Uncovering Career Patterns: How Exemplary Career Paths can Guide Young Female Scientists

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Abstract

Seeking to identify career patterns and major drivers of and barriers to scientific careers, we conducted a multivariate statistical analysis of *1.135* curricula vitae of prominent female scientists, provided online by AcademiaNet. We found no typical career paths within the sample. Simultaneously, our findings confirmed our initial assumption that career paths in so-called male-dominated and female-dominated fields significantly differed, especially with regard to subjects' mobility. We also conducted an online survey of *245* AcademiaNet scientists. Most of them regarded publication productivity as the major career driver and those in male-dominated fields identified different major carrier barriers than those in female-dominated fields.

Our findings indicate that women's scientific careers can develop in a wide variety of ways and be largely influenced by individual and field-specific factors. In particular, our findings can help young female scientists construct cognitive role models and help decision-makers more effectively support such scientists in their career development.

> "The participation of women in science and technology can contribute to increasing innovation, quality and competitiveness of scientific and industrial research and needs to be promoted." (European Commission 2006).

Introduction

In Europe in general and Germany in particular, women's potential in research and science remains largely untapped. In commercial and industrial organizations in Europe in 2009, only 34.4% of those working in research and development were women (Eurostat 2009). Accord- ing to the recent statistics, the proportion of women in science in the 27 states of the European Union constituted 33% on average. In Germany, this proportion constituted only 25% and was among the lowest (Joint Science Conference [GWK] 2014). Proportions of women remain low in both national universities and research organizations and often decrease with each successive rank of the academic ladder. In its higher ranks, these proportions usually lie between 5% and 16% (GWK 2013; GWK 2014). Bührer, Hufnagel, and Schraudner (2009) regard such limited participation of women as a large waste of potential, which impedes national capacity for innovation.

Seeking to identify major drivers of and barriers to scientific careers, in particular those of women, we conducted a statistical analysis of exemplary career paths and an online survey of prominent female scientists. The purpose was to provide valuable information to young female scientists. In research and science, role models are often indispensable as they provide guidance and foster both personal and professional development (Shapiro, Haseltine, and Rowe 1978;

Erikson 1985; Gibson 2004). Unlike many studies that "merely" explored the influence of role models on career aspirations and choices (e.g., Hackett, Esposi- to, and O'Halloran 1989; Nauta, Epperson, and Kahn 1998; Bandura 2000; Rask and Bailey 2002; Quimby and De Santis 2006; Sonnert, Fox, and Adkins 2007; Hoffman and Oreopoulos 2009), the study presented in this paper was intended, *inter alia*, to guide young female scientists and help them develop cognitive role models (Gibson 2003; Gibson 2004).

This paper presents theoretical findings on the participation of women and career development in science, the method and findings of the statistical analysis, the description and findings of the online survey, and implications for further research and application.

THEORETICAL BACKGROUND

Recently, the limited participation of women in science and in higher-ranked positions, in particular, has received increasing attention. Sonnert and Holton (1995) distinguish between the deficit model and the difference model, according to which women are treated differently in science and women act differently in science, respectively. *(1)* According to the *deficit model*, women as a group receive fewer chances and opportunities in their careers, and for this reason, they collectively have worse career outcomes. Formal and informal structural barriers may directly affect the careers of women scientists, but they may also affect the careers of an even larger number of women by turning them away from a science career. *(2)*

The *difference model* emphasizes deep-rooted differences in the outlook and goals of women and men. According to this model, the obstacles to career achievement lie within women themselves; they are either innate or the result of gender-role socialization and concomitant cultural values (Sonnert and Holton 1995).

Many recent studies describe scientific careers as a series of barriers for women, which results in the so-called leaky pipeline – at various segments of the pipeline, people drop out but rarely drop in; the dropouts are disproportionately female (Sonnert and Holton 1995; Connolly, Fuchs, and Vinkenburg 2011; German Council of Science and Humanities 2012). Scholars have identified a range of such barriers, for example, (a) family influence during childhood (Macha and Klinkhammer 2000; Blickenstaff 2005), (b) lack of early institutional support (Geenen 2000; Blickenstaff 2005), (c) structural obstacles and thresholds (Bebbington 2002; Schone et al. 2010), and (d) family matters (Sonnert and Holton 1995; Bebbington 2002; Schone, Kellermann, and Busolt 2012).

In STEM fields, in particular, proportions of women are extremely low. As a reason, Britton (2010) identified a lack of clarity in the process of obtaining a PhD degree. Other scholars identified structural obstacles, aversion to technology as a result of socialization, and lack of role models (Blickenstaff 2005; Eagly and Carli 2007; Solga and Pfahl 2009; Grühn et al. 2009).

Career patterns and parameters of career development

Vinkenburg and Weber (2012) found very few empirical studies on career patterns and career development published in peer-reviewed journals. These studies usually considered no more than three different parameters of career development and the quality of examined data largely determined the reliability of their findings. By developing a questionnaire and conducting interviews, Sonnert and Holten (1995) were among the first to study career patterns in science and differences between men's and women's careers. Within their sample, they found no distinctive career patterns and universal career drivers and concluded that career success was largely random. By utilizing quantitative biographical data and conducting qualitative interviews, Vinkenburg et al. (2012) identified five distinct types of scientific careers. Vinkenburg and Weber (2012) provide accessible starting points for conducting a statistical analysis of individual career stages and relationships between them.

While a wide range of studies has been conducted on the construct of career success in science, very little research has been done on career patterns. Our literature research indicates that publication productivity remains the major driver of scientific careers (Long, Allison, and McGinnis 1993; Dietz et al. 2000; Gaughan and Bozeman 2002; Dietz and Bozeman 2005; Lee and Bozeman 2005; Sabatier, Carrere, and Mangematin 2006; Heining, Jerger, and Lingens 2007; Graber, Launov, and Wälde 2008; Riggs et al. 2012).

Lind and Löther (2007) studied scientific careers and identified field-specific practices that led to the exclusion of women; they also established that even in female-dominated[1] fields, the proportions of women significantly decreased with each successive rank of the academic ladder. A thorough evaluation of such field-specific practices, differences between them, and their influence on women's careers might provide valuable insights on career drivers. For the purposes of our study, we identified and utilized the following three career parameters (1) mobility, (2) pace

[1] A field is defined as female-dominated, or feminized if the proportion of women among students in this field is equal to or larger than 60% (Lind and Löther 2007; Ceci et al. 2014); Gstöttner (2014) distinguishes between the proportion of women among students and among professors; in this regard, the same field can be both a feminized field of study and masculinized field of professors.

of career development, and (3) degree of integration in the scientific community.

