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Original Article

# Well-Being of Early-Career Researchers: Insights from a Swedish Survey

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Several studies have documented the importance of optimal work situation and the general well-being of early-career researchers (ECRs) for enhancing the academic performance of universities. Yet, most studies focused on specific categories of ECRs, or on specific academic disciplines as well as on specific outcomes. With this study, we recognize the need for a broader sample encompassing different categories of ECRs across academic disciplines. In a national survey of Swedish universities, the National Junior Faculty of Sweden (NJF) collected data from ECRs in order to study the influence of work situation and well-being on perceived scientific environment. We observed that work situation and well-being are interdependent and jointly influence each other in shaping the conditions for ideal scientific environment. Importantly, we employ structural equation model (SEM) analysis to account for the endogenous relationship between work situation and personal well-being in predicting perceived scientific environment. Results from SEM indicate that support from the university, work time management, job clarity, contract length and quality of life satisfaction were related to the perceived possibility of conducting the best science. Our research also highlighted

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individual differences across demographic factors and contract length in the perceived work situation and the possibility of conducting the best science.
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## Introduction

An early-career researcher (ECR) is defined as a PhD holder who has not yet a tenure position and is typically considered to be between 1 and 7 years following PhD completion. However, as more PhD researchers are educated each year, academic institutions struggle to provide clear and secure career paths (Sauermann and Roach, 2016), potentially leading to a negative impact on the well-being of ECRs and the quality of science (see the special issue editorial on young scientists in Nature News (Nature News, 2016a; Smaldino and McElreath, 2016). To date, most studies investigating the work situation of ECRs only focus on a specific work category of ECRs (as postdoctoral researchers for example, see Bessudnov *et al.*, 2015; Powell, 2015; van der Weijden *et al.*, 2015) or on a specific research field (as medical science for example, see Cantwell and Taylor, 2013; Poirazi *et al.*, 2016). These studies have highlighted extensive job insecurities (Dany and Mangematin, 2004), lack of clarity, skewed funding and gender bias (de Machado-Taylor *et al.*, 2014), as general hindrances for ERCs (Wöhrer, 2014). According to the Job Demand–Resources model (Bakker and Demerouti, 2007) which is proposed to apply irrespective of the job nature, the difficulties encountered by ECRs could be due to high job demands and low job resources. However, to our knowledge, the validity of this model has not yet been tested for ECR's work situation. Also, the impact of an ERC's work situation on the quality of science has not been evaluated in Sweden, a country having progressive labour laws, gender polices and all-round governmental transparency (Kogan and Bauer, 2006) within autonomous universities. The National Junior Faculty of Sweden (NJF)[1], which is an umbrella organization for local junior/future faculties at Swedish universities, organized a survey to investigate factors influencing ECR's work situation, across work categories (from the first year of PhD until lectureship) and research fields (encompassing medical, technical and humanity areas). This approach enabled us to identify common trends and possible key target areas for policy makers to focus on. Indeed, it is already established that well-being of employees is strongly associated with organizational performance (for a review, see Daniels and Harris, 2000). To ensure that future scientific challenges are tackled, it is of utmost importance to identify factors influencing the work situation, and hence scientific quality, of ECRs.

Career issues encountered by ECRs are a general problem that has been reported in several countries (Åkerlind, 2005). In a French (Dany and Mangematin, 2004) and two Dutch studies (Weijden *et al.*, 2015), it has been shown that the growing body of ECRs (defined as postdoctoral researchers), while being productive, have limited career perspectives. The results were suggested to reflect the desire of ECRs to stay in academia and lacking knowledge of career paths outside academia. Similar conclusions has been found in an United States based survey (Sauermann and Roach, 2016). Considering the growing number of postdoctoral researchers pursuing an academic career and the limited number of faculty positions available, all studies recommended that students should develop career plans early in their doctoral education by considering labour market conditions and career options. This is in accordance with the American National Academies report (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2014). However, a critical point for enabling the development of career plans is the structure of career paths. Academic careers are thought to be "boundaryless", i.e. the academics are free to choose the university that will offer the best opportunity in terms of career and research (Baruch and Hall, 2004). But pursuing an academic career without clarity (Dany *et al.*, 2011) or insecurity (McAlpine and Turner, 2012) in the career path is not compatible with a boundaryless perspective.

## The Swedish context

According to the 2016 status report on higher education in Sweden (Andersson *et al.*, 2016, pp. 49–52), the Swedish academic system is organized with a combination of tenured positions, including professorship (17%), senior lecturers (29%), lecturers (17%), fixed-term career development positions (10%) and teaching positions subdivided on the basis of whether they have PhDs (12%) or not (15%). As considerably more PhDs are awarded each year than the number of career development positions available, these positions are highly competitive. In this group, the number of women has tripled between 2005 and 2015, while the number of men has doubled.

