International Journal for Educational and Vocational Guidance
https://doi.org/10.1007/s10775-023-09580-4

Social capital in academia: How does postdocs' relationship with their superior professors shape their career intentions?

Nurith Epstein[1] · **Christina Elhalaby**[2]

Received: 18 January 2022 / Accepted: 17 February 2023

Abstract
In this study, we hypothesize that full professors have an important impact on their postdocs' career intentions. Using multivariate regression analysis, we found a positive association between postdocs' ratings of their professor relationship, their integration into the scientific community and their career intentions. In addition, publications as a co-author were significantly related to the intention to pursue professorship. Our results suggest that social capital but specifically the quality of postdocs' social capital is important for their career intentions: particularly the relationship with their professor, integration into the scientific community and ties to other scientists that translate into publications. Implications for career strategy on the individual level and policy implications are discussed.

Keywords Academic careers · Professor relationship · Social capital

Résumé
Le capital social dans le monde universitaire : Comment les relations des postdocs avec leurs professeures supérieures influencent-elles leurs intentions de carrière ? Dans cette étude, nous émettons l'hypothèse que les professeures titulaires ont un impact important sur les intentions de carrière de leurs postdocs. En utilisant une analyse de régression multivariée, nous avons trouvé une association positive entre l'évaluation par les postdocs de leur relation avec leur professeure, leur intégration dans la communauté scientifique et leurs intentions de carrière. En outre, les publications en tant que co-auteur et autrice étaient significativement liées à l'intention de poursuivre une carrière de professeure. Nos résultats suggèrent que le capital social, et plus particulièrement la qualité du capital social des postdocs, est

✉ Nurith Epstein
nurith.epstein@gmail.com

[1] Institut für Didaktik und Ausbildungsforschung in der Medizin, Klinikum der Universität München, LMU Klinikum, Munich, Germany

[2] Bayerisches Staatsinstitut für Hochschulforschung und Hochschulplanung (IHF), Munich, Germany

Published online: 21 April 2023

important pour leurs intentions de carrière : notamment la relation avec leur professeure, l'intégration dans la communauté scientifique et les liens avec d'autres scientifiques qui se traduisent par des publications. Les implications pour la stratégie de carrière au niveau individuel et les implications politiques sont discutées.

Zusammenfassung

Sozialkapital in der Wissenschaft: Wie prägt die Beziehung von Postdocs zu ihren vorgesetzten Professor*innen ihre Karriereintentionen? In dieser Studie stellen wir die Hypothese auf, dass Professor*innen einen wichtigen Einfluss auf die Karriereintentionen ihrer Postdocs haben. Multivariate Regressionsanalysen zeigen einen positiven Zusammenhang zwischen den von den Postdocs eingeschätzten Vorgesetztenbeziehungen, ihrer Integration in die wissenschaftliche Gemeinschaft und ihren Karriereintentionen. Darüber hinaus standen Veröffentlichungen als Koautor*innen in einem signifikanten Zusammenhang mit der Absicht, eine Professur anzustreben. Unsere Ergebnisse deuten darauf hin, dass Sozialkapital, insbesondere die Qualität des Sozialkapitals von Postdocs, für ihre Karriereintentionen wichtig ist: Insbesondere die Beziehung zu ihren vorgesetzten Professor*innen, die Integration in die wissenschaftliche Gemeinschaft und die Verbindungen zu anderen Wissenschaftler*innen, die sich in Publikationen niederschlagen. Abschließend diskutieren wir Implikationen für individuelle Karrierestrategien und politische Implikationen.

Resumen

Capital social en el mundo académico: ¿Cómo influye la relación de los postdoctorandos con sus profesores superiores en sus intenciones profesionales? En este estudio se plantea la hipótesis de que los profesores titulares tienen un impacto importante en las intenciones profesionales de sus postdoctorandos. Mediante un análisis de regresión multivariante, encontramos una asociación positiva entre las valoraciones de los postdoctorandos sobre su relación con el profesor, su integración en la comunidad científica y sus intenciones profesionales. Además, las publicaciones como coautor estaban significativamente relacionadas con la intención de seguir siendo profesor. Nuestros resultados sugieren que el capital social, y en concreto la calidad del capital social de los postdoctorandos, es importante para sus intenciones profesionales: en particular, la relación con su profesor, la integración en la comunidad científica y los vínculos con otros científicos que se traducen en publicaciones. Se discuten las implicaciones para la estrategia profesional a nivel individual y las implicaciones políticas.

Introduction

The precarious working conditions in academia have attained increased attention in the scientific literature and political debate (e.g., Afonso, 2016; Stephan, 2012; Ullrich, 2019). While the vulnerable phases of academic career trajectories vary in different national contexts, an increase in "outsiders", academics working on a series of fixed-term employment contracts with little to no opportunities of future

stable employment, is observed in many countries (Afonso, 2016). This is in most cases, a problem for post PhD researchers [hereinafter "postdocs"[1] (see ibid.)]. In many European countries and the US, the situation for postdocs has worsened with a "movement of casualization", i.e. a drastic increase in fixed-term employment (e.g., Afonso, 2016; Stephan, 2012). These employment characteristics of academia are more of a traditional situation in the German context that has only exacerbated (Afonso, 2016).

Already in 1919, Max Weber described the characteristics of an academic career in Germany as a highly insecure path. The only certain way to achieve secure employment is scavenging one of the few positions as a full professor, who constitute 10 percent of academic positions (Kreckel, 2017). Special characteristics of the German system are: (1) a second thesis (Habilitation), which is often still required to attain professorship. (2) The chair-system, which means that university chairs are held by professors, who then represent the respective discipline at their university (Kreckel, 2017). Financial means and personal infrastructure are attached to the chairs, but individually negotiated and set to the individual professor holding the chair. (3) The third peculiarity concerns the "legal ban on internal appointments and promotions" (Kreckel, 2017, p. 5). This means that postdocs cannot become professors at the university of their doctoral studies (Afonso, 2016; Kreckel, 2017). As a result, there are mostly "two categories of academic staff" at German universities: "tenured professors recruited from outside and assisting staff in transitory employment whose task is further qualification, with no career prospects in their own university" (Kreckel, 2017, p. 6). Compared to many other European countries, but also to the United States, Germany stands out by the fact that there are only few permanent positions for PhD graduates (Afonso, 2016; Kreckel, 2016, 2017). Austria and Switzerland are similar to Germany in this respect (Afonso, 2016; Kreckel, 2016). Hence, postdocs have to endure a long period of insecurity with consecutive career decisions – staying or leaving. Postdocs may find it critical to estimate *their subjective success probabilities*, which are part of decision theories (e.g., Opp, 2019; Kroneberg, 2006, Breen & Goldthorpe, 1997), in order to decide whether to race for one of the scarce positions as professor.

Empirical evidence supports the importance of social capital for a successful academic career and indicates that talent alone may not be sufficient (e.g., Godechot, 2016). We argue in this article, that postdocs with higher professional social capital—postdocs who are well integrated into their scientific communities and have a good relationship with their superior professors—rate their success probability for an academic career higher and are therefore more likely to keep pursuing an academic career. We justify the central role of the professor in this context as follows: As indicated, the terms of employment and privileges of full professors in Germany stand in steep contrast to the insecurities faced by postdocs. They decide whom to hire, promote and recommend (Gallas, 2018; Ullrich, 2019). Qualitative data

[1] In distinction to the concept of specifically institutionalized postdoc-positions which applies in the US (e.g., Stephan, 2013), we define postdocs independent of their current position in general as (early career) scientists who have completed their doctorate and have not yet attained a position as full professor.

suggest that full professors are mainly responsible for promoting the careers of their employees, yet perform this task at their own discretion (Richter & Reul, 2016). Professors are not only employers and mentors, but they also facilitate their postdocs' access to their network and function as gatekeepers to their scientific communities (Jungbauer-Gans & Gross, 2013).

While, overall, empirical studies support that social capital has an impact on various career outcomes of postdocs at different career stages to some extent, there is also conflicting evidence (see section "Social Capital and Postdocs' Career Intentions (Success Probability)" for more details). It also remains unclear how social capital shapes the ambitions, career intentions and decisions of early career scientists and postdocs.

Against this backdrop, we pursue the questions how integration in their respective scientific community and the relationship to their superior professors affects postdocs in terms of their career intentions: to pursue an academic career and professorship in the long-term. We analyze these questions using data from a postdoc survey in the disciplines of medicine and basic life sciences. With these two disciplines, we are also able to compare two groups who face different labour market circumstances, i.e. different "exit possibilities". Whereas the basic life sciences are rather "oversupplied" (Stephan, 2012) and face more difficulties in the non-academic labour market (Plasa, 2014), physicians face excellent labour market circumstances as clinicians (Demary & Koppel, 2013).

Postdoc's career intentions in the light of subjective expected utility (SEU)

In the light of the long career insecurity postdocs have to face the extreme uncertainty in regards to whether they will find permanent employment in academia at all (e.g., Stringer et al., 2018), it is likely that the question of "staying or leaving" is not a onetime question (Wöhrer, 2014). Specifically, when opting out of academia is not perceived as easy and career opportunities outside seem to diminish with time spent in the "ivory tower" (Enders, 1996; Grönlund, 2020).

Following the well accepted notion that human behaviour is goal oriented (Opp, 2019), but acknowledging that careers' utility is not only bound to monetary rewards, but may also serve other purposes as, e.g., self-fulfilment (e.g., Gubler et al., 2014; Hall, 2004), we frame our research question within a wide version of rational choice/ subjective expected utility theory. We assume that postdocs aspire to an academic career/professorship, if they *subjectively perceive* this goal as attainable (success probability) and desirable (utility) in the face of alternatives and the associated costs (e.g., Breen & Goldthorpe, 1997; Kroneberg, 2006; Opp, 1999, 2019).

