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Social background effects in the transition to a doctoral degree – Empirical evidence from a German prospective study

Anna Bachsleitner, Michael Becker, Marko Neumann, Kai Maaz

Abstract

This study examines the relationship between social background and the transition to a doctoral degree, based on data from a longitudinal study ($N = 2214$) conducted in Germany. Drawing on theoretical concepts developed by Boudon (1974) and Erikson and Jonsson (1996), the study investigates what proportion of the social background effect is transmitted via performance differences (primary effect) and the degree to which mechanisms of a cost-benefit analysis (secondary effect) and educational biographical factors can contribute to the explanation. Tertiary graduates from more highly educated family backgrounds are found to have a higher probability of transitioning to a doctoral programme, especially if they have at least one parent who holds a doctoral degree. The effect decomposition shows that nearly half of the social background effect can be attributed to differences in final secondary school and university marks and to performance on standardised tests. On closer examination, the social background effect can mainly be traced back to differences in final marks and in the choice of subject and type of tertiary institution.

Keywords: Social background; Transition to doctoral degree; Effect decomposition; KHB

1 Introduction

The influence of social background on transitions in the education system has been demonstrated many times. In particular, researchers have conducted comprehensive studies on transitions to various types of secondary schools and to university (e.g., Blossfeld & Shavit, 1993; Erikson, 2007; Neugebauer, Reimer, Schindler, & Stocké, 2013; Pietsch, & Stubbe, 2007; Schindler & Lörz, 2012). According to this research, educational transitions have been identified as important stations in the generation of social inequality (e.g., Breen & Goldthorpe, 1997; Erikson & Jonsson, 1996). Respective studies have demonstrated that children from the upper service class as well as the middle class have a significantly higher chance of transitioning to tertiary education than working class children (e.g., Becker & Hecken, 2009; Maaz, 2006). Likewise, there is evidence that differences in the probability of transition can be linked primarily to – according to Boudon (1974) – secondary effects of social background, i.e., class-specific differences in educational decisions that are net of academic performance (e.g., Erikson, 2007; Neugebauer et al., 2013; Schindler & Reimer, 2010).

Relatively few studies have been conducted on the influence of social background on educational decisions following the completion of a first university degree, for example, on the transition to a doctoral degree (see Jaksztat, 2014; Mastekaasa, 2006). The start of doctoral studies represents a relevant educational transition, as it is normally also associated with the entrance into the labour market. Although most findings suggest that social background effects are still relevant for the transition to a doctoral degree (e.g., Jaksztat, 2014; Mastekaasa, 2006; Mullen, Goyette, & Soares, 2003), there is a lack of studies that, first, explicitly decompose existing social background effects into primary and secondary effects while also including performance on standardised tests, and second, develop models to explain the secondary effects of social background. This question regarding socially unequal access to doctoral programmes is not only relevant from a fundamental science perspective. The aspect bears direct individual and societal impacts, since studies have shown subject-specific higher incomes and higher job satisfaction among doctoral degree holders (e.g., Falk & Küpper, 2013; Mertens & Rübken, 2013).

Hence, we seek to investigate the relationship between social background and transitions to doctoral programmes, and to reveal the mechanisms underlying the social background differences. We use the example of Germany, a country that has a number of particular characteristics with regard to entering tertiary institutions and undertaking doctoral studies that are also of significance for the international debate on access to doctoral degree

programmes. Using an effect decomposition, we tested what proportion of the social background effect is due to differences in final marks and test scores (primary origin effects). An in-depth investigation of the social background effect is based on modelling the secondary origin effect in terms of cost-benefit analyses (see Erikson & Jonsson, 1996) and by considering factors related to the educational biography as further explanatory variables. Before presenting empirical findings, we first give an overview of the tertiary education system in Germany. We then describe the empirical research on social background effects during transitions to doctoral degrees and finally present theoretical explanatory approaches.

2 The tertiary education system in Germany

Acceptance to a doctoral programme in Germany typically requires the applicant to have completed a first academic degree with above-average marks – either a *Diplom*, *Magister*, or master’s degree – or to have passed the state examinations (*Staatsexamen*). In exceptional cases, bachelor’s degree graduates can be admitted to doctoral programmes.¹ In contrast to education systems in other countries such as the US, which are characterised by more formalised pathways to doctoral degrees involving an application to a graduate school, access to doctoral degrees in Germany is typically informal and involves applications to a university professor (Bosbach, 2009). This is also reflected in the fact that the most common form of doctorate in Germany is the internal doctorate, i.e. the doctoral candidate is employed by the university. Other forms of doctorates are external doctorates (e.g., where the candidate has a position at a non-university research institute or in business) and structured doctoral programmes (for example, within the framework of graduate schools), the relevance of which have increased in Germany in recent years (Federal Statistical Office, 2016).

