fncr			1.507 (0.256) *
Num.Obs.	114	112	111
AIC	155.7	125.9	121.1
BIC	161.1	134.0	137.3
Log.Lik.	-75.835	-59.940	-54.546
RMSE	0.49	0.43	0.40

Three models with different independent variables were calculated for biology: (1) gender, (2) gender and age, and (3) with gender, age, pub, fncr, and journal_fncr. Model (1) suggests that men have a significantly higher chance of being granted. The significant influence of gender disappears when age is added as an additional independent variable (2). The younger an applicant is, as higher is his chance of being granted. The significant influence of age of the applicant is found also in last model (3). In addition, the Journal FNCr is significant. A higher Journal FNCr increases the chances of being funded. For the other three research fields (chemistry, medicine, and physics), gender is not significant if it was included as the only independent variable in the models (not part of this paper).

Table 4 shows the models for the four research fields with all independent variables. In all four models, age has a significant influence on the funding decision. A younger age of the applicants is associated with a higher probability of being funded. The results for the natural sciences (chemistry, physics) and life sciences (biology, medicine) are similar. For chemistry and physics, there is a significant influence only for age. For biology and medicine, the variable “journal fncr” is also significant. A higher journal fncr is associated with a higher

probability of getting a grant. The influence of journal metrics in the life sciences tends to be more pronounced. It also plays a role in the performance-based allocation of funds in the medical faculties of the German universities (Aman & van den Besselaar 2024). In this respect, the results reflect subject differences between the life sciences and other disciplines.

Table 4. Logistic regression models of the funding decision in four research fields

Logistic Regression Models of 4 Fields - estimates & (std. errors) in odds ratios				
	Biology (OR)	Chemistry (OR)	Medicine (OR)	Physics (OR)
(Intercept)	17211198100.617 (91845320949.030) ***	715413.599 (3718031.580) **	2853159.831 (10933282.472) ***	34426.405 (130185.167) **
gendermale	1.274 (0.669)	1.423 (0.968)	1.393 (0.549)	0.896 (0.497)
age	0.479 (0.078) ***	0.639 (0.104) **	0.616 (0.073) ***	0.731 (0.083) **
pub	0.789 (0.137)	1.104 (0.257)	0.833 (0.121)	0.920 (0.087)
fncr	0.950 (0.074)	0.968 (0.040)	0.896 (0.053) +	1.056 (0.030) +
journal_fncr	1.507 (0.256) *	1.147 (0.179)	1.489 (0.195) **	1.024 (0.072)
Num.Obs.	111	88	164	120
AIC	121.1	121.5	205.4	162.2
BIC	137.3	136.4	224.0	178.9
Log.Lik.	-54.546	-54.752	-96.679	-75.111
RMSE	0.40	0.46	0.45	0.47

Modelling the funding decisions revealed that gender had no significant influence on the final decision when controlling for the age and bibliometric past performance indicators. It is worth discussing whether the age of the applicant could conceal an indirect gender effect. If women had given birth before or during their doctoral period or shortly thereafter, this could have interrupted their career and thus reduced their chances of receiving an Emmy Noether grant. For women and men with children, a career slowdown due to parental leave might also be possible. On the other hand, the applying men were required to do military or civilian service whose length varied somewhat over the period of the study. For the age cohort of the male applicants, it can be assumed that the military or civilian service lasted between one and one and a half years.² Thus, several gender-related factors could affect the age of applicants in our study.

We do not have the year of the doctorate for all participants. The following picture emerges for those for which we have the data: Women were on average half a year younger at the time of their doctorate and half a year older at the time of their application. The results differ between the disciplines: In biology, women were on average 8.2 months older than men at the time of application. In chemistry, however, there are only minor age differences – women are 1.2 months older than men. In contrast, men were older than women at the time of application in medicine (7.7 months) and physics (8.4 months). The age differences do not provide a clear picture in favour of an indirect gender effect due to childbearing and/or childcare responsibilities or military or civilian service. The age of the applicants seems to be

² <https://de.wikipedia.org/wiki/Wehrpflicht#Deutschland>

influenced by several factors. Since the Emmy Noether Program has had extension rules for childcare since 2005, the effects of parental leaves are considered in the application process of the Emmy Noether grant.

5.2. Career models

We have investigated who among the Emmy Noether applicants received a professorship up to 15 years after the funding decision. The careers of applicants from the year 2000 were analysed up to 2015; for applicants from 2001 up to 2016 and so on. For this purpose, we conducted a web search. As it was not always possible to determine the type of professorship, the dependent variable was coded binary (1 = professor, 0 = no professor). The web research revealed that some academics in the sample were appointed to a professorship even after 15 years. Due to a consistent period of observation (15 years after the funding decision), we have counted these cases as not being appointed.