While other behavioural models that focus on attitudes (Ajzen, 1991; Ajzen & Fishbein, 1980) may be combined with wide rational choice approaches (Opp, 1999, 2019), we see a difficulty of separating attitudes from preferences/utilities, e.g., a positive attitude towards flexible work and a preference for flexible work will probably be highly confounded. Existing research on most prevalent perceived utilities and costs within academia, gives us the opportunity to include relevant control

variables while focussing on the impact of the professional social environment of postdocs, i.e., integration into the scientific community and relationship with the superior professor. However, since postdocs cannot decide whether they will achieve a professor position in academia, but can only aspire to that position, we will use intentions as dependent variables instead of actual career decisions (Ajzen, 1991; Ajzen & Fishbein, 1980).

In the empirical implementation, we follow an indirect approach of operationalizing the rational choice model. This means that we do not measure utilities, costs and subjective success probabilities directly, but derive them from theory and empirical research ("bridge assumptions"). While this approach does not allow for a direct empirical test of the theory, it is preferrable in the context of surveys, e.g., due to problems of retroactive rationalization tendencies (summarized in Brüderl, 2004).

Social capital and postdocs' career intentions (success probability)

Although there are many different theoretical approaches to social capital, theorists agree that social capital describes resources that can only be accessed through social ties: "The social capital metaphor is that people who do better are somehow better connected" (Burt, 2001, p. 32). Nahapiet and Ghoshal (1998) define social capital as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (p. 243). Social ties are therefore crucial for scientific careers, as ties to other scientists can translate into social capital and thus provide access to career-enhancing resources, such as domain-specific knowledge, career-relevant information or scientific reputation.

In this section, we discuss two types of social capital that we consider essential for postdocs' career intentions, as they affect postdocs' productivity and career success (cf. e.g. Lee & Bozeman, 2005; Wieczorek et al., 2020, Godechot, 2016): The *integration into the scientific community* and the *relationship to their superior professors.* In the next two chapters ("Scientific community integration" and "Postdocs' relationship with their superior professor"), we argue that both forms of social capital not only directly affect career success, but they also have an impact on postdocs' career intentions by affecting their *subjectively perceived success probabilities* of attaining a long-term academic career/professorship.

Scientific community integration

Integration into the scientific community is essential for postdocs' career success in academia, as academic careers evolve within scientific communities who attach prestige and recognition to individual scientists by, e.g., peer review and citations (Laudel & Gläser, 2007). Being referenced by other scientists leads to a higher visibility and increases the impact of the scientific work (Bikard et al., 2015). Moreover, research is produced by teams rather than single scientists and the average number of authors per paper has been increasing in every discipline

(Wuchty et al., 2007; Schmidt et al., 2017). Publishing with other scientists increases the visibility and impact of one's research, since more scientists can share their work with their contacts (Bikard et al., 2015). Working with other scientists also increases productivity, since social ties can give access to human capital, i.e., domain-specific knowledge and skills and/or access to needed technical resources, and encompasses more opportunities for co-authorship (Lee & Bozeman, 2005; Wieczorek et al., 2020). Consequently, the "lone scientist" may have little chance of surviving the academic pipeline (Leahey, 2016). Considering that the scientific community may increase postdocs' productivity and visibility, scientific community integration may have an impact on postdocs' career intentions and decisions by affecting their actual and *perceived success probabilities*.

Numerous studies find that social capital is related to career outcomes in academia by positively affecting research productivity (e.g., Davis, 2009; Epstein & Lachmann, 2018; Lee & Bozeman, 2005; Scaffidi & Berman, 2011; Wieczorek et al., 2020; Zubieta, 2009). Given the growing importance of collaboration in modern research (e.g., Gross & Jungbauer-Gans, 2007; Leahey, 2016), it is no surprise that social capital plays a major role in scienstists' productivity. Social capital in general has been linked to finding employment (Hadani et al., 2012; Walker & Yoon, 2016), also specifically in academic research: Walker and Yoon (2016) find that social capital is particularly important for PhD-graduates holding permanent research and teaching positions. In their study, postdocs with more professional contacts got more job opportunities. However, other studies suggest a lower relevance of social capital. Schröder et al. (2021) and Plümper and Schimmelfennig (2007) do not support that social capital impacts chances of being appointed as a professor in political science in Germany. However, Schröder et al. (2021) measure social capital indirectly via mobility, co-authors and positions as interim professors. These variables may not fully reflect the actual social capital of their respondents, nor the qualitative differences of their contacts. In Plümper and Schimmelfennig's study, social capital was nonsignificant when accounting for publications, however, they established a link between social capital and productivity. This makes it difficult to clearly distinguish between the two.

Since achieving a position is not only a result of individual decisions and goals, it is also important to consider how social capital shapes the *intentions* of postdocs. We look at intentions both as a proxy for decisions (Ajzen, 1991; Ajzen & Fishbein, 1980) and an opportunity to analyze what postdocs want, with a lower impact of what opportunity structures allow them to achieve.

H1 Positive ratings of scientific community integration are significantly and positively related to **(a)** postdocs' intentions to pursue an academic research career, and **(b)** negatively related to the intention to leave one's current job.

Postdocs' relationship with their superior professor

The extent to which resources can be mobilized depends on both access to networks and one's degree of centrality within networks (Nahapiet & Ghoshal, 1998). Professors are likely to hold more central positions (Burt, 2001) within their scientific community. Actors who hold central positions "carry more valued resources and exercise greater power" (Lin, 1999, p. 31). Specifically, superior professors may have a meaningful impact on the career trajectories of their employed postdocs since they combine several potentially career-enhancing roles: They hold a twofold powerful position as superiors with a quasi-employer function and as supervisors who evaluate scientific work. They decide about the hiring, promotion and recommendation of their postdocs (Gallas, 2018; Ullrich, 2019). In addition, superior professors influence their postdocs' careers by assigning them administrative tasks that keep them from doing research (summarized in Dorenkamp & Weiss, 2018). "[The postdoc's] career [is] highly dependent on a single professor who is responsible for work tasks, evaluations, and contract renewal and whose recommendation is often critical when the postdoc applies for a permanent position elsewhere" (Dorenkamp & Weiss, 2018, p. 750). Moreover, professors also function as gatekeepers to their scientific communities and can provide postdocs with access to their networks (Jungbauer-Gans & Gross, 2013). Therefore, professors can have a tremendous impact on their postdocs' careers – not only by providing or denying access to resources/networks and employment opportunities, but also due to the impact of their perception of their postdocs' potential and resulting encouragement or discouragement to pursue an academic career. By their degree of support, professors may affect postdocs' motivation and their *perceived success probabilities* to obtain tenure with one of the scarcely available professor positions.

Studies indicate a career-enhancing effect of a supportive relationships between postdocs and experienced scientists/professors: Davis (2009) finds that postdocs, whose supervisors write down a plan with them, submit and publish more articles and are more successful with grant proposals. Social contact to experienced scientists has further been linked to finding employment as a postdoc (Fuchs et al., 2001; Lang & Neyer, 2004; Schubert & Engelage, 2011). Lang and Neyer (2004), for instance, discover that the supervisor's productivity increases a PhD student's chances of finding a postdoc position. Social capital has also been linked to reaching tenure (Combes et al., 2008; Godechot, 2016; Lutter & Schröder, 2016). Combes et al. (2008) find that the presence of a PhD advisor in a hiring committee increases chances of success as much as having published five additional papers. Similarly, Godechot (2016) finds that the (random) presence of a PhD advisor doubles an applicant's chances of being short-listed. While effects of social capital on tenure are mixed in the German context (Jungbauer-Gans & Gross, 2013; Plümper & Schimmelfennig, 2007), differing operationalization of social capital and survivorship bias needs to be considered. Against this backdrop, we propose the following hypotheses:

H2 Positive ratings of professor relationship are significantly and positively related to **(a)** postdocs' intentions to pursue an academic research career, and **(b)** negatively related to the intention to leave one's current job.

Other influencing factors on postdocs' career intentions in the context of SEU

Social capital is not the only factor influencing postdocs' career intentions. Therefore, we present other relevant factors and subordinate them into the Subjective Expected Utility Model. The factors presented herein will be introduced as control variables in our statistic models.

Productivity/human capital (success probability)

It can be assumed that scientists perceive an academic career as attainable if they have a high level of productivity and hence human capital. While credentials do not perfectly depict the human capital of an individual, publications have become the most important signal of human capital in academia. They are the strongest predictor for achieving professorship (Plümper & Schimmelfenning, 2007; Jungbauer-Gans & Gross, 2013; Lutter & Schröder, 2016). Furthermore, PhD graduates with more publications aspire more strongly for an academic career (Epstein & Fischer, 2017). A study on postdocs in the life sciences finds that postdocs are mostly concerned about publishing as a first author for their career progress (Müller, 2012). Interviewees in the study use "drastic language" to describe the importance of publications, such as "you're dead if you don't publish well" (Müller, 2012, p. 25). In addition, the acquisition of third-party funds is an indicator for high academic ability. It indicates that one's research idea was rated positively and prevailed against competing proposals, signaling the ability to acquire third-party funds in the future which is crucial considering their important role in funding academic research (e.g., Afonso, 2016; Gross & Jungabauer-Gans, 2007). The acquisition of third-party funds has also been associated with being appointed as professor (Schröder et al., 2021).