In a recent study (Björck, 2015) based on three groups of PhD holders in Sweden (doctoral graduates from 1995 to 1996, 2002 to 2003 and 2008 to 2009), a generally slower career development is observed for the most recent doctoral students (2008–2009 group), which was explained by an extended career development period preceding employment on a tenured position. Indeed, the period after completing a PhD, typically lasting seven to 12 years (see the example stories in McKay *et al.*, 2012, p. 20, p. 57), is characterized by a lack of secure conditions and a lack of clarity about what is required to qualify for a permanent position. ECRs work then in situations seen as "academic precariat" (Ivancheva, 2015) where limited or no tenured work positions are available and juggle between several fixed-term contracts without security or clarity about their future career

opportunities. One of the possible reasons explaining this situation is that postdoctoral contracts in Sweden are limited to 2 years (see the reported Kurt's story in McKay *et al.*, 2012, p. 152). This leads to the accumulation of several different types of fixed-term contracts causing the ECRs to risk their scientific focus, experience job insecurity due to times (days to months) of unemployment between contracts (see Hellgren *et al.*, 1999 for a definition), and work overload. Indeed, the ECRs have to apply for available academic positions while continuing research and teaching duties (see Beehr *et al.*, 1976). Despite Swedish academic institutions having undergone several reforms and changes (Kogan and Bauer, 2006), no coherent career structure exists (Statens Offentliga Utredningar, 2016). This could in turn possibly lead to an experienced work ambiguity and conflict in career development (see in general Levinson, 1965; and for ECRs in particular, Wöhrer, 2014). Job insecurity, work overload, ambiguity and conflict are stress sources (Jacobs and Pienaar, 2017) and occupational stress can lead to burnout and even depression (Ahola and Hakanen, 2007; Iacovides *et al.*, 2003). Further, security and clarity in the career path is shown to be correlated with quality of scientific outputs (Öquist and Benner, 2012). Hence, the work situation of ECRs needs to be evaluated according to these particular career issues.

## The current study

The growing number of studies reporting issues for ECRs in different countries (see for example, Maher and Sureda Anfres, 2016) demonstrated a need for collecting data from a broad group of ERCs on their work situation in terms of the career path within academia, career perspectives inside and outside academia, as well as perceived work conditions encompassing pressure and stress. This prompted us to analyse data collected broadly from ECRs working in different autonomous Swedish universities. The present survey organized by the NJF encompassed 10 questions aiming to give (1) an overview of the work situation of ERCs in Sweden, focusing on career path evaluation and career opportunity as well as (2) a subjective evaluation of the work situation and the general quality of life. Identifying the factors that could influence the quality of life of ECRs would be useful to avoid several issues, such as job insecurity, work overload, ambiguity and conflicts related to work environment. Most importantly, (3) highlighting the factors that allow ECRs to conduct the best possible science is of crucial importance for their career development and by consequence for the universities and research in general. In the present study, we describe the actual work conditions of ERCs in Sweden. Further, using structural evaluation modelling on the collected data, we show relevant factors that may impact on the quality of produced science. Moreover, we highlight factors that could allow ECRs to develop in a better research environment and provide the best possible science.

## Methods

### Participants and procedure

The questionnaire was sent to all the 3212 members of junior/future faculties from universities represented at the NJF at the date of the survey (Gothenburg Sahlgrenska University (GU): 270, Linköping University (LiU): 286, Karolinska Institute (KI): 1338, Uppsala University (UU): 789, Lund University (LU): 170, and Umeå University (UmU): 359) via a link included in an invitation email. Participants were assured that all responses would be anonymous and all results presented at a group level. The survey (see Appendix 1) was introduced with a description of the NJF that outlined what was expected from the respondents and explained that the purpose of the survey was to investigate the general working conditions of junior researchers (i.e. ECRs) in Sweden. The first email was sent out in March 2015 followed by two reminders within 1 month.

### Questionnaire

The questionnaire included 10 questions. Questions 1–4 included demographic characteristics of individuals (gender, age, conjugal and familial status). Questions 5–7 were related to the actual contractual situation of the respondent (university of employment, contract length, funding). Question 8 was related to the career path and the career opportunities proposed at the workplace of the respondents and included a set of 13 statements. Question 9 was related to the subjective evaluation of the work situation, research environment and quality of life of the respondents and included a set of 10 statements. For each statement, respondents were asked to indicate how much they agree with the statement using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Question 10 was an open question, where the respondent could provide further comments in relation to work as a junior researcher in Sweden and has not been analysed in the present study (see Appendix 1).

### Outcome measures

We organized the general discussion of working conditions of ECRs in Sweden around four constructs that are measured through questions 8 and 9. First, **career path evaluation** was assessed by the statements 8-1 to 8-5, measuring career path clarity (Q8-1), attractiveness (Q8-2), security (Q8-3), job clarity (Q8-4) and support from the university (Q8-5). Second, **career opportunity** was assessed by the score difference between WANT (indicating preference) and CAN (indicating feasibility) variables (Q8-6 vs Q8-7; Q8-8 vs Q8-9 and Q8-10 vs Q8-11). Third, **perceived work situation** was assessed by the statements measuring attractiveness of working in Sweden (Q9-1) or within academia (Q9-2), pressure (Q9-3), stress (Q9-4) and work time management (Q9-5). Fourth, **perceived quality of life** was assessed by

the statements measuring time for non-work activities (Q9-7 and Q9-8), the salary satisfaction (Q9-9) and a subjective measure of general quality of life as a junior researcher (Q9-10). Furthermore, we employ the response item **best possible science** (Q9-6) to assess the factors that correlate with ECRs' possibility to conduct the best science.