(1) Mobility is probably one of the most researched career parameters. Cañibano, Otamendi, and Andújar (2008) established a positive correlation between mobility and publication productivity. By conducting a number of studies on both academic career paths and publishing activities, Sandström (2009) similarly established a positive correlation between a scientist's mobility, measured as the number of both his or her relocations and transfers between organizations, and the number of citations of his or her publications. Within the group researched by Zubieta (2009), those who conducted applied research had usually transferred between science and industry more often than those who conducted theoretical research. Simultaneously, those who had transferred more often also had published less often. Cañibano, Otamendi, and Andújar (2008) investigated different aspects of mobility within three different groups – biologists; physicists and astrophysicists; and philosophers and linguists – and established that members of the first group scored higher with regard to each investigated aspect than members of the other two groups and that those who were more mobile were also more internationally connected. Lee and Bozeman (2005) compared university employees who had worked in industry with those who had not and established that the former and women among them, in particular, had published significantly less often than the latter. Within the group studied by Dietz and Bozeman (2005), however, those who had worked outside science more often had usually published and applied for patents more often, which led to the conclusion that a higher frequency of transferring led to a higher number of professional contacts and access to a wider range of professional networks.

Drawing from these theoretical findings, we identified and utilized the following three variables for measuring mobility: (a) geographical mobility, (b) organizational mobility, and (c) sector mobility.

(2) Pace of career development, which is defined as the time between obtaining a Master's or Diploma degree and being appointed to a professorship, is another career parameter (Mangematin 2000; Dietz et al. 2000; Sabatier, Carrere, and Mangematin 2006; Jungbauer-Gans and Gross 2013). Both Long, Allison, and McGinnis (1993) and Sabatier, Car- rere, and Mangematin (2006) found that as compared to women, men usually took significantly less time to be appointed to a professorship. Both groups of authors explained such differences by men's more active cooperation and participation in networks. Riggs et al. (2012) evaluated the curricula vitae of professors of medicine and established that the subjects who had first published earlier in

their careers usually published more and were cited more over the course of their careers. Youtie et al. (2013) compared the curricula vitae of US-American and European scientists; they established that those in the USA who had completed their PhD studies earlier in their careers had more successful careers and that within both groups, *fast job promotion within academia* was a predictor for career success.

Jungbauer-Gans and Gross (2013) studied over 700 holders of a Habilitation degree in law, sociology, and mathematics in Germany. Even though they found certain field-specific differences, they established that in each of these three groups, the subjects who had obtained their Habilitation degrees earlier in their careers usually took less time to be appointed to a professorship. Schulze, Warning, and Wiermann (2008) arrived at a similar conclusion by investigating conversions to unlimited-term contracts with economics professors in Austria, Germany, and Switzerland.

Many scholars have observed that the pace of career development has increased over recent years. In our study, we explored differences in the pace of career development both between more experienced and less experienced subjects and between subjects in different fields.

(3) Integration in the scientific community. Within the group of biologists studied by Sabatier, Carrere, and Mangematin (2006), women, as compared to men, were on average networking and cooperating with others less and their careers developed more slowly, which led to the conclusion that cooperation and the availability of mentors were major career drivers. Gaughan and Ponomariov (2008) researched scientists working both at universities and research centers and established that the latter, on average, cooperated more with others. The scholars concluded that working at a research center required more cooperation with others, which ultimately led to higher publication productivity. Gaughan and Bozeman (2002) arrived at the conclusion that women usually published less often and participated in networks less actively than men.

In Germany, in particular, many scholars share the conclusion that scientific careers thrive on cooperation and networking. Simultaneously, according to the German Council of Science and Humanities (2007), the proportions of women in decision-making and appointing committees remain very low. Certain practices, established in scientific organizations, lead to women being consistently excluded from the early stages of their careers. To describe this phenomenon, Allmen-dinger, Fuchs, and Stebut (2000) coined the term *cooling out.* Newmann (2001) showed that by being better integrated into a research group, a scientist is given a better opportunity to participate in the exchange of ideas, to be cited, and to co-author publications. Lang and Neyer (2004) studied publications in mathematics and numbers of their co-authors as a cooperation measure and established that the average number of co-authors in more conventional disciplines was significantly lower than that in newer disciplines. For example, a publication in computer science and biomedicine had, on average, 3.59 and 18.1 co-authors, respectively. Within the group studied by Lincoln, Pincus, and Leboy (2011), women had usually received fewer scientific awards than men. Another study (Eloy et al. 2013) showed how women were often disadvantaged by the distribution of research grants.

These findings indicate that the degree of integration in the scientific community provides an important parameter for exploring career patterns.

Drawing from the theoretical findings presented above, we formulated the following two research questions. (1) What career patterns can we identify by looking at career paths of prominent female scientists presented at AcademiaNet? (2) What career drivers and barriers have these prominent scientists identified?

THE METHOD

Seeking to answer these questions, we conducted an exploratory quantitative analysis of the AcademiaNet career paths and a quantitative online survey.

The sample

Funded by the Robert Bosch Foundation and available online at www.academia-net.de, AcademiaNet contains the curricula vitae of a range of prominent female scientists. For a scientist's CV to be added to the database, she must be recommended by one of cooperating organizations, have outstanding academic qualifications, be an independent leader, etc. For the purpose of our study, we selected *1.135* curricula vitae and analyzed them statistically. Drawing from Jungbauer-Gans and Gross (2013), we divided these curricula vitae into two cohorts, based on whether a subject obtained her PhD. degree before of after 1995, and into two subsets, based on subjects' fields of work. We identified fields of mathematics, engineering, and computer science to be male-dominated and fields of linguistics, social sciences, and cultural studies to be female-dominated. We then statistically analyzed both the total sample and each of these two groups of fields.

Between October and November 2014, we conducted an online survey of 245

AcademiaNet scientists, constituting 60% of those invited, about their perceptions of career drivers and barriers.

Variables and the Encoding Procedures

To identify the variables and develop the encoding procedures for the statistical analysis, we utilized the findings of Dietz et al. (2000), Dietz (2004), Cañibano and Bozeman (2009), and Sandström (2009). Dietz has probably done the most research on CV analysis and, together with both Gaughan and Ponomariov (2008) and Cañibano and Bozeman (2009), regards CVs as a reliable and valuable source of data for career research.

For the statistical analysis, we identified a range of variables and placed them in four categories, as shown in Table 1. After a pre-test, a team of researchers conducted coding between August and September 2013. Originally, *1.299* CVs were selected, of which *164* were regarded as incomplete and removed. Data from the remaining *1.135* CVs were entered into a SQL database. Out of all variables, 42 and 25 were encoded by an automated process and manually by three people, respectively. We selected those variables, which proved to be useful for the purposes of our analysis and which we describe in the following section. Draw- ing from Cañibano and Bozeman (2009), we verified and documented each step of the encoding process in order to ensure the reliability of the data.

We developed a questionnaire for the online survey by utilizing the findings of Sonnert and Holton (1995). The questionnaire contained questions about (1) biographical information, (2) career drivers, and (3) career barriers.