Preferences (utility and costs)

When choosing a job, personal preferences determine whether certain aspects of the job are perceived as utility or cost. Empirical findings support that a strong preference for research activities is an important reason to pursue an academic career (e.g., Åkerlind, 2005; Roach & Sauermann, 2010; Wöhrer, 2014). With a sample of postdocs, we can assume that the majority of postdocs like the tasks associated with an academic career. Moreover, work autonomy is one main contributor to job satisfaction in academic research (e.g., Amarasena et al., 2015; Bellamy et al., 2003; Cano & Castillo, 2004; Teelken & van der Weijden, 2018). The freedom and autonomy/flexibility that academia provides in comparison to a company job may be perceived favourably. Unsurprisingly, insecure employment is one major source of job dissatisfaction in academia (e.g., Castellacci & Viñas-Bardolet, 2020; Felisberti & Sear, 2014; Teelken & van der Weijden, 2018). In addition, the duration of the postdoc

might increase perceived costs of leaving, while perceived chances of achieving tenure might decrease.

Gender (success probability and costs)

In most disciplines, women are underrepresented at the professor level. In fields with a majority of female students, like biology and medicine, the drop out from PhD to professorship is specifically high (Destatis, 2020).[2] Women in both disciplines publish fewer articles during their PhD period (Epstein & Fischer, 2017; Feldon et al., 2017), although only in medicine recent female PhDs are less interested in an academic career (Epstein & Fischer, 2017). In addition, female physicians start their specialization less often at a university hospital and base their career decisions more on family planning (Busche, 2017). Given that our sample consists of postdocs, (self-)selection processes may already have taken place at that point, since previous studies indicate that after the second thesis, women do not seem to be disadvantaged in terms of being appointed as a professor (Brodesser & Samjeske, 2015; Jungbauer-Gans & Gross, 2013; Lind & Löther, 2007; Lutter & Schröder, 2016). In theory, women may perceive lower success probabilities, and possibly higher costs when considering sacrifices such as postponing family planning.

SEU of career alternatives

In disciplines with fewer non-academic employment options, postdocs tend to stay longer in academia (Stephan & Ma, 2005). Moreover, postdocs may perceive themselves as less suitable for the non-academic job-market in comparison to PhD students (Müller, 2012). A qualitative interview study with postdocs in the social sciences supports that lacking an alternative career plan is inhibiting postdocs from leaving academia (Wöhrer, 2014).

In addition, postdocs are lacking information and career guidance in respect to the non-academic labour market. Supervisors strongly encourage a career in academic research while not being able to give advice for non-academic careers (Hayter & Parker, 2019; Puljak & Sharif, 2009; Sauermann & Roach, 2012; Teelken & van der Weijden, 2018). Leaving the academic career context and moving to another, possibly extremely different, work environment and culture might also be frightening (Blackford, 2018). While we have no information of postdocs' perceptions on alternative career paths in our dataset, we have two groups with different career chances outside of academia. While the "basic life sciences" represent a variety of disciplines and specializations, one can generally say that (PhD) graduates from those fields face problematic labour market conditions both inside and outside academia (e.g., Klöck, 2010; Jaksztat et al., 2010; Stephan, 2013;

[2] In medicine in 2019, 64 percent of students are women, but only 19.5 percent of professorships are held by women. Comparable figures can be found in biology: 65 percent of students are women and only 26 percent of professorships are held by woman (Destatis, 2020a; 2020b).

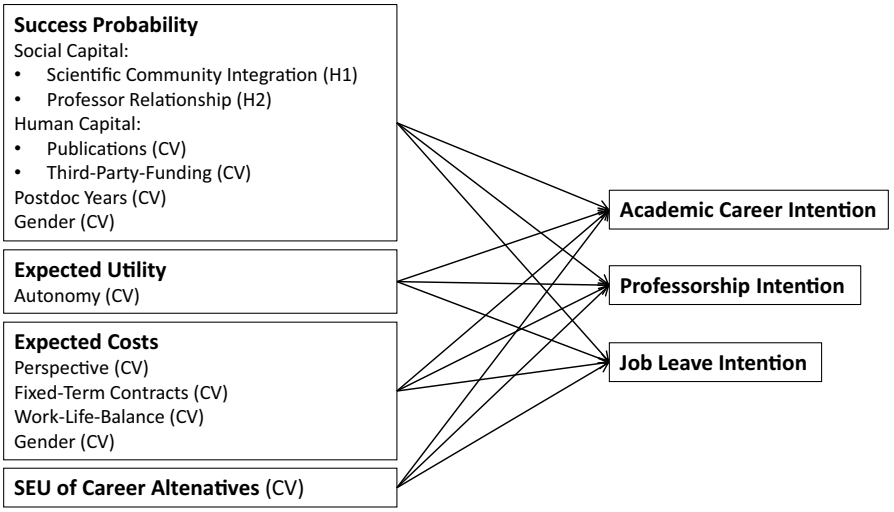

Figure 1 Conceptual framework

Plasa, 2014). However, in medicine, clinical practitioners are in high demand (Gerst & Hibbeler, 2012; Stallmach et al., 2011). Empirical evidence suggests that recent medical PhD graduates[3] in Germany are less interested in academic careers in comparison to those from the basic life sciences (Epstein & Fischer, 2017). Based on previous findings and theoretical considerations, we assume that postdocs in medicine are less interested in a long-term research career, but perceive less pressure to leave academia.

Conceptual framework

To give a brief overview of the discussed aspects that presumably affect postdocs' career intentions, we present our Conceptual Framework in Figure 1. Since our respondents were not asked directly about success probabilities, utilities and costs and their perceived career alternatives, and our data is cross-sectional, we would like to stress, that we cannot test the theoretical model empirically and thus we do not claim causality for our results.

[3] In contrast to other disciplines, medical students in Germany mostly conduct their PhD (Dr. med.) within undergraduate studies, which usually represents their first scientific thesis. The quality of the Dr. med. in comparison to a PhD in other disciplines is debated (Epstein & Fischer, 2017). The European Research Council (ERC) does not accept the Dr. med. degree as equivalent to a PhD (ERC, 2017).

The present study

The present study aims to investigate the impact that professional social capital has on postdocs' career intentions with cross-sectional survey data including postdocs from medicine and the basic life sciences. Professional social capital is operationalized by postdocs' ratings of their relationship with their superior professor and their scientific community integration. In addition, co-authorships are assessed, as they are not only an indicator of productivity but also an indicator of scientific community integration. Furthermore, they can serve as a more objective indicator of integration, i.e., indicating the *quality* of the postdocs' professional ties. Our hypotheses and control variables are derived from the perspective of a wide rational choice approach. We expect a positive and significant relationship between our measures of professional social capital and postdocs career intentions in our multivariate models.

Methods

Description of survey data

To analyze the research question, we used data from a German research project that investigated academic research careers in medicine and the basic life sciences (Epstein et al., 2020; Meuleners et al., 2020). Within the project, recent PhD graduates and postdocs from 13 medical and biological faculties from three German federal states[4] were surveyed. To explore our research questions, we combined two datasets from the project, both collected in 2018 and comprising postdocs at different career stages. The larger data set originated from a cross-sectional survey conducted with postdocs and professors, who were recruited from the websites of their universities ($N = 447$). The second dataset represents the last wave of a multicohort-panel survey with PhDs who graduated in 2013, 2014 and 2015 ($N = 395$). Both surveys were undertaken in the same year with the same target group, entailing the same questions, only the way of recruitment differed, therefore we see their combination as unproblematic. To account for the possibility of unobserved heterogeneity, i.e. systematic differences not captured by our control variables, we included a dummy variable for sample association (panel = 0 and internet recruitment = 1).

We excluded respondents who indicated to have left academia ($N = 184$). Moreover, we excluded professors ($N = 54$) and postdocs who had completed their PhD 20 years ago and more ($N = 92$). In the final sample, 53 percent of postdocs were men, 46 percent women and 1 percent diverse, 37.5 came from medicine and 63.5 percent from the basic life sciences. Years as a postdoc varied between 0 and 19.5 years with a mean of 6.5 years and a median of 5 years.

[4] Openly available email addresses of postdoctoral researchers and professors from their university websites were used. All universities with biological and medical faculties from the federal states of Bavaria, Saxonia and North Rine Westphalia were included.

Measures

The surveys were conducted in German language and are only translated for the readers of this article.

Dependent Variables: We assessed career intentions with three single items[5]: Academic Career Intention, Professorship Intention and Job Leave Intention. For the variables *Academic Career Intention* and *Professorship Intention* respondents indicated on 5-point-Likert scales to which extent they agreed or disagreed with the statements "In the long term, I would like to pursue a research career at a university or university hospital" and "In the long term, I would like to pursue professorship" (1 = completely disagree, 5 = completely agree) (cf. Table 7 in Appendix). The variable *job leave intention* included several "positive"-categories signifying different stages of changing jobs: believing that a change in jobs is worth considering, browsing through job advertisements, actively applying, already having a new job offer, and working on becoming self-employed. The "negative" category stated that respondents were not currently considering a job change. We created a dummy variable with the value "0", the negative category, and "1" for all positive categories (cf. Table 8 in Appendix).