### Statistical analysis

The analyses were performed using the Statistical Package for the Social Sciences (SPSS/IBM statistics version 23.0). Mean (*M*) and standard deviation (*SD*) for data based on Likert scale responses were used as descriptive statistics. The maximal score is 5, and the minimal score is 1. A score below 3 means that the respondents did not agree with the statement, while a score above 3 means that they did. Consequently, higher scores mean stronger agreement with the statement. Frequency responses were calculated for ordinal and nominal data, and Chi-square ($\chi^2$) non-parametric analysis was used for testing homogeneity between groups under the null hypothesis. Pearson's *r* correlation was calculated to estimate the associations between the career path evaluation (Q8-1 to 5) and the general quality of life satisfaction (Q9-10) and the best possible science (Q9-6), as well as the associations between the general quality of life (Q9-10) and the perceived work situation (Q9-1 to 5). Cronbach's alpha was calculated to measure reliability when combining different scales measuring the same effect: a level superior of .7 was considered as acceptable for reflecting internal consistency (Nunnally, 1978). An alpha level of .05 was used to define level significance. Structural equation model (SEM) was employed in Stata MP version 12.1 to estimate the set of factors that correlates with the possibility to conduct the best science. SEM is a general framework for mapping the relationship among a set of variables and is a combination of factor analysis and regression models. Unlike traditional implementation of regression models, SEM allows error covariance between various predictors that are highly related to each other (Kline, 2015). This is especially important for our case because the various predictors in our model, although not mapped into latent constructs (see Appendix 2), are highly related to each other. Nevertheless, given the cross-sectional design of this study, the SEM estimates of our model indicate only the strength of relationships among the variables and do not imply any directionality.

## Results

### Descriptive statistics

Following one initial mail and two reminder follow-ups, a 20.73% response rate was achieved (662 respondents: 50 respondents affiliated to GU, 148 respondents affiliated to KI, 61 respondents affiliated to LiU, 58 respondents affiliated to LU, 32

respondents affiliated to UmU, 281 respondents affiliated to UU, and 32 respondents without reported affiliation). More than half of the respondents were female (55.4%, see Figure 1 panel A), two-third (65.4%) of respondents were aged between 31 and 40 years (see Figure 1 panel B), a majority (82.0%) had a partner

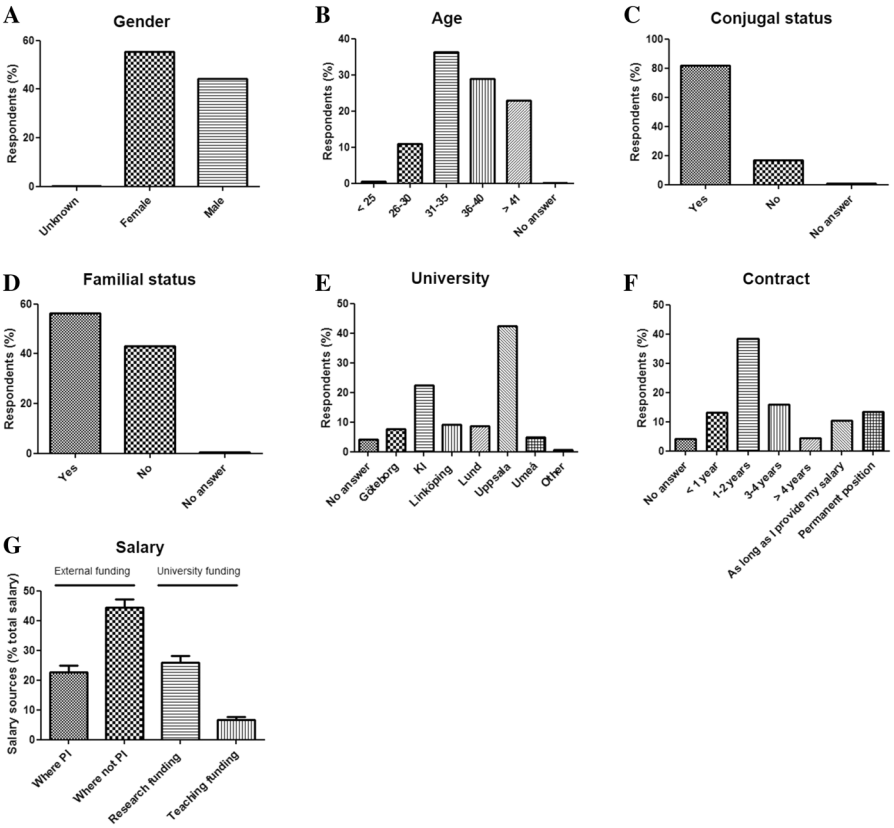


**Figure 1.** Description of the respondents' demographic factors. *Panel A*: Percentage of respondents according to the gender (unknown, female, male); *Panel B*: Percentage of respondents according to the age range (< 25, 26–30, 31–35, 36–40 > 41); *Panel C*: Percentage of respondents according to the conjugal status (Yes = have a partner, No = do not have a partner); *Panel D*: Percentage of respondents according to the familial status (Yes = have at least one child, No = do not have a child); *Panel E*: Percentage of respondents according to the university of employment, (KI = Karolinska Institute); *Panel F*: Percentage of respondents according to the contract length in year (< 1, 1–2, 3–4, > 4, as long as I provide my salary, permanent position); *Panel G*: Salary sources in percentage divided into two categories (external funding and university funding). External funding was separated in funding where the respondent was the principal investigator (PI) and funding where the respondent was not the PI. University funding is separated as a function of research or teaching funding.

(see Figure 1 panel C), and more than a half (56.3%) had at least one child (see Figure 1 panel D). A majority (42.5%) of respondents were from UU (see Figure 1 panel E).