Statistical Analysis

To conduct the statistical analysis, we utilized the R program. First, we conducted a descrip- tive analysis of all items. In order to explore differences between subsets and cohorts, we conducted a range of two-tailed independent two-sample t-tests. We assumed that variances were heterogeneous, which justified conservative testing for significance (Bortz and Döring 2006; Field 2013). Finally, we analyzed product-moment correlations within both the total data set and each of the two sub-groups of male and female-dominated fields.

FINDINGS

Our findings can be placed in the following four groups. *(1) The descriptive statistics* show the selected variables and the broad range of ways in which the subjects' careers have developed. (*2) The results of the comparative statistical tests* show values of studied variables within each cohort and both the male-dominated or female-dominated fields and how they compare between these cohorts and fields. *3) Correlations* provide established correlations between the variables within the total sample, the male-dominated fields, and the female-dominated fields. Finally, *(4) individual perceptions* describe potential career drivers and barriers in both the male-dominated and female-dominated fields.

(1)Descriptive statistics

Table 1 shows gathered descriptive statistics and variables selected for the analysis. Over half of the subjects worked in the natural sciences, mathematics, engineering, or agricultural science. Approximately one quarter worked in the humanities or social sciences. Approximately one quarter worked in human science, psychology, or medicine. The values of variables denoting mobility ranged substantially.

Approximately 22% of subjects had only worked in the same country in which they had obtained their PhD degree and this way had little to no international experience. Only approximately seven percent had worked in industry. The average subject had transferred between science and industry 0.15 times and had worked in industry for 0.37 years. The average subject had needed 3.67 years to obtain a PhD degree, and the duration of PhD studies varied across subjects to a little degree. The values of all other variables that described the pace of career development varied substantially. The values of all four variables denoting the degree of integration in the scientific community ranged substantially. The descriptive statistics show the diversity of career paths within the sample and indicate that the careers of female scientists can develop in a wide variety of ways.

(2) Results of the comparative statistical tests

To explore differences between the career paths of the two cohorts (PhD. ≤ 1995 and PhD > 1995), we conducted a range of independent samples t-tests. Similarly to Jungbauer-Gans and Gross (2013), we found a range of statistically significant differences, most of which could be ascribed to the fact that the average subject in the first cohort had more professional experience. The average subject in the first cohort had relocated, changed organizations, or transferred between science and industry or government significantly more often, which indicated high mobility of subjects throughout their careers. Simultaneously, we found no statistically significant differences between the two cohorts with regard to international mobility. This fact indicated that the average, less experienced subject from the second cohort had as much international experience as more experienced members of the first cohort. These findings matched the observations that international cooperation in science had increased over the last two decades (Federal Ministry of Education and Research 2008).

The average subject in the first cohort was a member of significantly more committees, which could again be explained by the degree of professional experience. Simultaneously, the average subject in each cohort had received approximately equal numbers of awards and scholarships. While the average, more experienced subject in the first cohort had taken significantly less time to obtain a PhD degree ($t(311) = 3.10$, $p < .01$), the average, less experienced subject in the second cohort had taken significantly less time to be appointed to a professorship. These statistics matched the findings of Jungbauer-Gans and Gross (2013), within whose sample, younger subjects had usually taken less time to be appointed to a professorship. See Table 2

The findings of Lind and Löther (2007) indicate that cultures in research fields can largely influence courses of women's careers. Similarly, we found significant differences between the career paths in the male-dominated and female-dominated fields, which are shown in Table 3. The average subject in the female-dominated fields, as compared to the average subject in the male-dominated fields, had obtained her PhD earlier, had more experience, and had taken a larger number of jobs, which indicated that this subject was also older. Between individual research fields, the values of these three variables significantly differed. Established differences in mobility between the two groups of fields matched the findings of Zubieta (2009) and Cañibano, Otamendi, and Andújar (2008). The average subject in the female-dominated fields had relocated to other cities ($t(184) = 3.06$, $p < .01$) and transferred between organizations significantly more often $t(191) = 3.07$, $p < .01$). Simultaneously, we found no statistically significant differences in international mobility ($t(224) = 3.98$, $p > .05$). We found the most significant differences in sector mobility. The average subject in the male-dominated fields had worked outside science both more often ($t(235) = 3.42$, $p < .001$) and longer in total $t(175) = 3.34$, $p < .01$).

While the average subjects in the male-dominated and female-dominated fields had approximately equal numbers of memberships in committees, the average subject in the male-dominated fields had been granted significantly more awards and scholarships ($t(225)= -2.02$, $p > .05$). Simultaneously, the average subject in the female-dominated fields had significantly more publications, which they authored jointly with no more than three co-authors (*t(241) = 11.46, p < .001)*, and significantly fewer publications, which they jointly authored with more than three co-authors *(t(143) = -10.61, p < .001*). Table 3 shows the career paths in the male-dominated and female-dominated fields in comparison.

(3) Established correlations

Seeking to identify career patterns, we explored correlations between selected variables both within and between categories. As expected, we found a range of highly significant correlations between different variables within the mobility category. Similarly, we found a range of highly significant correlations within the integration category. Numbers of relocations to other cities were correlated with numbers of transfers to other organizations (r=.93***). Similarly, numbers of relocations to other countries were correlated with numbers of transfers to other organizations (r=.69***) and with numbers of relocations to other cities (r=.72***). Numbers of transfers between sectors correlated with times outside science; these two variables had a causal relationship. Exclusively within the total sample, numbers of relocations to other countries were significantly negatively correlated with times outside science, which indicated that those who had worked outside science longer had usually relocated to other countries less often and vice versa.

We also found a range of significant positive correlations between different mobility and integration variables. Both numbers of relocations to other cities and numbers of transfers between organizations were significantly positively correlated with both numbers of granted awards and scholarships or numbers of memberships in committees, which indicated that subjects who were usually more mobile had been granted more awards and scholarships and participated more actively in committees (see Table 4). These findings confirmed the assumption of Dietz and Bozeman (2005) that more frequent transfers between organizations provided access to more communities and ultimately led to better integration. In the female-dominated fields, as opposed to male-dominated fields, correlations between both numbers of relocations to other cities and transfers between organizations and both numbers of awards and memberships were stronger.

Exclusively in the female-dominated fields, subjects who had relocated to other cities and transferred between organizations more usually had been granted more awards and scholarships and more actively participated in committees.

Correlations between variables denoting international mobility and those denoting integration were somewhat different. Numbers of relocations to other countries were significantly positively correlated with numbers of granted awards and scholarships. In the female-dominated fields, these correlations were stronger. Numbers of granted awards and scholarships were significantly positively correlated with numbers of memberships (r=.32***). Similarly, these correlations were stronger in the female-dominated fields. Simultaneously, we found no significant correlations between numbers of relocations and memberships in committees. Exclusively within the total sample, both numbers of relocations to other cities and of transfers between organizations were significantly positively correlated with numbers of publications authored with no more than three other co-authors and significantly negatively correlated with numbers of publications written with more than three co-authors.