Influencing Variables: The central influencing variable *professor relationship*, was operationalized by 13 items (5-point Likert scaled, 1 = completely disagree, 5 = completely agree). The scale was conceptualized by the researchers involved in the research project (Epstein et al., 2020; Meuleners et al., 2020). It included the disciplinary fit between postdoc and professor ("my professor is a specialist in my research field"), since a professor with a specialization too far from the postdoc can likely not be as good a mentor as someone from a more closely related field and may not be able to provide as much professional advice as someone from the same scientific community. Moreover, the scale encompasses the professors' professional support of the postdoc (e.g., "my professor is a great support in publishing), career support (e.g., "my professor talks to me about my career progression") and contact frequency (e.g., "I have regular employee interviews with my professor"), (cf. Table 5 in Appendix). An exploratory, unrotated factor analysis (minimum eigenvalue > 1), a screeplot (cf. Table 5, Figure 2 in Appendix), and Velicer's Minimal Average Partial Correlation test (MAP-test) (Velicer, 1976; Velicer et al., 2000) suggested a one-dimensional scale. We excluded items that referred to career advice outside academia (items 9 and 13), due to low factor loadings and overall approval, supporting that non-academic careers are not discussed with supervisors/professors (Åkerlind, 2005; Scaffidi & Berman, 2011). Since professors probably do not have enough expertise to give guidance for non-academic careers, these items designate neither a negative nor a positive relationship. We also excluded the item "I have regular performance reviews with my professor" (item 10). The relatively low fit of

[5] Whereas scales with multiple items are preferable when measuring complex psychological constructs, single items have a place: Bergkvist & Rossiter (2007), e.g., found that single items are adequate measures – especially if the construct being measured is narrow and concrete. In this study, single items are used for such unambiguous, concrete questions that do not reflect complex psychological constructs.

item 10 suggests that informal contact with one's professor (item 11) and the contents discussed (e.g., items 5 and 7) are more important than formal performance reviews. After excluding the described items, we summarized the remaining items into an additive index. *Scientific community integration* was operationalized with five items (5-point Likert scaled, 1 = completely disagree, 5 = completely agree) that addressed the quantity of contacts (e.g., "I know many members of my scientific community personally") but also quality of contacts (e.g., "I feel that I can always ask questions to members of my scientific community") (cf. Table 6 in Appendix) (Epstein & Lachmann, 2018). An exploratory, unrotated factor analysis (minimum eigenvalue of factors > 1), a screeplot (cf. Table 6, Figure 3 in Appendix) and Velicer's MAP-test suggested a one-dimensional scale. Items were summarized into an additive index. The variables "Scientific community integration" and "professor relationship" were barely correlated with r = 0.19.

Control Variables: We controlled for *self-reported publications as lead, co, and last author* (a key position in the life sciences, cf. Wren et al., 2007) per postdoc year[6] and controlled for the total amounts of *years as a postdoc*. Moreover, we controlled for the *successful acquisition of third-party funds* (self-reported, 0 = no, 1 = yes). In addition, we measured personal preferences in terms of *importance of work autonomy*, *importance of career prospects* and *importance of work-life balance.* Herby, we asked the respondents to rate the importance of the aspects "independent scheduling and organization of work", "long-term employment prospects", and "compatibility with family/private life" for their professional future (all assessed with 5-Point Likert scales, 1 = not important at all, 5 = very important). Because work-life-balance needs may not only vary between genders but also affect career decisions differently by gender, we included an *interaction term of gender and importance of work-life-balance*. Moreover, we controlled for *gender* (women vs. men/diverse) and *discipline* (medicine vs. basic life sciences) as well as for *permanent vs. fixed-term employment*. Since we combined two different datasets, we included a dummy variable to control for *sample association* (panel = 0 and internet recruitment = 1).

Variables not measured: The dataset did not include preferences on a task-level. Moreover, our dataset only comprised rough details on the respondents' family situation; we did not include further measures in addition to work-life-balance.

Data analysis

We carried out descriptive and bivariate analyses to investigate variable distributions and possible differences between gender and disciplines. To determine group differences, we conducted t-tests for the scale variables and chi-square tests for dummy variables. We report the results of the chi-square tests in the text only. To test our hypotheses, we carried out linear multivariate regression analyses, and logistic multivariate regression analyses when the dependent variable was dummy coded. We

[6] We set the values of those respondents who were postdocs for one year or less and reported more than five publications as lead/co/last author per year to missing. We considered such values unrealistically high.

achieved a sample size of 512 respondents within the linear multivariate regression models in which missing values were imputed. Missing values were imputed with Stata's "sem command", specifying for a full information likelihood approach (FIML) (Medeiros, 2016). By imputing missing values, 316 cases were added to the final regression model. On the level of individual variables, the maximum amount of missing values was 50 percent for the variable "professor intention" and less than 33 percent for the rest of variables. For descriptive, bivariate and logistic regression analysis, only complete cases were analyzed.

Results

Descriptive and bivariate results

In Table 1, we depict the results of the t-tests by gender and in Table 2 we show the results by discipline.

In Table 1, there are no significant differences between female and male respondents with the exception of co-authorships. Since the difference is so small, we argue it is negligible. Women and men wanted to leave their current position at comparable rates (64 and 65 percent, $chi^2 = 0.032$, $df = 1$, $p = 0.860$). There were also no significant differences in the number of fixed-term contracts (72 percent of men and 71 percent of women, $chi^2 = 0.056$, $df = 1$, $p = 0.813$). Women had acquired slightly more third-party funding (50 percent of men and 56 percent of women, $chi^2 = 1.26$, $df = 1$, $p = 0.261$).

Postdocs from the life sciences have a higher intention to pursue an academic research career, this difference is apparent in both variables assessing the intention to pursue an academic research career (cf. Table 2). Moreover, postdocs from the life sciences were better integrated into their scientific communities. Life sciences postdocs intended to leave their current position to a significantly higher extent than respondents from medicine (71 percent vs. 54 percent, $chi^2 = 11.63$, $df = 1$, $p = 0.001$). 72 percent in the basic life sciences and 68 percent in medicine were employed on fixed-term contracts ($chi^2 = 0.62$, $df = 1$, $p = 0.431$).

Respondents from the life sciences published significantly more lead and co-author articles and had more often acquired third-party funding (66 percent vs. 35 percent, $chi^2 = 34.56$, $df = 1$, $p = 0.000$). Postdocs from the basic life sciences indicated a higher importance of work autonomy and career prospects.

Multivariate results

In Table 3, we report the results of the logistic regression analyses with odds ratios (ORs) concerning the dependent variables "job leave intention". Respondents who wanted to leave their job to attain professorship were not included in this analysis. Following the recommendations of Best and Wolf (2012), we interpret the direction ($OR > 1$ positive effect, $OR < 1$ negative effect) and significance of the ORs but not effect sizes.

Table 1 Gender differences in dependent, influencing and control variables (scales)

Dependent variables	Men			Women			p value
	N	M	SD	N	M	SD	
Academic career intention	150	3.06	1.56	107	2.98	1.60	0.693
Professorship intention	150	2.52	1.58	108	2.41	1.38	0.552
Influencing variables							
Professor relationship	141	3.27	1.10	138	3.24	1.07	0.822
Scientific community integration	143	3.25	0.87	135	3.07	1.00	0.283
Control variables							
Importance of autonomy	184	4.28	0.79	166	4.32	0.66	0.547
Importance of career prospects	186	4.52	0.77	166	4.54	0.73	0.796
Importance of WLB	185	4.28	0.80	164	4.32	0.65	0.473
Publications as lead author p.a	209	0.81	0.97	175	0.79	1.24	0.642
Publications as co-author p.a	209	1.25	1.60	175	0.95	1.10	0.035
Publications as last author p.a	209	0.21	0.73	175	0.10	0.21	0.076

M Mean values and *SD* standard deviations are rounded to the second decimal place, p-values to the third decimal place, *N* number of postdocs, *WLB* work-life balance

Table 2 Disciplinary differences in dependent, influencing and control variables (scales)

Dependent variables	Basic life science			Medicine			p value
	N	M	SD	N	M	SD	
Academic career intention	145	3.58	1.47	104	2.25	1.41	0.000
Professorship intention	145	2.73	1.56	104	2.11	1.35	0.001
Influencing variables							
Professor relationship	245	3.27	1.07	84	3.08	1.13	0.178
Scientific community integration	232	3.31	0.92	79	3.06	0.89	0.023
Control variables							
Importance of autonomy	242	4.42	0.69	142	4.07	0.78	0.000
Importance of career prospects	244	4.70	0.57	143	4.33	0.87	0.000
Importance of WLB	244	4.54	0.74	141	4.63	0.68	0.237
Publications as lead author p.a	301	0.80	1.15	182	0.54	1.09	0.016
Publications as co-author p.a	301	1.11	1.41	182	0.75	1.25	0.004
Publications as last author p.a	301	0.16	0.54	182	0.11	0.59	0.073

M Mean values and *SD* standard deviations rounded to the second decimal place, p-values to the third decimal place, *N* number of postdocs, *WLB* work-life balance

Professor relationship is negatively related to the intention to leave jobs (support of Hypothesis 2b) scientific community integration is not (against Hypothesis 1b). In addition, postdocs in the fields of medicine are less inclined to leave jobs. The assessed performance variables, publications and having acquired third-party funding, are nonsignificant. Autonomy and career prospects are not related to job leave intention; however, a fixed-term contract is significantly and positively so. There are

Table 3 Logistic regression analyses, job leave intention

	Job leave intention		
	OR	SE	*p* value
Influencing variables			
Professor relationship	0.53	0.09	0.000
Scientific community integration	1.23	0.27	0.341
Control variables			
Lead author p.a	0.79	0.13	0.368
Co author p.a	1.17	0.16	0.262
Last author p.a	1.71	0.86	0.283
Third-party funding: yes	1.98	0.74	0.067
Importance of autonomy	0.62	0.18	0.094
Importance of career prospects	0.78	0.19	0.316
Importance of WLB	0.66	0.24	0.255
Women (Reference: men)	2.32	5.98	0.745
Women*WLB	0.80	0.44	0.689
Medicine (Reference: basic life sciences)	0.26	0.11	0.001
Fixed-term contract: yes	4.47	1.86	0.000
Postdoc years	0.96	0.05	0.431
Sample affiliation: internet recruitment	1.85	0.88	0.195
Constant	215.86	543	0.032
N	221		
$P > \text{chi}^2$	0.000		
Pseudo R^2	0.21		

OR Odds rations and *SE* standard errors rounded to the second decimal place, p-values to the third decimal place, *WLB* work-life balance

no significant differences between genders concerning job leave intention, including the interaction term between gender and the importance of work-life-balance. The amount of postdoc years and integration into the scientific community are not significantly related to job leave intention.