## Contractual situation

Most respondents (82.5%) did not have a permanent position, with more than a half (51.7%) working on contracts shorter than 2-years (Figure 1, panel F). The results slightly differed across universities (see Table 1), and a significant difference is observed between the contract length distribution as a function of the university ($\chi^2_{(25)} = 39.99$; $p = .029$). Even if the association between university and contract length is small (Cramer's $V = .113$), it means that the contract length distribution is not homogeneous across universities. By comparing to the total distribution of the work contract length, the proportion of respondents with a permanent position was almost twice as high at LiU and GU, whereas the proportion for those with work contract established as long as they could provide their salary was half at LiU. Another example at GU, the proportion of respondents with work contract length between 1 and 2 years was half, while the proportion for those with work contract length of more than 4 years was double (see Figure 1, panel F, and Table 1).

Two-third (67.0%) of the respondents have a salary paid from external funding: with only 22.6% funded as a principal investigator and 44.5% funded via another principal investigator. Very few (6.8%) ECRs have a salary paid from teaching activities. The remaining respondents (25.9%) received a salary from research funding at the university level (see Figure 1, panel G).

## Career path evaluation

Overall, the respondents did not agree with the statements of clarity ($M = 2.50$, SD = 1.17), security ($M = 1.80$, SD = 1.00) and attractiveness ($M = 2.82$, SD = 1.07) of the career path existing at their workplace. While the job title on

**Table 1** Distribution of the work contract length (in per cent) as a function of the university (GU: Gothenburg Sahlgrenska University, LiU: Linköping University, LU: Lund University, UmU: Umeå University, UU: Uppsala University, KI: Karolinska Institute) and for the total number of respondents. Note that 4.1% of respondents did not answer this question.

| *Contract length* | *GU* | *KI* | *LiU* | *UU* | *LU* | *UmU* | *Total* |
|---|---|---|---|---|---|---|---|
| < 1 year | 16.0 | 16.2 | 14.8 | 12.1 | 10.3 | 18.8 | 13.1 |
| 1–2 years | 16.0 | 37.8 | 39.3 | 45.9 | 39.7 | 43.8 | 38.5 |
| 3–4 years | 24.0 | 15.5 | 13.1 | 15.7 | 22.4 | 15.6 | 16.0 |
| > 4 years | 10.0 | 4.1 | 1.6 | 5.0 | 1.7 | 6.3 | 4.4 |
| As long I provide my own salary | 12.0 | 11.5 | 6.6 | 9.3 | 19.0 | 12.5 | 10.4 |
| Permanent | 22.0 | 14.9 | 24.6 | 12.1 | 6.9 | 3.1 | 13.4 |

**Table 2** Chi-square ($\chi^2$) and statistical significance value ($p$) reported for each significant demographic factors (age, familial status and workplace) influencing the career path evaluation (clarity, attractiveness, security, job title and support from university).

| | *Path clarity* | *Path attractiveness* | *Path security* | *Job title* | *Support form university* |
|---|---|---|---|---|---|
| Age | $\chi^2_{(3)} = 11.61$<br>$p = .009$ | $\chi^2_{(3)} = 18.32$<br>$p = .000$ | $\chi^2_{(3)} = 12.59$<br>$p = .006$ | $\chi^2_{(3)} = 23.47$<br>$p = .000$ | $\chi^2_{(3)} = 18.83$<br>$p = .000$ |
| Familial Status | $\chi^2_{(1)} = 4.15$<br>$p = .042$ | $\chi^2_{(1)} = 12.35$<br>$p = .000$ | $\chi^2_{(1)} = 7.33$<br>$p = .007$ | $\chi^2_{(1)} = 10.45$<br>$p = .001$ | $\chi^2_{(1)} = 22.50$<br>$p = .000$ |
| Workplace | $\chi^2_{(5)} = 20.27$<br>$p = .001$ | $\chi^2_{(5)} = 24.49$<br>$p = .000$ | $\chi^2_{(5)} = 25.60$<br>$p = .000$ | $\chi^2_{(5)} = 14.11$<br>$p = .015$ | $\chi^2_{(5)} = 34.12$<br>$p = .000$ |

the work contract corresponded to the actual work ($M = 3.83$, SD = 1.08), suggesting that the university as an employer recognized their skills, the respondents reported a lack of support from the university ($M = 2.67$, SD = 1.13). Demographic factors influencing the evaluation of the career path, see Table 2 for statistical significance, are age (younger respondents reported higher career path evaluation scores than older respondents), familial status (respondents having no child reported higher scores) and workplace (highest scores obtained by respondents from LiU that proposed, at the time of the survey, a tenure-track career path, see Discussion). The other demographic factors (conjugal status and gender) were not significantly associated with the evaluation of the career path. The career path evaluation scores are particularly interesting to report because the five individual items measuring career path evaluation (clarity, attractiveness, security, job clarity and support from the university, Cronbach's alpha = .745) were positively associated with the general quality of life satisfaction ($r = .31$, $p < .001$; $r = .43$, $p < .001$; $r = .28$, $p < .001$; $r = .32$, $p < .001$ and $r = .41$, $p < .001$, respectively) and the possibility to conduct the best science ($r = .24$, $p < .001$; $r = .34$, $p < .001$; $r = .28$, $p < .001$; r = .32, p < .001 and $r = .45$, $p < .001$, respectively).