We found no significant correlations between pace and integration variables denoting integration and those denoting time between obtaining a PhD degree. We found some correlations between certain mobility and pace variables. Exclusively in male-dominated fields, times between obtaining a PhD degree and being appointed to a professorship were weakly significantly positively correlated with time outside science, which indicated that subjects who had worked outside science longer had usually taken more time to become professors (r=.26*). While we found no significant correlations between numbers of relocations to other cities and pace of career development within the total sample, these variables were significantly negatively correlated in the female-dominated fields (r=-.25), which indicated that subjects in these fields who had relocated to other cities more often usually had taken less time to become professors. See Table 4.

These correlations matched the findings of Sabatier, Carrere, and Mangematin (2006), who found that the probability of being promoted was higher for those of their subjects who were more mobile. Table 4 shows the correlations between selected mobility, pace, and integration variables.

(4) Drivers of and barriers to scientific careers

The sample of the online survey can be described as follows. Forty-eight, nine, nine, and nine percent of respondents resided in Germany, the Netherlands, Switzerland, and the United Kingdom, respectively. Approximately three-quarters of respondents were professors. On average, 60% had two children. Finally, 54% and 46% worked in male-dominated and female-dominated fields respectively and 39% and 61% obtained their PhD degree before and after 1995, respectively. In response to the question about drivers of scientific careers, 68%, 56%, 53%, and 37% named publication productivity, personal determination, academic qualification, and networking. These statistics matched the findings of a range of studies, which identified publication productivity to be the major driver of scientific careers (Gaughan and Bozeman 2002; Dietz et al. 2000; Sabatier, Carrere, and Mangematin 2006; Heining, Jerger, and Lingens 2007; Graber, Launov, and Wälde 2008). We found no statistically significant differences between responses in the male-dominated and female-dominated fields.

In response to the question about major barriers to their careers, 54% and 44% of respondents in the male-dominated and female-dominated fields respectively named difficulties in reconciling work and family responsibilities. Simultaneously, while 42% of those in the male-dominated fields mentioned discrimination, 44% of those in the female-dominated fields mentioned financial insecurity. These statistics matched the findings of Sonnert and Holton (1995) and Morrison, Bourke, and Kelley (2005) that female scientists, and those in the male-dominated fields, in particular, often experienced discrimination and that such discrimination sometimes substantially impeded their careers. Similarly, Schaffer and Riordan (2004) studied a number of insurance companies and found a negative correlation between the relative size of a group and the discrimination of its members.

Table 5 shows career drivers and barriers most often mentioned by all respondents, those in the male-dominated fields, and those in female-dominated fields.

CONCLUSIONS

The examined career paths of the prominent female scientists provided by AcademiaNet varied widely, and we found no typical career paths within the sample. The values of mobility variables ranged most, with one exception. Very few of the subjects had worked in industry or government and only for very short periods of time. We find these findings particularly interesting with regard to the Triple Helix approach, which refers to the knowledge transfer between scientific, business, and political organizations and suggests the need for a more pro-active position of scientists in the innovation process, similar to those of politicians and businessmen (Etzkowitz and Leydesdorff 2000). Higher sector mobility of scientists can thereby increase the national capacity for innovation.

The studied scientists were very mobile – the average subject had transferred to another city approximately three times, and 80% of subjects had worked in a foreign country at least once. These findings indicate that prominent scientists fulfill the expectations of agenda-setting international organizations such as OECD (2013) and the Commission of the European Communities (2007), which emphasize that increased mobility can help foster knowledge production and transfer. We found a range of significant positive correlations between variables denoting the degree of integration in the scientific community and those denoting mobility, in particular, international mobility. These correlations were particularly strong within the female-dominated fields. According to Sabatier, Carrere, and Mangematin (2006) and Cañibano, Otamendi, and Andújar (2008), scientific careers thrive on cooperation and networking. Simultaneously, women in science often network and cooperate less actively than men (Kanter 1977; Baker 1994; Wellington and Spence 2001; Forret and Dougherty 2004). Our findings indicate that by encouraging women to be more mobile, we can simultaneously help them network and cooperate more actively and, ultimately, more effectively advance their careers.

Many respondents in the male-dominated fields regarded discrimination as one of the major career barriers, which matched the findings of a range of studies (e.g., Goldenhar et al. 1998; Schaffer and Riordan 2004; King et al. 2010). These studies often connect discrimination to *tokenism* (Kanter 1977), which refers to making perfunctory gestures toward the inclusion of minority groups and creating the appearance of inclusiveness. By making their gender equality practices more accessible, German scientific organizations can avoid tokenism and substantially increase the effect of such practices.

Limitations

The presented study and its methodology had the following two limitations. (1) Similar to the studies conducted by Dietz et al. (2000) and Corley, Bozeman, and Gaughan (2003), the available CVs were too compressed and often lacked valuable information such as complete lists of publications and patent applications. The CV format also provides no information about the motivations behind career choices. In this regard, narrative information (Diekmann 2008) could provide deeper insights into career development. (2) We only studied a very specific group of prominent, exclusively female scientists. Research on career paths of less successful female scientists or of both male and female scientists might provide deeper insights into career patterns and drivers. Finally, our sample was somewhat disproportional – approximately one-third of the subjects were biologists.

Implications for further research and practical application

The study presented in this paper provides accessible starting points for both further research and practical application. (1) Our statistical analysis found a broad variance among the career courses within the total sample and significant differences between career choices in the male-dominated and female-dominated fields. Thus, further studies might examine the ways in which careers develop both within and across particular fields. (2) Similar studies on all-male or mixed-gender samples can supplement our findings and help establish differences in career development between men and women. (3) Similarly to the studies conducted by Dietz et al. (2000) and Sandström (2009), CVs could be supplemented with bibliometric data such as lists of publications, patent applications and received awards. (4) The large range of established correlations indicates relationships between individual career stages and matches the findings of Vinkenburg and Weber (2012). Systematic empirical research on career development and relationships between individual career stages is still in its infancy and shows a great deal of promise. (5) Female role models in research and science remain scarce (Blickenstaff, 2005). In a broader sense, Gibson (2014) defines role models as "cognitive constructs based on individual perspectives, preferences, and aspirations." By providing information on exemplary career paths, our findings can help young female scientists develop such constructs. Finally, decision-makers might utilize our findings to develop career support programs for female Master's and PhD students.