At tertiary level, the German institutional landscape is characterised by two main institution types: the universities, which have the sole right to award doctorates, and the universities of applied sciences, which are more professionally oriented and practical, and mainly provide study programmes in engineering and economics as well as in social subjects like social work (Mayer, Müller, & Pollak, 2007). Graduates from universities of applied sciences can, however, enrol in doctoral studies usually after providing proof of ability. Also, there is the possibility for doctoral students to be supervised at universities of applied sciences,

¹ In Germany, the two-cycle degree structure (Bachelor/Master) was introduced with the Bologna Process in 1999 and gradually implemented around the mid-2000s.

and cooperative programmes of doctoral studies between universities and universities of applied sciences are gaining in importance (Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2017). However, the percentage of doctoral students who study at universities of applied sciences is still very low (about 2% in recent years; Federal Statistical Office, 2012; HRK (German Rectors' Conference), 2017). While the traditional general school certificate, the *Abitur*, permits the holder to attend both types of institutions, the applied-sciences-focused *Fachhochschulreife* certificate, which usually takes one school year less to complete, only entitles the holder to study at a university of applied sciences. Institutions in Germany do not charge tuition fees for undergraduate or postgraduate degrees,² and students from less privileged homes can, in principle, get state financial support for the duration of a standard degree (Federal Training Assistance Act; BAföG), of which half must usually be paid back in the student's subsequent working life. Thus, the financial burden of tertiary education is comparatively low compared to other countries, e.g., the US.

In Germany, a doctoral degree plays an additional role over and above its importance for an academic career; it is a key consideration even when filling management positions in other sectors, such as the private sector (Falk & Küpper, 2013). In 2014, 28,147 doctoral candidates successfully obtained their doctoral degrees (Federal Statistical Office, 2015); the graduation rate is above the international average (OECD, 2015).

3 State of the empirical research

Empirical research on the influence of social background on starting a doctoral degree is still relatively limited internationally. For the US, there have been inconsistent results on the transition from undergraduate to postgraduate studies, which can in part be linked to the different measurement points and, in part, to the range of different postgraduate courses available to students after college. Mare (1980) and Stolzenberg (1994) found no important effects of social background. Mare (1980) looked at the transition from college to graduate school (master's and doctoral degrees), and Stolzenberg (1994) focused on participation in entrance tests for graduate school and the transition to MBA programmes. Mullen et al. (2003), however, found a positive effect of parents' education for the transition from college to postgraduate studies. In their study, they differentiated between master's and doctoral degrees.

² In Germany, tuition fees amounting to 500 euros per semester were introduced in some western German states in 2006 and 2007, but they have since been abolished in all states.

The effect of social background was rather moderate for the transition to a master's programme, but relatively strong when transitioning to a doctoral degree. It can be traced back mainly to student's performance indicators, characteristics of the undergraduate institution, career values and educational expectations. Also, positive effects of social background on starting postgraduate education could be shown for the UK (Wakeling, 2009), Norway (Mastekaasa, 2006) and Switzerland (Leemann, 2002).

Present studies for Germany indicate that social background differences exist in the transition to doctoral studies (de Vogel, 2017; Jaksztat, 2014; Lörz & Schindler, 2016; Neumeyer & Alesi, 2018). Jaksztat (2014) analysed tertiary degree holders' class-specific probability of transitioning to a doctoral degree based on a representative study of university graduates. He reports that the probability of starting a doctoral degree varies substantially with the parents' educational background of the tertiary graduate. Jaksztat (2014) also undertook an effect decomposition, in order to determine which variables can explain the differences in the probability of transition between the highest and lowest parental education groups. This analysis shows that 27% of the social background effect can be attributed to performance differences in terms of final marks. In addition, social-background-specific differences in subject choice and in the proportion of those who held student assistantship positions are of particular importance. Lörz and Schindler (2016) examined the influence of parents' educational background on taking up doctoral studies as one step from higher education entrance qualification until the transition to a postdoctoral position. The authors analysed the relevance of educational biographical characteristics (field of study, form of secondary school and vocational education before higher education entrance qualification), performance indicators (university and secondary school marks) and general motivational aspects (extrinsic, intrinsic and social motivation, family orientation, and cost sensibility) to the explanation of social background differences. They regarded the motivational aspects, collected directly after school graduation, as rough proxies for the mechanisms underlying secondary effects. For the transition from university to doctoral studies, they showed an effect of parents with an academic degree that was strongly associated with educational biographical characteristics and to performance differences. The ratio of explanation of the motivational aspects was rather low. A small background effect remained unexplained. Neumeyer and Alesi (2018) also estimated an effect decomposition at the transition to doctoral studies using data from a study of tertiary institution graduates 1.5 years after graduation. They could include measures of secondary effects (expected costs of extended time of study, expected probability of success of a doctoral degree and expected returns and professional motives), however, their explanatory power is