## Career opportunity

The respondents reported to have few career plans outside academia ($M = 2.49$, SD = 1.16), with the lowest score obtained in response to work experience as a researcher outside academia ($M = 1.75$, SD = 1.22), which is not consistent across universities ($\chi^2_{(5)} = 13.53$; $p = .019$; indicating LiU obtained the highest scores). In order to assess how likely it was for the respondents to have the career opportunity they wanted, we computed the difference between whether they wanted to and whether they could continue to work as a researcher, either at their own universities, at another Swedish university, or in another country. Regarding the career opportunities at their own university, 61.9% of the respondents indicated that

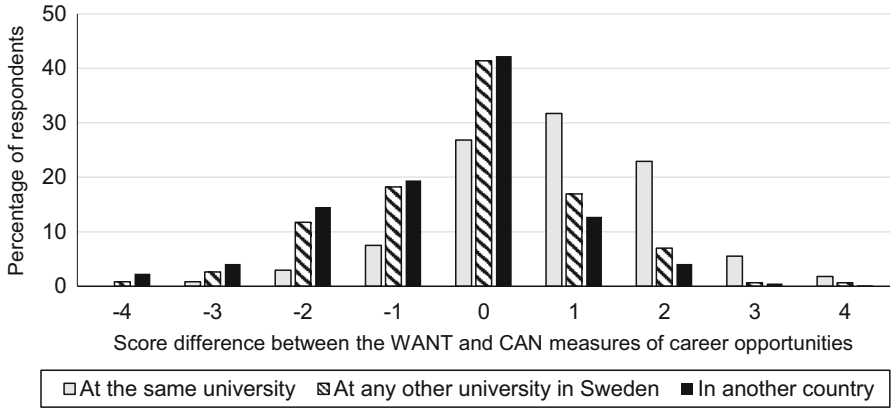


**Figure 2.** Score difference between what the respondents WANT and CAN, reflecting career opportunity at the same university, at any other university in Sweden, and in another country; positive values reflecting preference for continuing without the possibility to do so, negative values reflecting opportunities for continuing but with a preference not to continue and 0 reflecting an agreement between WANT and CAN variables.

they wanted to continue working at the same university but could not (see Figure 2). Only 11.2% of the respondents had opportunities at the same university but did not want to stay. Regarding the opportunity to work in another university in Sweden, the results showed another pattern: 41.4% of the respondents could have the career opportunity that they wanted, while 33.3% would like to have a career opportunity in another Swedish university but could not. A similar pattern is observed for the career opportunity outside Sweden, such that 42.3% can and want to continue research in another country, while 40.3% reported to have a career opportunity outside Sweden but did not want to take it. In accordance with this pattern of results, the respondents also agree on the fact that it is attractive to work in Sweden ($M = 3.56$, SD = 1.02) as well as work within academia ($M = 3.25$, SD = 1.12).

## Perceived work situation

Working within academia was perceived as stressful ($M = 3.51$, SD = .96) and encompassing pressure ($M = 3.58$, SD = .96). Note that these two factors are positively and strongly correlated ($r = .76$, $p < .001$, Cronbach's alpha = .876). The respondents did not agree to have enough time for performing all the work tasks they have ($M = 2.59$, SD = 1.10), and this was influenced by gender ($\chi^2_{(1)} = 7.93$; $p = .005$; women obtaining lower scores than men), age ($\chi^2_{(3)} = 16.17$; $p = .001$; respondents 26–30 reported higher scores, while respondents at age at age 36–40 reported lower scores), familial status ($\chi^2_{(1)} = 11.91$;

$p = .001$; respondents without children reported higher score than respondents with at least one child) and contract length ($\chi^2_{(5)} = 16.05$; $p = .003$; respondents having a contract as long as they provide their salary obtained the lowest scores).

### Perceived quality of life

Perceived quality of life (Cronbach's alpha = .705) was assessed by the statements measuring time for non-work activities (i.e. family, $M = 3.19$, SD = 1.03 and leisure, $M = 2.97$, SD = 1.08), the salary satisfaction ($M = 3.09$, SD = 1.15) and a subjective measure of general quality of life as a junior researcher ($M = 3.0$, SD = 1.06). The responses in relation to the perceived quality of life in terms of salary, time for family or leisure activities were at the neutral level "neither agree or disagree". Demographic factors influencing significantly the evaluation of the general quality of life satisfaction (Cronbach's alpha = .705) are age ($\chi^2_{(5)} = 9.49$; $p = .023$: respondents at the age 36–40 reported lower scores, while respondents form age 26–30 reported better scores) and contract length ($\chi^2_{(5)} = 10.39$; $p = .034$: having a contract less than 1 year negatively influenced the evaluation of the perceived quality of life). The general quality of life satisfaction was positively associated with the attractiveness of working in Sweden and in academia ($r = .20$, $p < .001$; $r = .31$, $p < .001$) as well as the work time management ($r = .16$, $p < .001$), but was negatively associated the perceived pressure and stress ($r = -.19$, $p < .001$; $r = -.30$, $p < .001$).

### Possibility to conduct the best science

In addition to discussing the general work, career and perceived life conditions for ECRs in Sweden, we also analysed the factors that correlate with the perception of ideal environment for scientific pursuits using a SEM for explaining the variable *best possible science* (Q9-6). Results reported in Table 3 present the maximum likelihood estimates of the perceived conditions to conduct the best possible science.[2] The results are interpreted as between-respondent *difference* in the odds on an outcome variable observed for a given between-respondent *difference* in the scale of predictor variable.