48.5% of Emmy Noether applicants obtain a professorship no later than 15 years after the funding decision. Among those who received funding, 62.2% were appointed, while the rate for non-funded applicants was only 34.0%. The high appointment rates underline the highly selective character of the funding program in both the application and the selection phases.

In addition, the web research showed, that many of the applicants who did not hold a professorship 15 years after the funding decision are still active in research. 70.7% of applicants are at least partially active in research (mostly, but not only, in public research). Of those funded, this is 79.1% and of those not funded, 61.8%.

We have calculated models for each of the four fields. According to our initial assumption the bibliometric indicators would gain more influence compared to the grant decision models as they now reflect the overall performance of the researcher over years. The early career grant could be seen as an enabling structure that makes it possible to remain in the scientific system and further increase the publication output. This would create a cumulative advantage that could more likely lead to an appointment as a professor. Are these assumptions supported by the results of the models?

In the models (Table 5), the positive funding decision is significantly associated with the appointment to a professorship in the fields of chemistry, medicine, and physics. Although the bibliometric indicators now represent the entire publication output of the career (around 20 years) – contrary to the assumption above – are not significant. This suggests that there is little difference in publications and impact between grantees and non-grantees in these three research fields. One reason for this may be the high proportion of applicants who are still active in research (see above) and who do not perform significantly lower on the bibliometric indicators, even though they do not yet hold a professorship. Thus, there is no cumulative advantage for the Emmy Noether grant and through the appointment to a professorship. The results indicate that the Emmy Noether grants themselves had a strong influence on subsequent appointment decisions.

Table 5. Logistic regression models. Appointment to a professorship up to 15 years after the funding decision

Logistic Regression Models of 4 Fields - estimates & (std. errors) in odds ratios

	Biology (OR)	Chemistry (OR)	Medicine (OR)	Physics (OR)
(Intercept)	0.269 (1.209)	1.271 (6.131)	0.000 (0.002) *	0.005 (0.018)
granted	2.278 (1.208)	4.842 (2.461) **	2.879 (1.124) **	4.245 (1.891) **
gendermale	3.084 (1.642) *	1.384 (1.017)	0.727 (0.291)	0.747 (0.430)
age	0.963 (0.126)	0.937 (0.135)	1.209 (0.138) +	1.124 (0.131)
pub	1.136 (0.057) *	0.979 (0.042)	1.007 (0.037)	0.997 (0.023)
fncr	0.996 (0.017)	0.999 (0.016)	1.022 (0.020)	1.013 (0.014)
journal_fncr	0.964 (0.041)	1.038 (0.033)	1.032 (0.034)	1.005 (0.019)
Num.Obs.	112	88	164	120
AIC	240.1	243.6	203.9	241.7
BIC	259.1	260.9	225.6	261.2
Log.Lik.	-113.035	-114.800	-94.960	-113.844
RMSE	0.43	0.43	0.45	0.45

However, the results for biology need to be interpreted differently. In biology, male gender and number of fractional publications are associated with professorial appointment. The results indicate that there is a gender bias in biology in favour of men when it comes to obtaining a professorship. Whether this applies to all professorial appointments in biology for the entire German university system or only for the sample cannot be answered on the basis of the data. In contrast to the other three subjects (chemistry, medicine, physics), the Emmy Noether grant is not a predictor for professorial appointment.

6. Conclusion

The Emmy Noether grant provides an exemplary case study to investigate differences in the selection procedure of an early career grant and the impact of funded and not funded applicants on their further academic career (appointment to professorship). The grant models indicate that gender has no significant influence on the funding decision when controlling for age and bibliometric indicators. The age of the applicants significantly influenced the funding decision in all four research fields: The younger the applicant, the greater the chance of receiving a grant. For the life sciences (biology and medicine), a higher journal impact of the applicant's publications also had a positive impact to be funded.

The factors influencing the achievement of a professorship up to 15 years after the funding decision were investigated. The result is that Emmy Noether grantees in chemistry, medicine and physics have a significantly higher chance of a professorial appointment. Other independent variables (gender, age, and the bibliometric indicators) were all insignificant. There is a different finding for biology. Male applicants have a significantly higher chance of

obtaining a professorship regardless of the previous Emmy Noether grant decision. A higher number of publications have a significant impact on professorial appointments in biology. The results show that in three of four fields the early career grant itself increases the chances of being appointed to a professorship.

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Open science practices

For legal and data protection reasons, the data used in this paper cannot be made publicly available.

Competing interests

The author declares that there are no competing interests.

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