limited in as far as their study is based on cross-sectional data and the items were measured retrospectively. The effect decomposition showed that besides educational biographical characteristics and final marks, probability of success was a relevant factor for the explanation of the social background effect between graduates without a parent with a tertiary degree and graduates with at least one parent with a doctoral degree. The academic integration, the expected returns and costs contributed little to the social background differentials.

In summary, most national and international studies indicate that social background effects are still relevant in transitions to doctoral degrees. These social background effects can be partly explained by differences in performance. However, there is a lack of studies on the transition to doctoral studies that first use prospective panel data and secondly measure primary effects extensively using test results to analyse if, besides school and university marks, standardised test scores can contribute to a mediation of the social background effect. Third, we need further studies that can model the mechanisms behind secondary effects of social background in terms of a cost-benefit analysis (see Erikson & Jonsson, 1996).

4 Theoretical background

Differing hypotheses and models support various assumptions with respect to the relevance of social background effects in transitions to doctoral degrees. Based on the selection hypothesis and the life course hypothesis, one might assume that social background plays little or no role in later educational transitions, such as transitions to doctoral degrees, since the influence of social background declines over the course of individuals educational careers (Blossfeld & Shavit, 1993; Mare, 1980; Müller & Karle, 1993). The *selection hypothesis* implies that a great degree of selection has already occurred during the various stages of the education system; accordingly the remaining students should be relatively homogeneous in terms of performance and motivation. Furthermore, the influence of social background is thought to decrease, because as they grow older people are more independent of the influence of their parental home and resources with respect to their decision-making (*life course hypothesis*).

However, we assume that Boudon's (1974) approach to study and explain social background effects in various educational transitions based on the primary and secondary effects of social background, should also apply for transitions to doctoral degrees. Primary social background effects are conditioned by the possibilities of support and influence in the parental home, which include financial and cultural resources, and which affect the child's

school or university performance. By contrast, for Boudon (1974), secondary effects are the rational considerations of the expected costs and benefits of educational alternatives, the parameters being evaluated differently according to social class.

Other scholars have formalised and advanced Boudon's (1974) theoretical model (e.g., Esser, 1999). They have expanded the concept to go beyond the costs and benefits of a particular educational alternative and to encompass a parameter indicating the perceived probability of being able to achieve the benefits of the educational alternative. The subjective probability of success should be higher for people from higher social classes, as they have a shorter distance to higher education and more opportunities for receiving parental support. According to Erikson and Jonsson (1996), people making educational decisions identify the expected utility of the various alternatives by deducting the cost of an educational choice from their expected benefits, weighted by the probability of success. Since higher-status individuals estimate the benefits and the probability of success as a result of completing further education as higher and estimate the costs as lower than people from less privileged parental homes, they should correspondingly be more likely to choose higher tertiary degrees such as doctorates. Against this background, one might assume that these social background effects would occur even during this later stage of educational transition and that tertiary graduates with parents from higher educational backgrounds are more likely to start doctoral studies. In the following sections, we derive hypotheses about the mechanisms underlying social background differences in the transition to doctoral studies: first, we hypothesize on the relevance of performance features (primary effects) and the evaluation of costs, returns and chances of success (secondary effects), and second, about the relevance of educational biographical factors.

4.1 Primary and secondary effects of social background in the transition to doctoral studies

Based on Boudon's (1974) model and the refinements to this model proposed by Erikson and Jonsson (1996), we assume the existence of both (primary) social background effects – in terms of performance differences – and (secondary) social background differences – which relate to weighing up the costs and benefits of a doctorate – when transitioning to a doctoral degree.