Seven variables of substantial interest emerged as statistically significant predictors of the perceived possibility to conduct best science — job clarity, university support, work time management, quality of life satisfaction, perceptions of career opportunity within academia as well as within the same university, and contract length. First, a unit difference in the scale of "job clarity" predicts an 11 per cent difference in the odds of respondent reporting a higher level of "best possible science" outcome (i.e. $e^{0.104} = 1.11$). Second, university support is another statistically significant predictor of "best possible science" outcome — estimates reporting a 24 per cent difference in the odds (i.e. $e^{0.218} = 1.24$). Third, a unit difference in the scale of "work time management" predicts a 41 per cent

**Table 3** Maximum likelihood estimates from Structural Equation Models on best possible science

| | *Best possible science* |
|---|---|
| Career path evaluation | |
| Path clarity | − 0.0742 |
| | (0.0416) |
| Path attractiveness | 0.0423 |
| | (0.0464) |
| Path security | 0.0518 |
| | (0.0468) |
| Job clarity | 0.104* |
| | (0.0407) |
| University support | 0.218*** |
| | (0.0436) |
| Sweden attractive | 0.0265 |
| | (0.0420) |
| Academia attractive | − 0.00550 |
| | (0.0390) |
| Perceived quality of employment | |
| Pressure in academia | 0.0153 |
| | (0.0625) |
| Stress in academia | − 0.0192 |
| | (0.0651) |
| Work time management | 0.345*** |
| | (0.0428) |
| Time for other activities | − 0.0509 |
| | (0.0436) |
| Satisfied with salary | − 0.0190 |
| | (0.0369) |
| Perceived quality of life | |
| Satisfied with quality of life | 0.262*** |
| | (0.0496) |
| Perceived career opportunity | |
| In Sweden | − 0.0392 |
| | (0.0339) |
| In academia | 0.0739* |
| | (0.0324) |
| In same University | 0.0673* |
| | (0.0325) |
| Demographic and other controls | |
| Contract length | 0.0947* |
| | (0.0423) |
| Logarithm of age | − 0.356* |
| | (0.163) |
| Conjugal status | 0.00615 |
| | (0.108) |
| Family status | − 0.0974 |
| | (0.0964) |

**Table 3** *continued*

| | *Best possible science* |
|---|---|
| Gender (= female) | − 0.0545 |
| | (0.0775) |
| Constant | 0.334 |
| | (0.363) |
| Observations | 540 |
| Log likelihood | − 14297.6 |

Standard errors in parentheses.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

difference in the odds of respondent reporting a higher level of "best possible science" outcome (i.e. $e^{0.345} = 1.41$). Fourth, a unit difference in the scale of quality of satisfaction with life predicts a 30 per cent difference in the odds of respondent reporting a higher level of "best possible science" outcome ($e^{0.262} = 1.3$). Fifth, a unit difference in the scale of perceptions of career opportunity within academia predicts an 8 per cent difference in the odds of respondent reporting a higher level of "best possible science" outcome ($e^{0.074} = 1.08$). Sixth, a unit difference in the scale of perceptions of career opportunity within same university predicts a 7 per cent difference in the odds of respondent reporting a higher level of "best possible science" outcome ($e^{0.067} = 1.07$). Finally, a unit difference in the number of years of employment contract predicts a 10 per cent difference in the odds of respondent reporting a higher level of "best possible science" outcome ($e^{0.095} = 1.10$).

Overall, the standardized root-mean-squared residual (SRMR) is equal to 0 and the coefficient of determination is 0.437, Tucker–Lewis Indicator (TLI) is equal to 1, Comparative Fit Index (CFI) is equal to 1, RMSEA is equal to 0, and Chi-squared value is 316.684 (baseline vs saturated), indicating a very good model fit.

## Discussion

This study aims to evaluate and improve the understanding of work situation of ECRs at autonomous Swedish universities since it is seen as problematic, as observed by the NJF and stressed by the Swedish government (Statens Offentliga Utredningar, 2016). This was investigated by using a web survey sent out in March 2015 to all local Swedish future/junior faculties that were represented at the NJF. The web survey was made to precisely describe the work situation of ECRs in Sweden and evaluate their perceived quality of life, as well as the factors influencing the perceived possibility to conduct the best science using advanced statistical analysis such as SEM. SEM analysis is warranted for two main reasons. First, it allows error covariance of closely related measures, which is the case in our

models. Second SEM accounts for the endogenous nature of relationship between work situations, personal well-being and perceived scientific environment because work situations and personal well-being are likely to be influenced in turn by the perception of scientific environment. Traditional models impose strict exogeneity and error covariance assumptions that are not likely to be met in data we presented in this paper. Consequently, analysing a comprehensive set of factors that influence perceived scientific environment as we proposed at the outset has been done with the use of advanced models like SEM. Thus, our findings show a more comprehensive picture of the conditions of ECRs than previous research.

A majority of respondents are in the range of 31–40 years, as in many other countries (Weijden *et al.*, 2015), the majority have a partner, and more than half have a family. However, few have a stable professional situation, as the majority of respondents had a contract length of 2 years or less. As reported previously in other countries (Cyranoski *et al.*, 2011), the number of ECRs is growing, while the number of tenure-track or permanent position is not. Consequently, ECRs can end up trapped, as defined by Powell (2015) as "permadocs", concatenating multiple postdoc positions, some never leaving them, jeopardizing their ability to develop an in-depth, coherent research profile (Wöhrer, 2014). This problem is similar across disciplines (see the news feature in Nature News, 2016b). In the present survey, the career opportunities within the same university are low: more than 80% of the respondents reported to have a non-permanent position and the majority of them that would like to have a career opportunity at the same university did not have this possibility. Another underlying structural factor is that respondents, as much as 67% in the present survey, are principally paid by external funding. This high proportion among the ECRs could be a limitation for developing independent research (Capewell, 2016; Wöhrer, 2014), a determinant criterion in grant funding and obtaining a permanent contract at the home university. However, career opportunities beyond the home university, both within and outside Sweden, are higher, encouraging mobility of ECRs, which could be seen as potentially conflicting with the age, the conjugal and familial status of ECRs.