Moving to Table 4, professor relationship is positively related to academic career intentions and professorship intention, which further supports Hypothesis 2a. Scientific community integration is also significantly related to both dependent variables (support of Hypothesis 1a). There is a small significant effect of postdoc years on the intention to pursue an academic research career. Further, there is a positive significant effect of publications as lead author on the intention to pursue an academic career, and a small positive effect of co-authorships on professorship intention. We understand the latter as a network effect, with co-authorships being an objective marker for scientific community integration. There is no significant effect of publications as last author. Having received third-party funds and having a high need for autonomy are only positively related to professorship intention. The importance of work-life-balance has a significant, negative effect on the intention to pursue an academic career and the intention to pursue professorship. Postdocs with a background

Table 4 Multivariate regression analyses, academic career intention and professorship intention

	Academic Career Intention			Professorship Intention		
	ß	SE	*p*	ß	SE	*p*
Influencing variables						
Professor relationship	0.42	0.07	0.000	0.28	0.08	0.000
Scientific community integration	0.25	0.11	0.024	0.23	0.11	0.035
Control variables						
Lead author p.a	0.26	0.13	0.037	0.21	0.13	0.102
Co author p.a	0.07	0.06	0.201	0.14	0.06	0.015
Last author p.a	0.11	0.19	0.543	0.13	0.16	0.425
Third-party funding: yes	0.16	0.17	0.357	0.50	0.18	0.005
Importance of autonomy	0.20	0.11	0.064	0.26	0.11	0.019
Importance of career prospects	0.11	0.10	0.239	0.06	0.10	0.565
Importance of WLB	-0.25	0.13	0.049	-0.42	0.14	0.003
Women (Reference: men)	0.74	1.05	0.480	-0.45	1.11	0.686
Women*WLB	-0.19	0.22	0.388	0.09	0.24	0.712
Medicine (Reference: basic life sciences)	-0.26	0.18	0.158	0.39	0.19	0.041
Fixed-term contract: yes	0.18	0.17	0.299	0.27	0.17	0.120
Postdoc years	0.05	0.02	0.037	0.01	0.02	0.631
Sample affiliation: internet recruitment	0.70	0.20	0.000	0.57	0.02	0.631
N	512			512		
R^2	0.49			0.39		

ß Coefficients and *SE* standard errors rounded to the second decimal place, *p* values to the third decimal place, missing values replaced by full maximum likelihood estimation, *WLB* work-life balance

in medicine are more inclined to pursue professorship. However, there are no significant differences between the disciplines when it comes to the intention to pursue an academic career in the multivariate model. The control variable for sample affiliation shows that the respondents who were recruited from the websites of their university are significantly more inclined to pursue an academic research career.

Discussion

The results of our study suggest, that social capital does not only directly impact postdocs career success (e.g., Davis, 2009; Hadani et al., 2012; Lee & Bozeman, 2005; Scaffidi & Berman, 2011; Zubieta, 2009), but has the potential to alter their career trajectories by shaping their ambitions. Studies who solely focus on the impact of social capital on being appointed as a professor (e.g., Plümper & Schimmelpfennig, 2007) do not capture the effects of social capital at different career stages and the indirect effect it has on career trajectories by affecting career intentions and presumably decisions. Due to the special status of the professor, the primary goal of our study was to investigate the link between postdocs' relationship with their superior professor and their career intentions. As we expected, postdocs

with higher professor relationship ratings reported higher academic career and professorship intentions. They were also less inclined to leave their current position. Since the data analyzed are cross-sectional, we cannot rule out that postdocs with high aspirations build a better relationship with their professors. Theoretically, a reciprocal relationship is conceivable. Longitudinal data on postdocs may reveal more about the direction of those correlations, but also qualitative data may be helpful to understand the mechanisms behind them. Following the rationale of SEU theories, we assumed that this would be the case because a positive relationship with the professor would affect postdocs' subjective probabilities of success with respect to an academic career. We were not able to test this theoretical mechanism with the present data. Apart from the professor relationship, the integration into the scientific community was also significantly related to academic career and professorship intention. Further, co-authorships were significantly related to the intention to pursue a professorship. Co-authorships may be a better parameter for the quality of scientific community integration. Integration into the scientific community that does pay off in terms of a longer publication record may be specifically relevant to postdocs' career intentions and specifically important if postdocs aspire to professorship.

With respect to utilities and costs, we supported the preference of work autonomy for academic scientists (Amarasena et al., 2015; Bellamy et al., 2003; Cano & Castillo, 2004; Teelken & van der Weijden, 2018). A high need for autonomy was significantly related the intention to pursue an academic career and professorship. Our results further show that postdocs from both disciplines highly agree that work-life balance is important to them. The negative association between the importance of work-life-balance and intentions to pursue an academic research career and professorship suggest that postdocs perceive this aspect rather as a cost of the academic career path. This is no surprise, considering the "publish or perish mentality" in academic research and the competition for the few permanent positions the system has to offer (e.g., Afonso, 2016). While the importance of career prospects received high approval, it did not have the expected negative effects on career intentions. These results may reflect perceived career alternatives of postdocs: while academia lacks long-term employment opportunities/career prospects, postdocs may fear a lack of alternatives (Müller, 2012). Moreover, postdocs on fixed-term contracts, approx. 70 percent, had higher job leave intentions.

Our results suggest a small positive association between the postdoc duration and academic career intention, possibly because postdocs with these career goals will work for them more persistently but may also perceive limited career alternatives over time.

Looking at objective performance variables, publications were significantly related to academic career and professorship intentions. Other measures of publication quality and visibility (e.g., citations) might be even better measures of academic productivity and were not available here. The reception of third-party funding was also positively related to the intention to pursue professorship. Postdocs who have successfully acquired third-party funding probably have higher chances to apply successfully for a position as professor, as it has already been shown in political sciences (Lutter and Schröder, 2021).

We found no meaningful gender differences in our sample. Since our data comprised postdocs at different career stages, we cannot rule out that gender differences

exist, e.g., in the early postdoc stage as previously shown (e.g., Epstein & Fischer, 2017). We further did not analyze gender effects within the different disciplines in order to keep our sample size big enough. Different disciplinary cultures could affect career decisions differently by gender. Our data also did not comprise details about the respondent's family situation, it is possible that our sample is not representative in this respect and that our female respondents are less burdened by family duties than the average. As we measured intentions rather than behaviour, we do not know how the assessed variables will affect the "final" career decisions and outcomes for women and men. This is a question for future research.

Postdocs in medicine had significantly lower ratings on many of the independent variables: i.e., importance of career prospects and autonomy, integration into the scientific community and publications as lead and co-author. These results are not surprising, considering that postdocs in medicine are usually very engaged with patient care. Since physicians in university hospitals are embedded in a larger health care team and must rely on the specific expertise of other health professionals, autonomy may be less crucial to them. In addition, they may for example cooperate with basic life scientists who conduct the laboratory work for their research.

Postdocs from medicine have no reason to fear for their future employment, hence, it is clear why they rated the importance of career prospects lower. The same interpretation applies to their lower job leave intention. While postdocs from medicine had lower academic career and professorship intentions on the bivariate level, this was not the case in the multivariate models. Their intention to pursue professorship was even higher here. This result may support that postdocs in medicine do not pursue a traditional professorship but an extraordinary professorship, which is equivalent to an honorary title but not a professor position at the university. In line with our results, a study conducted by Sorg et al. (2016) finds that physicians mostly pursue a Habilitation (second thesis) to advance their clinical careers and to a lesser extent to achieve a position as professor (Sorg et al., 2016). Acquiring societal prestige and climbing up the clinical career ladder may be a more important aspect here than being a scientist. However, more data is needed to support this claim.

Limitations

As already discussed, the data of this study is cross-sectional and therefore is limited with respect to the prediction of actual future behaviour and with respect to the direction and causality of correlations. Moreover, actual behaviour is not only influenced by intentions but also the opportunity structures of the respondent, i.e. career alternatives, career opportunities in academic research, career decisions based on the family situation, the willingness to move etc. While our study incorporated aspects of the quality of social capital, there is potential in capturing these aspects more deeply. Qualitative research for instance could help to get a deeper insight into how superior professors support their postdocs and how it affects them.

Further, we only investigated the impact of professional social capital. Social capital outside the workplace, e.g., resources and support by the family, may also be important for career development. For instance, if the postdoc's close family/spouse

expects her or him to provide a stable and secure income, this could push postdocs away from academia.