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REFERENCES

Allmendinger, Jutta, Stefan Fuchs, and Janina v. Stebut. 1999. "Drehtüre oder Paternoster? Zur Frage der Verzinsung der Integration in wissenschaftliche Organisationen im Verlauf beruflicher Werdegänge von Wissenschaftlerinnen und Wissenschaftlern." In *Grenzenlose Gesellschaft?* edited by Claudia Honegger, 96–107. Opladen: Leske + Budrich.

Baker, Wayne E. 1994. Networking smart: How to build relationships for personal and organizational success. New York, NY: McGraw-Hill.

Bandura, Albert. 2000. "Exercise of human agency through collective efficacy." *Current Directions in Psychological Science* 9 (3): 75–78. doi:10.1111/1467-8721.00064.

Bebbington, Diane. 2002. "Women in science, engineering and technology: A review of the issues." *Higher Education Q* 56 (4): 360–75. doi:10.1111/1468-2273.00225.

Blickenstaff, Jacob C. 2005. “Women and science careers: leaky pipeline or gender filter?”*Gender and Education* 17 (4): 369–86. doi:10.1080/09540250500145072.

Bortz, Jürgen and Nicola Döring. 2006. *Forschungsmethoden und Evaluation: Für Human- und Sozialwissenschaftler.* 4th ed. Springer-Lehrbuch. Heidelberg: Springer.

Britton, Diana M. 2010. “Engendering the University through Policy and Practice: Barriers to Promotion to Full Professor for Women in the Science, Engineering and Math Disciplines.” In *Gender Change in Academia 2010*, edited by Birgit Riegraf, 15–26.Wiesbaden: VS Verlag für Sozialwissenschaften.

Bührer, Susanne, Miriam Hufnagl, and Martina Schraudner, eds. 2009. *Frauen im Innovationssystem - im Team zum Erfolg.* Stuttgart: Fraunhofer.

Cañibano, Carolina and Barry Bozeman. 2009. “Curriculum vitae method in science policy and research evaluation: the state-of-the-art.” *Research Evaluation* 18 (2): 86–94. doi:10.3152/095820209X441754.

Cañibano, Carolina, Javier Otamendi, and Inés Andújar. 2008. “Measuring and assessing researcher mobility from CV analysis: the case of the Ramón y Cajal programme in Spain.” *Research Evaluation* 17 (1): 17–31. doi:10.3152/095820208X292797.

Ceci, Stephen J., Donna K. Ginther, Shulamit Kahn, and Wendy M. Williams. 2014. “Women in academic science: A changing landscape.” *Psychological Science in the public interest* 15 (3): 75–141. doi:10.1177/1529100614541236.

Commission of the European Communities. 2003. “Researchers in the European Research Area: One Profession, Multiple Careers: Communication from the Commission to the Council and the European Parliament.” COM(2003) 436 final.

———. 2007. “The European Research Area: New perspectives: Green Paper.” COM(2007)161 final.

Connolly, Sara, Stefan Fuchs, and Claartje Vinkenburg. 2011. “Work-life balance academia evidence from two technical universities.” In *Going Diverse: Innovative answers to future challenges: Gender and diversity perspectives in science, technology and business,* edited by Carmen Leicht-Scholten, 175–93. Opladen: Barbara Budrich.

Corley, Elizabeth, Barry Bozeman, and Monica Gaughan. 2003. “Evaluating the impacts of grants on women scientists’ careers: the curriculum vitae as a tool for research assesssment.” In *Learning from science and technology policy evaluation: Experiences from the United States and Europe*, edited by Philip Shapira and Stefan Kuhlmann, 293–315. Cheltenham, UK, Northhampton, MA: Edward Elgar.

Diekmann, Andreas. 2008. *Empirische Sozialforschung: Grundlagen, Methoden, Anwendungen.* 19th ed. Rororo Rowohlts Enzyklopädie 55678. Reinbek bei Hamburg: Rowohlt-Taschenbuch-Verlag.

Dietz, James S. 2004. “Scientists and Engineers in Academic Research Centers An Examination of Career Patterns and Productivity.” Dissertation, Georgia Institute of Technology.

Dietz, James S. and Barry Bozeman. 2005. “Academic careers, patents, and productivity:industry experience as scientific and technical human capital.” *Research Policy* 34 (3): 349–67. doi:10.1016/j.respol.2005.01.008.

Dietz, James S., Ivan Chompalov, Barry Bozeman, Eliesh O. Lane, and Jongwon Park. 2000. “Using the curriculum vita to study the career paths of scientists and engineers: An exploratory assessment.” *Scientometrics* 49 (3): 419–42. doi:10.1023/A:1010537606969.

Eagly, Alice H. and Linda L. Carli. 2007. “Women and the labyrinth of leadership.” *Harvard Business Review* 85 (9): 63–71.

Eloy, Jean A., Peter F. Svider, Olga Kovalerchik, Soly Baredes, Evelyne Kalyoussef, and Sujana

S. Chandrasekhar. 2013. “Gender differences in successful NIH grant funding in otolaryngology.” *Otolaryngology -- Head and Neck Surgery* 149 (1): 77–83. doi:10.1177/0194599813486083.

Erikson, Erik H. 1985. *Childhood and society.* 35th ed. New York, NY: W.W. Norton. Etzkowitz, Henry and Loet Leydesdorff. 2000. “The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university-industry–government relations.” *Research Policy* 29 (2): 109–23. doi:10.1016/S0048-7333(99)00055-4.

European Commission. 2006. *A roadmap for equality between women and men 2006-2010.*Luxembourg: Office for Official Publications of the European Communities.

Eurostat. 2009. “Careers of doctorate holders: Data from the CDH 2009 voluntary data collection, most recent data: Further Eurostat information, main tables and database.” From statistics explained.

Federal Ministry of Education and Research. 2008. “Deutschlands Rolle in der globalen Wissensgesellschaft stärken: Strategie der Bundesregierung zur Internationalisierung von Wissenschaft und Forschung.”.

Field, Andy P. 2013. *Discovering statistics using IBM SPSS statistics.* 4th ed. Los Angeles, CA: Sage.

Forret, Monica L. and Thomas W. Dougherty. 2004. “Networking behaviors and career outcomes: differences for men and women?” *J. Organiz. Behav.* 25 (3): 419–37. doi:10.1002/job.253.

Gaughan, Monica and Barry Bozeman. 2002. “Using curriculum vitae to compare some impacts of NSF research grants with research center funding.” *Research Evaluation* 11 (1): 17–26. doi:10.3152/147154402781776952.

Gaughan, Monica and Branco Ponomariov. 2008. “Faculty publication productivity, collaboration, and grants velocity: using curricula vitae to compare center-affiliated and unaffiliated scientists.” *Research Evaluation* 17 (2): 103–10. doi:10.3152/095820208X287180.

Geenen, Elke M. 2000. “Akademische Karrieren von Frauen an wissenschaftlichen Hochschulen.” In *Wissenschaftskultur und Geschlechterordnung: Über die verborgenen Mechanismen männlicher Dominanz in der akademischen Welt*, edited by Beate Krais, 83–105. Frankfurt a.M. Campus.