The respondents reported high scores in evaluating pressure and stress related to work. Similar findings have been reported for ECRs in other countries (see for example in Australia, Åkerlind, 2005, 2009). High levels of pressure and stress are associated with burnout and depression (Ahola and Hakanen, 2007; Iacovides *et al.*, 2003), suggesting that there may be an important role for universities in developing a structured programme helping ECRs to improve well-being at work (Bessudnov *et al.*, 2015). Indeed, well-being at work has been directly related to organization performance (Schulte and Vainio, 2010), and importantly publication record for ECRs (Bessudnov *et al.*, 2015).

The academic career path has been reported to lack clarity, security and attractiveness and is non-coherent between universities (Statens Offentliga Utredningar, 2016). As reported here for Swedish universities, but also as in other

European countries (Ates and Brechelmacher, 2013), autonomous universities could have different rules in terms of career path and criteria used for recruitment. This leads to a lack of attractiveness and security for ECRs, as well as insufficient clarity about the requirements to reach existing academic positions. In the present study, the career path evaluation was positively correlated with the perceived quality of life and with the possibility to conduct the best science. This suggests that having a better evaluation of the clarity, attractiveness and security of the career path will enhance the perceived quality of life and the opportunity to conduct the best science. Overall in the present results, the respondents did not agree with the statements that the career path was clear, attractive or secure; one exception was respondents from one university who were more positive about the evaluation of the career path. This could be explained by the fact that in this university, it was possible at the time of the survey to be employed on a tenure position as an ECR. As this possibility is no more available, future research should evaluate the impact of this decision on the career path evaluation. According to the results observed for other autonomous universities, we could predict that the career path evaluation will then decrease for this specific university.

Among the factors influencing the perceived work situation and quality of life, demographic factors such as gender entered also into the picture. Women reported a higher disagreement, compared to men, in their perceived available time to complete work-related tasks and the perceived possibility to conduct the best science. This could be related to the fact that women are more often employed on fixed-term contracts (Andersson *et al.*, 2016) and dedicate more time teaching and administrative tasks (de Machado-Taylor *et al.*, 2014). Other significant factors influencing the perceived work situation and quality of life were the age and the familial status of the ECRs. The highest disagreement in work-related time management, the perceived quality of life and the possibility to conduct the best science were ECRs in the age 36–40 with at least one child.

Seven factors emerged correlating with the perceived possibility to conduct the best science. Strongest correlation was work-related time management, implying that having enough time to develop long-term research perspectives has a strong influence on the perception of ideal conditions for conducting science. Not surprisingly, the perceived quality of life was also a significant factor influencing the perceived possibility to conduct the best science. Interestingly, a strong correlation was found between university support and the perceived possibility to conduct the best science. This suggests that when ECRs feel supported by their institution, the perceived possibility to conduct the best science improves, highlighting the need for focusing on the quality of working environments. These findings are in line with the standing theory of organizational support which identify fairness, supervisor support, organizational rewards and job conditions as key aspects for employee well-being. In the present study, the lack of organizational support is reflected in the lack of career path clarity (i.e. fairness in procedure, such as promotion based on merits) and university support

linked to the perceived possibility to conduct the best science. This suggests that universities, through behavioural and structural means as for examples mentor programs (Kuhn and Castaño, 2016), can improve the work conditions for ECRs and the possibility for conducting the best science will increase. Another interesting significant factor is job clarity. It appears that job clarity, where the title corresponds to the actual work, increases the chances that respondents report having better opportunity for scientific pursuits. This could be related to the career path clarity, which should include positions that correspond to the actual job that ECRs have. In addition, the perceived career opportunity in academia and at the same university also had an influence on the possibility to conduct the best science. These findings are in line with the Job Demand–Resources model (Bakker and Demerouti, 2007), proposing that low job resources (i.e. low university support in our study) could explain the issues encountered by ECRs.

In conclusion, the results of this survey clearly demonstrated that the career path for ECRs at Swedish universities, like in other countries, is neither clear nor secure. The NJF is suggesting, in line with our current data, that longer duration of contracts, clearer career paths and description of the recruitment criteria could improve the perceived quality of life and the possibility to conduct the best science for ECRs. Together with stronger support from the universities (as for example the establishment of career plans, career development programs and/or the establishment of basic funding), we propose that unified and more attractive academic career path can lead to better well-being (encompassing less stress and pressure) of ECRs and produce higher-quality research outputs.

## Acknowledgements

The authors are thankful for help from the members of NJF (GU, LiU, LU, UmU, UU, KI) for preparing the survey and sending the link to the web survey at each local future/junior faculty, as well as for useful discussions in order to prepare the survey and discuss the interpretation of the results (GU, LiU, LU, UmU, UU, KI and ÖU). We would also like to thank the participation of the respondents to the web survey.

## Notes

1 Any local organization is free to join the NJF — As of 2017, universities from Gothenburg (Sahlgrenska (GU)), Linköping (LiU), Lund (LU), Umeå (UmU), Uppsala (UU), Karolinska Institute (KI) and most recently Örebro (ÖU) are represented. NJF represents all faculties (whereof the medical faculties are overrepresented to date) and has a unified voice speaking for ECRs who hold a doctoral degree and carry out active research (for details about the definition of ECRs, please see the local junior/future faculty at each university). The mission of NJF is to represent and support ECRs by making their collective voice heard, recognizing their values and competences, strengthening their

professional development and advocating for policies that promote positive changes in the academic system in order to influence on the academic working environment that will enable ECRs to achieve their full potential.