With respect to human capital, our study included publications and self-acquired third-party funds. In addition, other human capital, such as specific knowledge and skills, may also affect postdocs' career chances but were not included in the survey. Further, our results may not be directly transferable to other disciplines; however, we argue that the structure of academia is similar in most disciplines. Differences may occur e.g., due to different labour market structures and opportunities. In addition, our results apply to a context of high job insecurity of postdocs. Postdocs who work in contexts in which a permanent position is more attainable and does not require switching universities, such as for instance in France or Spain (Afonso, 2016), may not be as dependent on their professional social ties to secure a permanent position. In this context, comparative research could yield interesting results.

As mentioned in the section entitled "Postdoc's Career Intentions in the Light of Subjective Expected Utility (SEU)", we used an indirect approach to operationalize our theoretical frame, a wide rational choice approach. Our results are not a direct test of the theory but rather a test of our theoretically and empirically derived bridge hypotheses (cf. Brüderl, 2004). Experimental studies/vignette studies may be a possibility for a direct test of the theory in the setting of an academic career, including our postulated link between social capital and subjective success probabilities.

Practical implications

Our results have implications for career strategy of postdocs on the individual level: to choose professional ties that are beneficial to their productivity. Moreover, when choosing a position, postdocs should take into consideration the supportive nature of their superior professor. Building a network that entails other professors in one's research area may also be beneficial, to reduce dependency on one person. In order to increase their integration into the scientific community postdocs should actively attend congresses and approach experienced researchers from their community and initiate collaboration.

However, postdocs should not be left alone with this task. More institutionalized, structured and meaningful career support for postdocs and early career scientists that is not bound to their superior seems necessary. This support should entail help to build a professional network supportive of one's career goals. In addition, professors may not always be aware of the impact they have on their postdocs' career trajectories. In addition, even if they are aware, they may not be prepared to support their postdocs optimally. In this sense, it would be desirable to better support and train professors in their role as mentors.

Since work-life-balance was an aspect that received high approval among the study participants, the culture of academia might have to change in order to attract young generations who are not willing to sacrifice large amounts of their private life. Our results also stress the need for better long-term career prospects in (German) academia. As other studies have stressed, insecure employment is an important factor for job dissatisfaction in academia (e.g., Castellacci

& Viñas-Bardolet, 2020; Felisberti & Sear, 2014; Teelken & van der Weijden, 2018). The respondents in our sample rated long-term career prospects as very important for their career. However, these are currently lacking for the vast majority. Better and securer long-term prospects may further diminish the impact of superiors on postdocs' career intentions and may give postdocs more independence with respect to their career planning.

Appendix

See Figures 2 and 3.

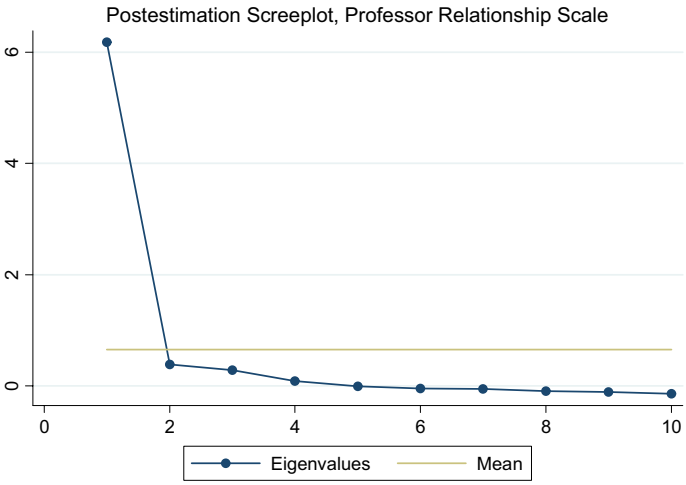

Figure 2 Postestimation Screeplot, Professor Relationship Scale

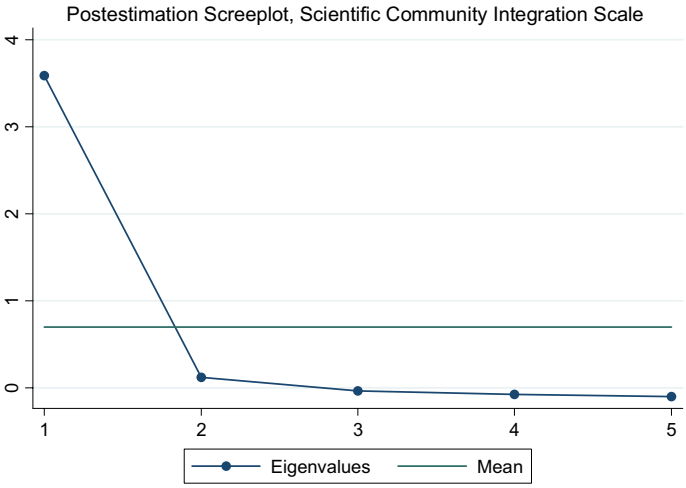

Figure 3 Postestimation Screeplot, Scientific Community Integration Scale

Measures: influencing variables

Tables 5 and 6.

Table 5 Factor analysis professor relationship Scale

	Factor loadings	Uniqueness
Item 1: I see my professor as a mentor	0.82	0.33
Item 2: My professor is a specialist in my research field	0.64	0.59
Item 3: My professor is a great support in publishing	0.81	0.35
Item 4: I have a good relationship to my professor	0.74	0.45
Item 5: My professor talks with me about publication strategies	0.87	0.24
Item 6: My professor conveys me the importance of a publication strategy	0.84	0.30
Item 7: My professor talks with me about my career progression	0.88	0.23
Item 8: My professor talks with me about my career options within academia	0.83	0.32
(Item 9: My professor talks with me about my career options outside of academia)	0.49	0.76
(Item 10: I have regular employee interviews with my professor)	0.57	0.67
Item 11: I have regular informal conversations with my professor	0.73	0.47
Item 12: My professor recommends me to keep pursuing an academic research career	0.63	0.60
(Item 13: My professor recommends me to pursue a career outside of academia)	0.19	0.96

Principal factor analysis, unrotated, numbers rounded to the second decimal place, items in brackets were excluded from the final scale, English translation of the original German items, $N = 334$

Table 6 Scientific community integration

	Factor loadings	Uniqueness
Item 1: I know many members of my scientific community personally	0.88	0.23
Item 2: Many members of my scientific community know me	0.92	0.17
Item 3: I have feel as a part of my scientific community	0.88	0.23
Item 4: I feel that my scientific community takes me seriously	0.83	0.31
Item 5: I feel that I can always ask questions to members of my scientific community	0.68	0.54

Principal factor analysis, unrotated, numbers rounded to the second decimal place, items in brackets were excluded from the final scale, English translation of the original German items, $N = 330$

Measures: dependent variables

Tables 7 and 8.

Table 7 Academic career and professorship intention

Please indicate the extent to which you agree or disagree with the statement for the following aspects In the long-term, I would like to… *(1 = completely disagree, 5 = completely disagree)*
… pursue a research career at a university or university hospital
… pursue professorship

Table 8 Job leave intention

Which of the following statements apply to you? (applies/does not apply)	
I am currently informing myself about job offers	+
I am currently actively applying for a job	+
I have a (new) job in prospect. / I will soon start a (new) job	+
A change of job is possible for me in principle, even if I am not making a specific effort to do so at the moment	+
A change of job is out of the question for me for the time being	−
I am currently building up a self-employed/freelance activity	+

The "positive "-categories signifies different stages of changing jobs (+) and the "negative"-category (−) states that respondents currently do not consider changing jobs. We created a dummy variable with the value "0" the "negative"-category and "1" for all "positive"-categories

Acknowledgements We would like to thank Dr. Maike Reimer for her constant support and advice. We would like to thank Helen Panzer for proofreading our manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL.

Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

Ethical approval The study was approved by the ethical committee of the LMU Klinikum, ethics approval numbers: 368-14 and 19-332.

References

Afonso, A. (2016). Varieties of academic labor markets in Europe. *PS Political Science & Politics, 49*(4), 816–821. https://doi.org/10.1017/S1049096516001505

Åkerlind, G. (2005). Postdoctoral researchers: Roles, functions and career prospects. *Higher Education Research & Development, 24*(1), 21–40. https://doi.org/10.1080/0729436052000318550

Amarasena, T. S. M., Ajward, A. R., & Ahasanul Haque, A. K. M. (2015). The effects of demographic factors on job satisfaction of university faculty members in Sri Lanka. *International Journal of Academic Research and Reflection, 3*(4), 89–106.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.