Regarding *primary* social background effects, we can assume that doctoral candidates and graduates from more educated family backgrounds exhibit better performance levels. Students with parents from higher educational backgrounds have better school and university marks (e.g., Jaksztat, 2014), hence they are more likely to begin a doctoral degree for two

reasons. First, a good university degree mark acts as a criterion for enrolment in a doctoral programme, thus influencing whether a student considers beginning a doctoral degree in the first place. Second, good school and university marks have a positive signaling effect, indicating the student's ability to university faculty members (Jaksztat, 2014; Lenger, 2009; Radmann, Neumann, Becker, & Maaz, 2017). To sum up, the effect of social background should be transmitted in part via performance differences, i.e., primary effects (*Hypothesis 1*).

Regarding *secondary* effects of social background and the evaluation of costs, returns, and chances of success, there are two main reasons to expect differences based on social background: (1) differences in the socioeconomic conditions of the parental home, and (2) cultural familiarity with higher education (Lenger, 2009; Lörz, 2012). With regard to the *costs of a doctorate*, we can expect the loss of income associated with a multi-year doctorate to be particularly relevant for lower social classes, and we expect this group to estimate the costs of a doctorate as higher. After many years of investment in a tertiary degree, which represents a greater financial burden for low-income families and involves greater funding from the government grant and loan scheme (Federal Training Assistance Act; BAföG), full-time employment should appear more attractive than pursuing a doctoral degree in combination with a part-time job or a scholarship (Jaksztat, 2014). Thus, we expect class-specific differences in the expected costs linked to a doctorate that should explain part of the social background effect (*Hypothesis 2*).

The decision to pursue a doctoral degree should also be substantially influenced by the *subjective probability of success* of achieving the benefits of a doctoral degree. Here, social background and the proximity or distance to higher education and the academic milieu are of great relevance. Students from families with experience with higher education are more familiar with the language and demeanour commonly exhibited across universities, which is why they should be more confident about finishing a doctoral degree and should assess their probability of success as higher. Due to their habitus, they should also be more likely to be considered up-and-coming scientists by university faculty members (Bourdieu, 1992; Leemann, 2002). Therefore, the social background effect should partly be mediated by the prospects of success of a doctoral degree (*Hypothesis 3*).

Regarding the *expected returns to a doctorate*, we can also assume that this differs by social class. For people from higher social classes, obtaining a doctorate may be important to maintain the social status of their parents, especially when one of their parents also has a doctorate (Jaksztat, 2014; Mastekaasa, 2006). A doctoral degree yields a higher subjective

return for this group, because people try to avoid downward social mobility (*relative risk aversion theory*; Breen & Goldthorpe, 1997). Following Bourdieu (1983a), privileged groups should also increasingly seek more exclusive and higher levels of educational qualifications because the traditional tertiary degrees (*Diplom, Magister*, or master's degrees) have lost their exclusivity due to educational expansion. A doctoral degree may therefore be a means of gaining distinction for people from high-status classes. For lower social classes, in contrast, taking up a doctorate can also have negative consequences, as students may fear alienation from the context of origin. If family and friends evaluate the aspiration for a doctoral degree as negative and out of touch with their lives, (inner) conflicts might emerge between the milieu of origin and the academic context (Jaksztat, 2014). In general, a doctorate involves scientific training that yields benefits of various kinds. In addition to intrinsic motivation, e.g., interest in research and personal development, many people also cite the potential economic and professional opportunities as benefits of a doctorate. The economic aspects are primarily of relevance for legal scholars, medical professionals, and natural scientists (Fabian & Briedis, 2009). We therefore expect that the effect of social background is partly transmitted by differences in benefits (*Hypothesis 4*). Taken together, cost-benefit evaluations (secondary effects) should be relevant for the explanation of social background differences in the transition to doctoral studies.

4.2 Educational biographical factors in the transition to doctoral studies

The socially unequal decision to start a doctoral degree should not only be influenced by class-specific performance differences and individual decision parameters but also by formal requirements and preconditions of the educational pathway (Lörz & Schindler, 2016). The selection into type of tertiary institution and field of study, in particular, are relevant context factors for the desirability and possibility of a doctoral degree. While traditional universities provide classic academic training, universities of applied sciences have no general right to award doctorates and are more practically oriented, thus educating only a small percentage of doctoral students (Federal Statistical Office, 2012; HRK (German Rectors' Conference), 2017). Further, the proportions of students who progress to complete doctoral degrees vary considerably across study subjects. Particularly in medicine and the natural sciences, a doctorate is useful for a professional career, being almost the standard qualification (Fabian, Rehn, Brandt, & Briedis, 2013; Federal Statistical Office, 2012). In addition, the choice of type of institution and field of study at the start of an undergraduate degree is socially selective