German Council of Science and Humanities, ed. 2007. Exzellenz in Wissenschaft und Forschung - Neue Wege in der Gleichstellungspolitik: Dokumentation der Tagung am 28./29.11.2006 in Köln. Köln: WR, Geschäftsstelle.

———. “Fünf Jahre Offensive für Chancengleichheit von Wissenschaftlerinnen und Wissenschaftlern – Bestandsaufnahme und Empfehlungen.” 2012. Drs. 2218-12. http://www.wissenschaftsrat.de/download/archiv/2218-12.pdf.

Gibson, Donald E. 2003. “Develping the professional self-concept: Role model construals in early, middle, and late career stages.” *Organization Science* 14 (5): 591–610. doi:10.1287/orsc.14.5.591.16767.

———. 2004. “Role models in career development: New directions for theory and research.”*Journal of Vocational Behavior* 65 (1): 134–56. doi:10.1016/S0001-8791(03)00051-4.

Goldenhar, Linda M., Naomi G. Swanson, Joseph J. Hurrell, Avima Ruder, and James Deddens. 1998. “Stressors and adverse outcomes for female construction workers.” *Journal of Occupational Health Psychology* 3 (1): 19–32. doi:10.1037/1076- 8998.3.1.19.

Graber, Michael, Andrey Launov, and Klaus Wälde. 2008. “Publish or perish? The increasing importance of publications for prospective economics professors in Austria, Germany and Switzerland.” *German Economic Review* 9 (4): 457–72. doi:10.1111/j.1468-0475.2008.00449.x.

Grühn, Dieter, Heidemarie Hecht, Jürgen Rubelt, and Boris Schmidt. 2009. “Der wissenschaftliche „Mittelbau“ an deutschen Hochschulen: Zwischen Karriereaussichten und Abbruchtendenzen.”.

Gstöttner, Anna. 2014. Hochschulkarrieren in Deutschland und Skandinavien: Eine qualitative Untersuchung der Erziehungswissenschaft unter Genderperspektive. SpringerLink : Bücher. Wiesbaden: Springer VS.

Hackett, Gail, Donna Esposito, and M. Sean O’Halloran. 1989. “The relationship of role model influences to the career salience and educational and career plans of collegewomen.” *Journal of Vocational Behavior* 35 (2): 164–80. doi:10.1016/0001-8791(89)90038-9.

Heining, Jörg, Jürgen Jerger, and Jörg Lingens. 2007. “Success in the Academic Labour Market for Economics - The German Experience.” University of Regensburg Working Papers in Business, Economics and Management Information Systems 422.

Hoffmann, Florian and Philip Oreopoulos. 2009. “Professor qualities and student achievement.” *Review of Economics and Statistics* 91 (1): 83–92. doi:10.1162/rest.91.1.83.

Joint Science Conference. 2013. “Pakt für Forschung und Innovation: Monitoring Bericht 2013.” Materialien der GWK 33.

———. 2014. “Pakt für Forschung und Innovation: Monitoring-Bericht 2014.” Materialien der GWK 38.

Jungbauer-Gans, Monika and Christiane Gross. 2013. “Determinants of success in university careers: Findings from the German academic labor market.” *Zeitschrift für Soziologie* 42 (1): 74–92.

Kanter, Rosabeth M. 1977. “Some effects of proportions on group life: Skewed sex ratios and responses to token women.” *The American Journal of Sociology* 82 (5): 965–90.

King, Eden B., Michelle R. Hebl, Jennifer M. George, and Sharon F. Matusik. 2010. “Understanding tokenism: Antecedents and consequences of a psychological climate of gender inequity." *Journal of Management* 36 (2): 482–510. doi:10.1177/0149206308328508.

Lang, Frieder R. and Franz J. Neyer. 2004. "Kooperationsnetzwerke und Karrieren an deutschen Hochschulen." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 56 (3): 520–38. doi:10.1007/s11577-004-0076-2.

Lee, Sooho and Barry Bozeman. 2005. "The impact of research collaboration on scientific productivity." *Social Studies of Science* 35 (5): 673–702. doi:10.1177/0306312705052359.

Lincoln, Anne E., Stephanie H. Pincus, and Phoebe S. Leboy. 2011. "Scholars' awards go mainly to men." *Nature* 469 (7331): 472. doi:10.1038/469472a.

Lind, Inken and Andrea Löther. 2007. "Chancen für Frauen in der Wissenschaft – eine Frage der Fachkultur? Retrospektive Verlaufsanalysen und aktuelle Forschungsergebnisse." *Schweizerische Zeitschrift für Bildungswissenschaften* 29 (2): 249–72.

Long, J. Scott, Paul D. Allison, and Robert McGinnis. 1993. "Rank advancement in academic careers: Sex differences and the effects of productivity." *American Sociological Review* 58 (5): 703–22.

Macha, Hildegard and Monika Klinkhammer. 2000. *Erfolgreiche Frauen: Wie sie wurden, was sie sind.* Frankfurt a. M., New York, NY: Campus.

Mangematin, Vincent. 2000. "PhD job market: professional trajectories and incentives during the PhD" *Research Policy* 29 (6): 741–56. doi:10.1016/S0048-7333(99)00047-5.

Morrison, Zoë, Mary Bourke, and Caroline Kelley. 2005. "'Stop making it such a big issue': Perceptions and experiences of gender inequality by undergraduates at a British University." *Women's Studies International Forum* 28 (2-3): 150–62. doi:10.1016/j.wsif.2005.04.020.

Nauta, Margaret M., Douglas L. Epperson, and Jeffrey H. Kahn. 1998. "A multiple-groups analysis of predictors of higher level career aspirations among women in mathematics, science, and engineering majors." *Journal of Counseling Psychology* 45 (4): 483–96. doi:10.1037/0022-0167.45.4.483.

Newman, Mark E. J. 2001. "Scientific collaboration networks. I. Network construction and fundamental results." *Physical Review E* 64 (1). doi:10.1103/PhysRevE.64.016131.

OECD. 2008. The Global Competition for Talent: Mobility of the Highly Skilled. Paris: OECD Publishing.

———. 2013. OECD Science, Technology and Industry Scoreboard 2013. Paris: OECD Publishing.

Quimby, Julie L. and Angela M. De Santis. 2006. "The influence of role models on women's career choices." *The Career Development Quarterly* 54 (4): 297–306. doi:10.1002/j.2161-0045.2006.tb00195.x.

Rask, Kevin N. and Elizabeth M. Bailey. 2002. "Are faculty role models? Evidence from major choice in an undergraduate institution." *The Journal of Economic Education* 33 (2): 99–124. doi:10.1080/00220480209596461.