Bellamy, S., Morley, C., & Watty, K. (2003). Why business academics remain in Australian universities despite deteriorating working conditions and reduced job satisfaction: An intellectual puzzle. *Journal of Higher Education Policy and Management, 25*(1), 13–28. https://doi.org/10.1080/1360080032000305740

Bergkvist, L., & Rossiter, J. R. (2007). The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research, 44*(2), 175–184. https://doi.org/10.1509/jmkr.44.2.175

Best, H., & Wolf, C. (2012). Modellvergleich und Ergebnisinterpretation in Logit- und Probit-Regressionen [Comparing nested models and interpreting results from logit and probit regression]. *KZfSS Kölner Zeitschrift für Soziologie Und Sozialpsychologie, 64*(2), 377–395. https://doi.org/10.1007/s11577-012-0167-4

Bikard, M., Murray, F., & Gans, J. S. (2015). Exploring trade-offs in the organization of scientific work: Collaboration and scientific reward. *Management Science, 61*(7), 1473–1495. https://doi.org/10.1287/mnsc.2014.2052

Blackford, S. (2018). Harnessing the power of communities: Career networking strategies for bioscience PhD students and postdoctoral reasearchers. *FEMS Microbioloby Letters*. https://doi.org/10.1093/femsle/fny033

Bourdieu, P. (1983). Ökonomisches Kapital, kulturelles Kapital, soziales Kapital [Economic capital, cultural capital, social capital]. In R. Kreckel (Ed.), *Soziale ungleichheiten* (pp. 183–198). https://doi.org/10.1007/978-3-531-18944-4_15

Breen, R., & Goldthorpe, J. H. (1997). Explaining educational differentials: Towards a formal rational action theory. *Rationality and Society, 9*(3), 275–305. https://doi.org/10.1177/104346397009003002

Brodesser, D., & Samjeske, K. (2015). Professorinnenanteile - *Entwicklung und Szenarien für Vergangenheit und Zukunft [Proportions of female professors - development and scenarios for past and future]*. (GESIS Papers, 2015/21). Köln: GESIS - Leibniz-Institut für Sozialwissenschaften. https://doi.org/10.21241/ssoar.46216

Burt, R. S. (2001). Structural Holes versus Network Closure as Social Capital. In N. Lin, K. S. Cook, & R. S. Burt (Eds.), *Social capital: Theory and research* (pp. 31–56). Transaction Publishers. https://doi.org/10.4324/9781315129457

Busche. (2017). *Projekt KarMed. Kurzfassung der Ergebnisse*. Retrieved from December 21, 2020, from http://tinyurl.com/vwwsj6fr

Cano, J., & Castillo, J. (2004). Factors explaining job satisfaction among faculty. *Journal of Agricutural Education, 45*(3), 65–74.

Castellacci, F., & Viñas-Bardolet, C. (2020). Permanent contracts and job satisfaction in academia: evidence from European countries. *Studies in Higher Education*. https://doi.org/10.1080/03075079.2019.1711041

Coleman, J. S. (1990). *Foundation of social theory*. Harvard University Press

Combes, P. P., Linnemer, L., & Visser, M. (2008). Publish or peer-rich? The role of skills and networks in hiring economics professors. *Labour Economics, 15*(3), 423–441. https://doi.org/10.1016/j.labeco.2007.04.003

Davis, G. (2009). Improving the postdoctoral experience: An empirical approach. In: *Science and engineering careers in the United States: An analysis of markets and employment* (pp. 99–127).

Demary, V., & Koppel, O. (2013). Der Arbeitsmarkt für Humanmediziner und Ärzte in Deutschland: Zuwanderung verhindert Engpässe [The Labor Market for Human Physicians and Doctors in Germany: Immigration Prevents Bottlenecks]. *IW-Trends-Vierteljahresschrift zur empirischen Wirtschaftsforschung*, *40*(3), 47–62. https://doi.org/10.2373/1864-810X.13-03-04

Destatis (Statistisches Bundesamt). (2020a). *Personal an Hochschulen*. [University staff]. Retrieved from https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Publikationen/Downloads-Hochschulen/personal-hochschulen-2110440197004.pdf?_blob=publicationFile

Destatis. (2020b). *Studierende an Hochschulen* [University students]. Retrieved from December 27, 2020, from https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/

Hochschulen/Publikationen/Downloads-Hochschulen/studierende-hochschulen-endg-2110410207004.pdf?_blob=publicationFile.

Dorenkamp, I., & Weiß, E.-E. (2018). What makes them leave? A path model of postdocs' intentions to leave academia. *Higher Education, 75*(5), 747–767. https://doi.org/10.1007/s10734-017-0164-7

Epstein, N., & Fischer, M. (2017). Academic career intentions in the life sciences: Can research self-efficacy beliefs explain low numbers of aspiring physician and female scientists? *PLoS ONE, 12*(9), e0184543. https://doi.org/10.1371/journal.pone.0184543

Epstein, N., Heuser, S., & Fischer, M. (2020). *Einflussfaktoren auf die Karriere Promovierter in den Lebenswissenschaften (E-Prom 2): Teilprojekt Klinikum der Universität München [Career influencing factors for postdocs in the life scienes (E-Prom 2)*: Subproject at the LMU Klinikum], Institut für Didaktik und Ausbildungsforschung in der Medizin [Influence of the doctoral phase on the career development of young scientists in medicine and the life sciences, cohort 1 (E-Prom). (project report).

Enders, J. (1996). *Die wissenschaftlichen Mitarbeiter: Ausbildung*. Beschäftigung und Karriere der Nachwuchswissenschaftler und Mittelbauangehörigen an den Universitäten. [The academic staff: training, employment, and careers of junior and mid-level faculty at universities.]

European Research Council (ERC). (2017). *ERC Work Programme 2017*. Retrieved December 21, 2020, from https://erc.europa.eu/sites/default/files/document/file/ERC-Work-Programme-2017.pdf

Epstein, N., & Lachmann, D. (2018). Gender inequity during the Ph.D: Females in the life sciences benefit less from their integration into the scientific community. *Social Sciences, 7*(8), 140. https://doi.org/10.3390/socsci7080140

Feldon, D. F., Peugh, J., Maher, M. A., Roksa, J., & Tofel-Grehl, C. (2017). Time-to-credit gender inequities of first-year PhD students in the biological sciences. *CBE Life Sciences Education, 16*(1), ar4. https://doi.org/10.1187/cbe.16-08-0237

Felisberti, F. M., & Sear, R. (2014). Postdoctoral researchers in the UK: A snapshot at factors affecting their research output. *PLoS ONE, 9*(4), e93890. https://doi.org/10.1371/journal.pone.0093890

Fuchs, S., Von Stebut, J., & Allmendinger, J. (2001). Gender, science, and scientific organizations in Germany. *Minerva, 39*(2), 175–201. https://doi.org/10.1023/a:1010380510013

Gallas, A. (2018). Precarious Academic Labor in Germany: Termed Contracts and New Berufsverbot. *Academic Labor: Research and Artistry, 2*, Article 8.

Gerst, T., & Hibbeler, B. (2012). Klinische Forschung: Ärztemangel im Labor [Clinical research: shortage of physicians in the laboratory]. *Dtsch Arztebl*, *109* (37).

Godechot, O. (2016). The chance of influence: A natural experiment on the role of social capital in faculty recruitment. *Social Networks, 46*, 60–75. https://doi.org/10.1016/j.socnet.2016.02.002

Gross, C., & Jungbauer-Gans, M. (2007). Erfolg durch Leistung? Ein Forschungsüberblick zum Thema Wissenschaftskarrieren [Success through achievement? A research overview on the topic of academic careers]. *Soziale Welt*, 453–471.

Grönlund, A. (2020). Having it all, or avoiding black holes? Career–family strategies and the choice between leaving or staying in academia among Swedish PhDs. *Community, Work & Family, 23*(5), 576–592. https://doi.org/10.1080/13668803.2020.1777090

Gubler, M., Arnold, J., & Coombs, C. (2014). Reassessing the protean career concept: Empirical findings, conceptual components, and measurement. *Journal of Organizational Behavior, 35*(S1), 23–40. https://doi.org/10.1002/job.1908

Hadani, M., Coombes, S., Das, D., & Jalajas, D. (2012). Finding a good job Academic network centrality and early occupational outcomes in management academia. *Journal of Organizational Behavior, 33*(5), 723–739. https://doi.org/10.1002/job.788

Hall, D. T. (2004). The protean career: A quarter-century journey. *Journal of Vocational Behavior, 65*(1), 1–13. https://doi.org/10.1016/j.jvb.2003.10.006

Hayter, C., & Parker, M. (2019). Factors that influence the transition of university postdocs to non-academic scientific careers: An exploratory study. *Research Policy, 48*(3), 556–570. https://doi.org/10.1016/j.respol.2018.09.009

Jaksztat, S., Schindler, N., & Briedis, K. (2010). Wissenschaftliche Karrieren [Academic Careers]. In: *Beschäftigungsbedingungen, berufliche Orientierungen und Kompetenzen des wissenschaftlichen Nachwuchses. HIS: Forum Hochschule* (Vol. 14, pp. 235–258).

Jungbauer-Gans, M., & Gross, C. (2013). Determinants of success in university careers: findings from the German Academic Labor Market. *Zeitschrift Für Soziologie, 42*, 74–92.

Klöck, G. (2010). Berufschancen für Bachelor und Master in der Biologie: Mehr als Praktikum oder Pharmaberater? [Career opportunities for bachelor's and master's degrees in biology: More than

internship or pharmaceutical consultant?*] Biologie in Unserer Zeit, 40*(6), 375–376. https://doi.org/10.1002/biuz.201090094

Kreckel, R. (2016). Zur Lage des wissenschaftlichen Nachwuchses an Universitäten: Deutschland im Vergleich mit Frankreich, England, den USA und Österreich [On the situation of junior academics in universities. Germany in comparison with France, England, the USA, and Austria]. *Beiträge Zur Hochschulforschung, 38*(1–2), 12–40.

Kreckel, R. (2017). University career models and international staff mobility. Germany, France, Great Britain, USA and Russia Compared. In: European Economics: Labor & Social Conditions eJournal, Vol. 11, No. 38. Retrieved from https://ssrn.com/abstract=2924590. https://doi.org/10.2139/ssrn.2924590

Kroneberg, C. (2006). The definition of the situation and variable rationality: The model of frame selection as a general theory of action. *Rationalitätskonzepte, Entscheidungsverhalten und ökonomische Modellierung*, *6*.