(Reimer & Pollak, 2010). Traditional universities attract students from higher social backgrounds to a much greater extent than universities of applied sciences, and prestigious subjects such as medicine and law are mainly popular among students from higher social classes (e.g., Mayer et al., 2007; Reimer & Pollak, 2010). Furthermore, some fields of study like medicine restrict access to top graduates from secondary school, meaning that primary effects should partly be transmitted by selection into study subject and tertiary institution.

A further relevant educational biographical factor concerning the transition to doctoral studies is the position as a student assistant or tutor as a source of social capital (e.g., Bourdieu, 1983b). Students who are embedded in the scientific network have the chance to meet professors and present themselves as high-performing and motivated students, which can yield the offer of a doctoral student position after graduation or other support, e.g., in the form of a letter of recommendation. We assume that students with good university marks are more likely to be selected as student assistants or tutors, as are students with higher parental education, as they are more familiar with the language and intellectual habitus of a university and are more confident within the academic context (Jaksztat, 2014; Lenger, 2009). Thus, students from privileged families would be expected to work more often in this study-related employment, although overall students from lower social classes are more dependent on employment to finance their studies (Bargel & Bargel, 2010). To sum up, we expect that choice of tertiary institution, field of study, and position as a student assistant or tutor are relevant educational biographical factors that contribute to the explanation of social background effect in the transition to doctoral studies (*Hypothesis 5*).

5 Data and method

5.1 Sample

The study is based on data from the longitudinal study BIJU (Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood Study) (see Baumert, Gruehn, Heyn, Köller, & Schnabel, 1997). The longitudinal study was initiated by the Max Planck Institute for Human Development (MPIB) with grade 7 students in 1991 and now comprises 7 waves; the last survey was carried out in 2009/10 with people who were 32 years old on average. The sampling comprised four German states: North Rhine-Westphalia, Mecklenburg-Western Pomerania, Saxony-Anhalt and Berlin; thus the study is not representative for all of Germany but only for the four states. The random sample, stratified by

state and school type, included two classes from each of 212 schools. For the present study, we mainly used data from wave 4 (grade 10, 1995), wave 5 (grade 12/professional training, 1997), wave 6 (work/tertiary degree, 2001-2002), and the most recent survey of wave 7 in 2009–2010.

During secondary school – up to wave 4 – the sample decreased from 8046 students to 5386 participants, which was primarily due to students leaving secondary school after grade 9, repeating a year, switching school type, or relocation, and to entire schools dropping out of the study. In the 5th wave of the survey, there was an oversampling of the students in the upper classes of the academic *Gymnasium* school type. The loss of study participants after formal schooling ended through to wave 7 can be attributed to two main causes: first, not all participants could still be contacted after secondary school ended (those for whom addresses were available), and second, not everyone who could be contacted replied. To establish contact in wave 7, the address data of $N = 5,523$ persons were available; the return rate of the survey was 75%. Analyses on which of the study participants were available in wave 7 and who replied revealed a slight bias in favour of women ($\chi^2 = 78.69$, $df = 1$, $p < .001$; $CC = .09$ and $\chi^2 = 75.16$, $df = 1$, $p < .001$; $CC = .12$), *Gymnasium* attendees (academic track) ($\chi^2 = 55.31$, $df = 1$, $p < .001$; $CC = .07$ and $\chi^2 = 82.79$; $df = 1$; $p < .001$; $CC = .13$), and people with mothers with a tertiary degree ($\chi^2 = 6.30$; $df = 1$; $p < .05$; $CC = .03$ and $\chi^2 = 17.93$, $df = 1$, $p < .001$; $CC = .06$) at both stages.

Information from wave 7 when the participants were around 32 years old served as the basis for determining the sample of 2214 participants with a tertiary degree. Using the information on professional activities, tertiary degree, and additional open activity details, we identified tertiary graduates who had started a doctoral degree and who had, in some cases, already completed it ($N = 363$, unweighted). We calculated the following analyses using weights that correct for the differential sampling probability by school type and survey wave ($N = 316$ doctoral students).