2 We mapped various measures to latent variables, but decided to keep the direct correlations of different indicators with the main outcome variable of "best possible science". Mapping of the two main clusters, career path evaluation and perceived quality of employment, is included in Appendix 2.

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# Appendix 1

## National Junior Faculty

Survey for all Sweden

Welcome to the national survey for Junior Researchers in Sweden!
This survey is organized by the National Junior Faculty that is a grouping of several junior faculty organizations at different universities in Sweden. You are invited to answer the following 10 questions in this survey via the Junior (or Future) Faculty of your university.

The aim of this survey is to have a quick and short view of the professional situation of junior researchers in Sweden. The results will be used for presenting in which conditions the junior researchers work nowadays.

The participation to this survey is anonymous and the results will be presented at a group level.

Thank you for participating in our survey. Your feedback is important. Thank you for your time.

### *General Information*

1. What is your gender?

☐ Female ☐ Male ☐ Other

2. Age

☐ <25 ☐ 26-30 ☐ 31-35 ☐ 36-40

☐ >41

3. Do you have a partner?

☐ Yes ☐ No

4. Do you have any children?

☐ Yes ☐ No

### *Actual situation*

5. At which university/institute do you work?

☐ Linköping ☐ Stockholm ☐ Uppsala ☐ Karolinska

☐ Umeå ☐ Lund ☐ Gothenburg ☐ Other?

6. How long is your current contract (i.e. how long it was from the start)?

☐ Less than 1 year ☐ 1 – 2 years ☐ 3 – 4 years ☐ > 4 years

☐ As long as I provide my own salary ☐ Permanent position

7. Please give an estimation of the percentage of your salary that is funded by the following:

A External funding where you are PI
B External funding where you are not PI
C Research funding from university
D Teaching funding from university

### *Career Path*

The career path is unique for each university in Sweden. We would like to evaluate how the career path is viewed by junior researchers at your university.

Please use the following scale to indicate how much you agree with each of the statements:

1 = Strongly disagree (very untrue about me)
2 = Disagree (somewhat untrue about me)
3 = Neither agree nor disagree
4 = Agree (somewhat true about me)
5 = Strongly agree (very true about me)

8. How much do you agree with the following statements?

---

8-1. The career path is clear
8-2. The career path is attractive
8-3. The career path is secure (i.e. includes tenure-track position)
8-4. My actual job corresponds to my job title on my contract
8-5. I fell supported by my university/institute in the development of my career path
8-6. I want to continue to work as a researcher at my university
8-7. I can continue to work as a researcher at my university
8-8. I want to continue to work as a researcher at another Swedish University
8-9. I can continue to work as a researcher at another Swedish University
8-10. I want to continue to work as a researcher in another country
8-11. I can continue to work as a researcher at / in another country
8-12. I have other plans for the future than to work as a researcher in academia
8-13. I have already worked outside academia as a researcher

### *Quality of Life*

The quality of life is important for each of us. We would like to have an overview of the quality of life of junior researchers in Sweden. Please use the following scale to indicate how much do you agree with each of the statements:

1 = Strongly disagree (very untrue about me)
2 = Disagree (somewhat untrue about me)
3 = Neither agree nor disagree
4 = Agree (somewhat true about me)
5 = Strongly agree (very true about me)

9. How much do you agree with the following statements?

---

9-1. It is more attractive to work in Sweden than somewhere else
9-2. It is more attractive to work in academia than somewhere else
9-3. It is more pressure to work in academia than somewhere else
9-4. It is more stress to work in academia than somewhere else
9-5. I have time for doing all my work tasks
9-6. My situation allows me to do the best possible science
9-7. I have time for my family and my friends
9-8. I have time for spare-time activities
9-9. I am satisfied with my salary
9-10. I am satisfied with my quality of life as a junior researcher

10. Do you have any comments in relation to your work as junior researcher in Sweden?

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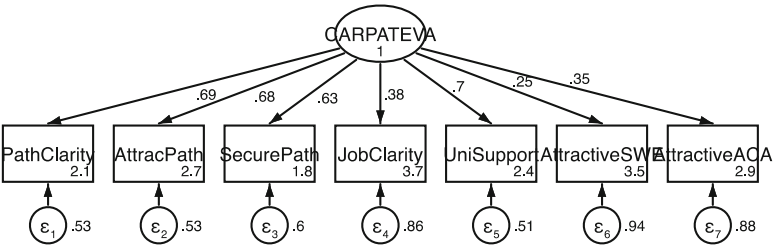
The National Survey for Junior **researcher** in Sweden ends here.
Thank you very much for taking the time to complete this survey. Your feedback is valued and very much appreciated!
We will come back to you via the Junior (or Future) Faculty of your university to disseminate the results.

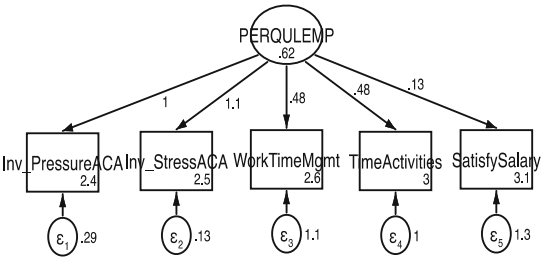
Have a nice day!

## Appendix 2: Mapping of Observed Variables into Constructs

1. Career path evaluation




2. Perceived quality of employment

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