Riggs, Kevin R., Zachary J. Reitman, Thelma J. Mielenz, and Philip C. Goodman. 2012. "Relationship between time of first publication and subsequent publication success among non-PhD physician-scientists." *Journal of Graduate Medical Education* 4 (2): 196–201. doi:10.4300/JGME-D-11-00068.1.

Sabatier, Mareva, Myriam Carrere, and Vincent Mangematin. 2006. "Profiles of academic activities and careers: Does gender matter? an analysis based on french life scientist CVs." *The Journal of Technology Transfer* 31 (3): 311–24.

Sandström, Ulf. 2009. "Combining curriculum vitae and bibliometric analysis: mobility, gender and research performance." *Research Evaluation* 18 (2): 135–42. doi:10.3152/095820209X441790.

Schaffer, Bryan S. and Christine M. Riordan. 2003. "A review of cross-cultural methodologies for organizational research: A best-practices approach." *Organizational Research Methods* 6 (2): 169–215. doi:10.1177/1094428103251542.

Schone, Wiebke, Pascale Bruno, Kordula Kugele, and Ulrike Busolt. 2010. "Building on diversity to enhance the leverage power of innovation on the German economy." In *Equality, Growth & Sustainability - Do they mix? Linköping Electronic Conference Proceedings, No.58*, edited by Anna Fogelberg Eriksson, 73–79. Forums skriftserie 5. Linköping.

Schone, Wiebke, Cornelia Kellermann, and Ulrike Busolt. 2012. "Raise It, Feed It, Keep It - Building a Sustainable Knowledge Pool Within Your R&D Organization." In *Sustainable Development: Policy and Urban Development - Tourism, Life Science, Management and Environment*, edited by Chaouki Ghenai, 253–68: InTech.

Schulze, Günther G., Susanne Warning, and Christian Wiermann. 2008. "What and how long does it take to get tenure? The case of economics and business administration in Austria, Germany and Switzerland." *German Economic Review* 9 (4): 473–505. doi:10.1111/j.1468-0475.2008.00450.x.

Shapiro, Eileen C., Florence P. Haseltine, and Mary P. Rowe. 1978. "Moving up: Role models, mentors, and the "patron system." *Sloan Management Review* (19): 51–58.

Solga, Heike and Lisa Pfahl. 2009. "Wer mehr Ingenieurinnen will, muss bessere Karrierechancen für Frauen in Technikberufen schaffen." *WZ Brief Bildung* (7).

Sonnert, Gerhard, Mary F. Fox, and Kristen Adkins. 2007. "Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time." *Social Science Quarterly* 88 (5): 1333–56. doi:10.1111/j.1540-6237.2007.00505.x.

Sonnert, Gerhard and Gerald J. Holton. 1995. *Who succeeds in science? The gender dimension.* New Brunswick, NJ: Rutgers University Press.

Vinkenburg, Claartje J., Channah Herschberg, Sara Connolly, and Stefan Fuchs. 2014.

"ERCAREER ERC-Support-2012-1 (317442) Final Report – short version: Capturing career paths of ERC grantees and applicants: Promoting sustainable excellence in research careers.".

Vinkenburg, Claartje J. and Torsten Weber. 2012. "Managerial career patterns: A review of the empirical evidence." *Journal of Vocational Behavior* 80 (3): 592–607. doi:10.1016/j.jvb.2012.02.001.

Wellington, Sheila W. and Betty Spence. 2001. *Be your own mentor: Strategies from top women on the secrets of success.* 1st ed. New York, NY: Random House.

Youtie, Jan, Juan Rogers, Thomas Heinze, Philip Shapira, and Li Tang. 2013. "Career-based influences on scientific recognition in the United States and Europe: Longitudinal evidence from curriculum vitae data." *Research Policy* 42 (8): 1341–55. doi:10.1016/j.respol.2013.05.002.

Zubieta, Ana F. 2009. "Recognition and weak ties: is there a positive effect of postdoctoral position on academic performance and career development?" *Research Evaluation* 18 (2): 105–15. doi:10.3152/095820209X443446.

APPENDIX

Table 1 The descriptive statistics and their variables

Category	Variable	Range (type of variable)	Mean/percentage (standard deviation/absolute value)	Missing values
Individual factors	Research field	5 levels (categorical)	Social sciences: 24.7% Human science: 24.2% Natural sciences: 52.1% Structural science: 7.5% Economics and law: 5.5%	0
	Cohort	2 levels (dichotomous; 2: PhD≤'95=1, PhD>'95=2)	PhD ≤ '95: 45.3% (491) PhD > '95: 54.7% (594)	50
	Year of PhD graduation	1950 – 2012 (continuous)	1994 (9.54)	50
	Year of the first professorship	1951 – 2013 (continuous)	2002 (8.33)	527
	Current residence	24 levels (string)	Germany: 62.0%; The Netherlands: 7.8%; Switzerland: 7.1%; Great Britain: 5.2%; Austria: 4.6%	83
	Worked at research organization	2 levels (dichotomous; 2: no=0, yes=1)	No: 44% (444) Yes: 56% (560)	131
	Number of research organizations	0 – 6 (continuous)	1.11 (1.75)	147
	Number of jobs	1 – 17 (continuous)	4.63 (2.09)	126
	Number of guest professorships	0 – 8 (continuous)	0.2 (0.70)	103
	Time in research	1 – 63 (continuous)	18.53 (9.54)	50
Mobility	Number of relocations to another city	0 – 17 (continuous)	3.27 (2.16)	119
	Number of relocations to another country	0 – 13 (continuous)	1.94 (1.72)	114
	Number of transfers to another organization	0 – 17 (continuous)	3.41 (2.15)	118
	Number of transfers between science and industry	0 – 5 (continuous)	0.15 (0.53)	106
	Time in industry	0 – 31 (continuous)	0.37 (2.15)	102
Pace of career development	Time between obtaining a Master's or Diploma degree and first professorship	3 – 38 (continuous)	14.41 (4.95)	641
	Time between obtaining a PhD degree and first professorship	1 – 35 (continuous)	10.47 (4.62)	518
	Duration of PhD studies	1 – 10 (continuous)	3.67 (1.10)	633
Integration in the scientific community	Number of memberships in committees	1 – 67 (continuous)	7.90 (7.72)	245
	Number of awards and scholarships	1 – 49 (continuous)	5.30 (4.33)	220
	Number of publications written with ≤ 3 co-authors	0 – 20 (continuous)	4.37 (3.55)	122
	Number of publications written with > 3 co-authors	0 – 14 (continuous)	3.48 (3.26)	122