Lang, F. R., & Neyer, F. J. (2004). Kooperationsnetzwerke und Karrieren an deutschen Hochschulen [Networks of cooperation and career opportunities in German Universities]. *Der Weg Zur Professur Am Beispiel Des Faches Psychologie, Kölner Zeitschrift Für Soziologie Und Sozialpsychologie, 56*, 520–538. https://doi.org/10.1007/s11577-004-0076-2

Laudel, G., & Gläser, J. (2007). From apprentice to colleague: The metamorphosis of early career researchers. *Higher Education, 55*, 387–406. https://doi.org/10.1007/s10734-007-9063-7

Leahey, E. (2016). From sole investigator to team scientist: Trends in the practice and study of research collaboration. *Annual Review of Sociology, 42*, 81–100. https://doi.org/10.1146/annurev-soc-081715-074219

Lee, S., & Bozeman, B. (2005). The impact of research collaboration on scientific productivity. *Social Studies of Science, 35*(5), 673–702. https://doi.org/10.1177/0306312705052359

Lin, N. (1999). Building a network theory of social capital. *Connections, 22*(1), 28–51. https://doi.org/10.4324/9781315129457

Lind, I., & Löther, A. (2007). Chancen für Frauen in der Wissenschaft–eine Frage der Fachkultur? Retrospektive Verlaufsanalysen und aktuelle Forschungsergebnisse. [Opportunities for women in science-a question of subject culture? Retrospective analyses of progress and current research results.] *Schweizerische Zeitschrift Für Bildungswissenschaften, 29*(2), 249–272.

Lutter, M., & Schröder, M. (2016). Who becomes a tenured professor, and why? Panel data evidence from German sociology, 1980–2013. *Research Policy, 45*(5), 999–1013. https://doi.org/10.1016/j.respol.2016.01.019

Medeiros, R. (2016). Handling missing data in Stata: Imputation and likelihood-based approaches. 2016 Swiss Stata Users Group meeting. Retrieved July 08, 2022, from www.stata.com/meeting/switzerland16/slides/medeiros-switzerland16.pdf

Meuleners, J., Eberle, J., Flores, P., & Neuhaus, B. (2020). *Einflussfaktoren auf die Karriere Promovierter in den Lebenswissenschaften (E-Prom 2): Teilprojekt Biologiedidaktik – E-Prom-LMU Biologie [Factors influencing the career of PhD students in the life sciences (E-Prom 2): Subproject Biology Didactics - E-Prom-LMU Biology]*. Project report.

Müller, R. (2012). Collaborating in Life Science Research Groups: The question of authorship. *Higher Education Policy, 25*, 289–311.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review, 23*(2), 242. https://doi.org/10.5465/amr.1998.533225

Opp, K. D. (1999). Contending conceptions of the theory of rational action. *Journal of Theoretical Politics, 11*(2), 171–202. https://doi.org/10.1177/0951692899011002002

Opp, K. D. (2019). Can attitude theory improve rational choice theory or vice versa? In J. Mayerl, T. Krause, A. Wahl & M. Wuketich (Eds.), *Einstellungen und Verhalten in der empirischen Sozialforschung* (pp. 65–95). Springer VS. https://doi.org/10.1007/978-3-658-16348-8_4

Plasa, T. (2014). Studienbedingungen und Berufseinstieg in der Biologie [Study conditions and career entry in biology]. *Biologie in Unserer Zeit, 44*(6), 364–366. https://doi.org/10.1002/biuz.201490091

Plümper, T., & Schimmelfennig, F. (2007). Wer wird Prof – und wann? Berufungsdeterminanten in der deutschen Politikwissenschaft [Who becomes professor — And when? Determinants of professorial recruitment in German Political Science.] *Politische Vierteljahresschrift, 48*, 97–117. https://doi.org/10.1007/s11615-007-0008-7

Puljak, L., & Sharif, W. (2009). Postdocs' perceptions of work environment and career prospects at a US academic institution. *Research Evaluation, 18*(5), 411–415. https://doi.org/10.3152/095820209X483064

Richter, C., & Reul, C. (2016). Nicht mit- und nicht ohneeinander: Professor_innen, Spezialist_innen und die institutionalisierte Ambiguität der Nachwuchsförderung [Not with and not without each other: professors, specialists and the institutionalized ambiguity of promoting young researchers]. In J. Reuter, O. Berli, & M. Zinnbauer (Eds.), *Wissenschaftliche Karriere als Hasard* (pp. 313–336). Campus Verlag.

Roach, M., & Sauermann, H. (2010). A taste for science? PhD scientists' academic orientation and self-selection into research careers in industry. *Research Policy, 39*(3), 422–434. https://doi.org/10.1016/j.respol.2010.01.004

Sauermann, H., & Roach, M. (2012). Science PhD career preferences: Levels, changes, and advisor encouragement. *PLoS ONE, 7*(5), e36307. https://doi.org/10.1371/jounal.pone.0036307

Scaffidi, A., & Berman, J. (2011). A positive postdoctoral experience is related to quality supervision and career mentoring, collaborations, networking and a nurturing research environment. *Higher Education, 62*, 685–698. https://doi.org/10.1007/s10734-011-9407-1

Schmidt, M., Fecher, B., & Kobsda, C. (2017). *How many authors does it really need to write a paper?* Retrieved from http://elephantinthelab.org/factory-science/. https://doi.org/10.5281/zenodo.818231

Schubert, F., & Engelage, S. (2011). Wie undicht ist die Pipeline? Wissenschaftskarrieren von promovierten Frauen. [How leaky is the academic pipeline for female PhDs in Switzerland?] *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie, 63*(3), 431. https://doi.org/10.1007/s11577-011-0144-3

Schröder, M., Lutter, M., & Habicht, I. M. (2021). Publishing, signaling, social capital, and gender: Determinants of becoming a tenured professor in German political science. *PLoS ONE, 16*(1), e0243514. https://doi.org/10.1371/journal.pone.0243514

Sorg, H., Betzler, C., Grieswald, C., Schwab, C., Tilkorn, D., & Hauser, J. (2016). Die medizinische Habilitation: Akademische Befähigung oder Karriereinstrument? [The medical habilitation: Academic qualification or career instrument] *Chirurg, 87*, 520–527. https://doi.org/10.1007/s00104-015-0131-8

Stallmach, A., Bauer, M., Witte, O. W., & Siegmund, B. (2011). Strategien zur Sicherung des wissenschaftlichen Nachwuchses [Strategies for securing the next generation of scientists.] *Deutsches Ärzteblatt, 108*(8), 380.

Stephan, P. (2012). Perverse incentives. *Nature, 484*(7392), 29–31.

Stephan, P. (2013). How to exploit postdocs. *BioScience, 63*(4), 245–246. https://doi.org/10.1525/bio.2013.63.4.2

Stephan, P., & Ma, J. (2005). The increased frequency and duration of the postdoctorate career stage. *American Economic Review, 95*(2), 71–75. https://doi.org/10.1257/000282805774669619

Stringer, R., Smith, D., Spronken-Smith, R., & Wilson, C. (2018). "My entire career has been fixed term": Gender and precarious academic employment at a New Zealand university. *New Zealand Sociology, 33*(2), 169–201.

Teelken, C., & van der Weijden, I. (2018). The employment situation and career prospects of postdoctoral researchers. *Employee Relations, 40*(2), 396–411. https://doi.org/10.1108/ER-12-2016-0241

Ullrich, P. (2019). In itself but not yet for itself: Organising the New Academic Precariat. In: W. Baier, E. Canepa & H. Golemis (Eds.), *The radical left in Europe: Rediscovering hope* (pp. 155–168). The Merlin Press. https://doi.org/10.14279/depositonce-856

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika, 41*(3), 321–327. https://doi.org/10.1007/BF02293557

Velicer, W. F., Eaton, C. A., & Fava, J. L. (2000). *Construct explication through factor or component analysis: A review and evaluation of alternative procedures for determining the number of factors or components. Problems and Solutions in Human Assessment* (pp. 41–71): Springer. https://doi.org/10.1007/BF02293557

Walker, J., & Yoon, E. (2016). Becoming an academic. The role of doctoral capital in the field of education. *Higher Education Research & Development, 36*(2), 401–415. https://doi.org/10.1080/07294360.2016.1207616

Weber, M. (1919). *Geistige Arbeit als Beruf: Wissenschaft als Beruf. [Intellectual work as a profession: science as a profession.]* Duncker und Humblot.

Wieczorek, O. J., Wittek, M., & Heiberger, R. H. (2020). Being published successfully or getting arXived? The importance of social capital and interdisciplinary collaboration for getting printed in a high impact journal in Physics. arXiv:2006.02148. https://doi.org/10.48550/arXiv.2006.02148

Wöhrer, V. (2014). To stay or to go? Narratives of early-stage sociologists about persisting in academia. *Higher Education Policy, 27*, 469–487. https://doi.org/10.1057/hep.2014.22

Wren, J. D., Kozak, K. Z., Johnson, K. R., Deakyne, S. J., Schilling, L. M., & Dellavalle, R. P. (2007). The write position: A survey of perceived contributions to papers based on byline position and number of authors. *EMBO Reports, 8*(11), 988–991. https://doi.org/10.1038/sj.embor.7401095

Wuchty, S., Jones, B. F., & Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science (new York, n.y.), 316*(5827), 1036–1039. https://doi.org/10.1126/science.1136099

Zubieta, A. (2009). Recognition and weak ties: Is there a positive effect of postdoctoral position on academic performance and career development? *Research Evaluation, 18*(2), 105–115. https://doi.org/10.3152/095820209X443446