Table 2 Career paths of the two cohorts in comparison

Category	Operationalization	**PhD ≤ '95** (n=491) mean (sd)	**PhD > '95** (n=594) mean (sd)	**Degrees of freedom**	**t-value**
Mobility	Number of relocations to another city	3.76 (2.38)	2.84 (1.69)	762	6.78***
	Number of relocations to another country	2.00 (1.82)	1.89 (1.44)	830	1.33
	Number of transfers to another organization	3.97 (2.32)	2.90 (1.69)	775	8.07***
	Number of transfers between science and industry	0.20 (0.63)	0.10 (0.42)	745	2.67**
	Time in industry	0.52 (2.66)	0.20 (1.05)	560	2.44*
Pace of career developme nt	Time between obtaining a Master's or Diploma degree and first professorship	15.87 (5.26)	12.28 (3.24)	459	9.12***
	Time between obtaining a PhD degree and first professorship	12.02 (4,93)	8.15 (2.79)	601	12.41***
	Duration of PhD studies	3.45 (1.15)	3.78 (1.01)	311	-3.10*
Integration in the scientific community	Number of memberships in committees	9.41 (8.49)	6.00 (5.83)	796	6.92***
	Number of awards and scholarships	5.36 (4.85)	5.18 (3.82)	742	.61
	Number of publications written with ≤ 3 co-authors	4.74 (3.71)	4.02 (3.36)	892	3.13**
	Number of publications written with > 3 co-authors	3.51 (3.38)	3.53 (3.14)	903	-0.10

Note: * shows statistically significant differences between cohorts, ****p < .001. **p < .01. *p < .05;* Results of independent two-sample t-tests, two-tailed.

Table 3 Career paths in male-dominated and female-dominated fields in comparison

Category	Variable	**Female-dominated** (n=131); mean (sd)	**Male-dominated** (n=159); mean (sd)	Degrees of freedom	t-value
Individual factors	Year of PhD graduation	1993 (10.29)	1996 (7.85)	225	-3.02**
	Number of jobs	5.1 (2.51)	4.37 (1.98)	211	2.53*
	Time in research	20.23 (10.29)	16.85 (7.85)	225	3.02**
Mobility	Number of relocations to another city	3.93 (2.90)	2.98 (1.89)	184	3.06**
	Number of relocations to another country	1.88 (1.95)	1.79 (1.66)	224	.398
	Number of transfers to another organization	4.05 (2.86)	3.10 (1.93)	191	3.07**
	Number of transfers between science and industry	0.09 (0.39)	0.32 (0.72)	235	-3.42***
	Time in industry	0.14 (0.90)	1.10 (3.36)	175	-3.35**
Pace of career developme nt	Time between obtaining a Master's or Diploma degree and first professorship	13.71 (4.95)	13.41 (4.41)	115	.35
	Time between obtaining a PhD degree and first professorship	3.72 (1.21)	3.83 (1.15)	63	.65
	Duration of PhD studies	7.66 (2.72)	7.5 (2.86)	147	-.12
Integration in the scientific community	Number of memberships in committees	7.79 (8.28)	7.89 (9.45)	218	-.09
	Number of awards and scholarships	3.65 (3.07)	4.59 (3.92)	225	-2.02*
	Number of publications written with ≤ 3 co-authors	7.79 (3.19)	3.47 (2.72)	241	11.46***
	Number of publications written with > 3 co-authors	0.51 (0.89)	3.44 (2.92)	143	-10.61***

Note: * shows statistically significant differences between subsets of fields, ****p* < *.001. **p* < *.01. *p* < *.05;* Results of independent two-sample t-tests, two-tailed.

Table 4 Correlations between selected variables

	Mobility					**Pace of career development**	**Integration in the scientific community**			
	City relocations	Country relocations	Organization transfers	Science-Industry transfers	Time Industry	PhD - professorship	Awards & scholarships	Member-ships	Publications ≤ 3 co-authors	Publications > 3 co-authors
City relocations	**1**									
Country relocations	**.72*** **	1								
r(f)	.71***									
r(m)	**.75*** **									
Organization transfers	**.93*** **	**.69*** **	1							
r(f)	**.97*** **	**.69*** **								
r(m)	**.94*** **	**.73*** **								
Science-Industry transfers	.04	-.01	**.08***	1						
r(f)	.04	.04	.05							
r(m)	.06	-.02	.09							
Time Industry	-.01	**-.06***	.03	**.61*** **	1					
r(f)	.08	-.01	.03	**.65*** **						
r(m)	-.01	-.11	.07	**.74*** **						
PhD - professorship	-.06	-.07	.00	.07	**.08***	**1**				
r(f)	**-.25***	-.17	-.21	-.11	.03					
r(m)	-.09	-.14	-.01	.17	**.26***					
Awards & scholarships	**.08***	**.11****	**.08***	-.01	-.01	-.07	1			
r(f)	**.29****	**.30****	**.31****	.03	.00	-.21				
r(m)	.12	**.21***	.13	.01	-.02	-.07				
Memberships	**.11***	.06	**.12*** **	.06	.07	.00	**.32*** **	**1**		
r(f)	**.21***	.14	**.22***	.06	.10	-.10	**.68*** **			
r(m)	.06	.01	.02	.02	.14	.10	.12			
Publications ≤ 3 co-authors	**.18*** **	.06	**.16*** **	.05	.04	-.03	**-.07***	.05	1	
r(f)	.08	-.02	.07	-.04	.01	-.03	-.12	-.06		
r(m)	.04	-.16	.03	.11	.05	.03	-.01	.00		
Publications > 3 co-authors	**-.14*** **	-.04	**-.11****	-.02	-.03	.05	**.16*** **	.06	**-.57*** **	1
r(f)	.15	.01	**.16**	.16	**.35*** **	.11	**.28****	**.32****	-.01	
r(m)	.03	.07	**.06**	.05	.04	.06	-.05	.08	**-.39*** **	

Note: Described variable mentioned first refer to correlations within the total sample; r(f) and r(m) refer to correlations established for female-dominated and male-dominated fields respectively; numbers in bold show statistically significant correlations, ****p < .001. **p < .01. *p < .05. N=1.135, n in each individual cell varies due to missing values*

Table 5 Most often mentioned career drivers and barriers

Category		**All respondents** (N=245)	**Respondents work ing in male-dominated fields** (n=130)	**Respondents working in female-dominated fields** (n=108)
Drivers	Number of publications	68%	66%	74%
	Determination	56%	58%	***54%***
	Academic qualification	53%	47%	***63%***
	Cooperation	37%	40%	34%
Barri-ers	Reconciliation of work and family responsibilities	49%	54%	44%
	Lack of structures and clarity with regard to career development	40%	**40%**	40%
	Gender-specific factors	34%	**42%**	**27%**
	Financial insecurity	33%	26%	***44%***
	No barriers	*10%*	*8%*	*14%*

Note: Respondents were asked to name the three major drivers of and barriers to their careers. Because some respondents did not provide information about their research fields, the total number of respondents are larger than the sum of the numbers of respondents working in either male-dominated or female-dominated fields.