5.2 Instruments

Social background served as the central independent variable in the analysis. This was operationalised via the parents' educational qualification (collected in wave 6), grouped into three exclusive categories: no parent with a tertiary degree, at least one parent with a tertiary degree, and at least one parent with a doctorate. Parental educational level should be especially relevant as a structural feature of family background for social comparison processes for the

group of tertiary graduates, who have already spent a lot of time in the education system. In addition, educational qualifications are ordered in a simple and hierarchical way, which makes it easy for young people to compare their own educational attainment with that of their parents (cf. Mastekaasa, 2006).

To measure performance differences as primary effects, we were able to access secondary school and tertiary degree scores as well as the results of standardised achievement tests from participants' time spent at school. Using the final marks and test performance scores, we extensively operationalised the primary effects, which is useful for maximally exploiting existing performance information and thus counteracting an underestimation of primary social background effects (see Stocké, 2007). The test results in mathematics and English were recorded in grade 12, while the cognitive skills were measured in grade 10. The maths test was conducted using national and international test tasks from various school performance studies (Cronbach $\alpha = .73$); English-language performance was based on a TOEFL test with the three subscales: listening comprehension (Cronbach $\alpha = .85$), structure and written expression (Cronbach $\alpha = .81$), and vocabulary and reading comprehension (Cronbach $\alpha = .82$). The reliability of the English full scale used was $\alpha = .92$. Cognitive skills were measured using a figural subtest from the KFT 4-13 (Heller, Gaedicke, & Weinländer, 1976) (Cronbach $\alpha = .88$). A WLE estimator (Weighted Likelihood Estimate; Warm, 1989) was used for the test results in maths and English and the basic cognitive skills assessment.

We modelled secondary effects in the form of cost and benefit considerations (see Erikson & Jonsson, 1996) using indicators taken from the period in which study participants would have been attending tertiary institutions (wave 6; 2001–2002). Table 1 gives an overview of the constructs and items used. The expected *benefits* were operationalised based on participants' responses to the statement that a doctorate would be useful for professional development (1 = very useful to 4 = rather disadvantageous) as well as their views on the relevance of entering a profession with a high reputation (1 = very important to 4 = unimportant). These two items were intended to capture the returns from a doctoral degree both in terms of professional usefulness and in terms of maintaining social status. The status maintenance motive should ideally be investigated in relation to parental status, but since there is no item in the data set that captures this aspect directly, we approximated this using the question of the relevance of entering a profession with high reputation because a participant's intention to achieve the same status as his/her parents should be reflected in the pursuit of a job with high standing (see Schindler & Reimer, 2010). The subjective *probability of success* was

operationalised using a scale with 6 items for self-efficacy expectations of aptitude ranging from 1 = strongly agree to 4 = strongly disagree (Skinner, Chapman, & Baltes, 1988) (Cronbachs $\alpha = .80$). The concept of self-efficacy expectations is related to the concept of the subjective probability of success, as this judgement expresses an assessment of one's own ability to act (Bandura, 1986). The *costs* were captured via an item on the relevance of degree duration – the question asks how important a shorter period of time to degree completion was for their choice to study at their current tertiary institution³ (1 = very important to 4 = not important). All items were reversed for the following analyses.

As relevant educational biographical factors, we considered the type of tertiary institution (0 = university; 1 = university of applied sciences, university of education, university of cooperative education⁴) and the subject studied. We grouped the subjects into the STEM subjects (science, technology, engineering, and mathematics), medicine, law, and ESC (economic, social, and cultural studies). Further, we created a dummy variable for position as a student assistant or tutor, collected from an item in wave 6 during participants' tertiary degree studies asking how many hours per week they spent pursuing this activity. We also took gender into account as a control variable.

5.3 Statistical analyses and dealing with missing values

To describe the social background effect, we first considered the bivariate associations between beginning a doctorate and parents' educational background. To analyse which variables can transmit a social background effect, we also reported on the relationships between the analysis variables and starting a doctorate and parents' educational background. The multivariate analyses are conducted in several steps: To test the interplay between social background and performance aspects, we carried out an effect decomposition of the social background effects to examine what proportion of the effects can be traced back to primary effects in sum. After, we conducted a stepwise logistic regression, as we expected variables of cost-benefit analysis and factors of the educational biography to contribute to the explanation of the social

³ The operationalisation of the costs means that differences in the responses are strongly mediated through institution type, since the average duration of studies at universities of applied sciences is shorter.

⁴ Universities of education and universities of cooperative education, which integrate vocational training and tertiary education, are less frequently attended tertiary institution types than traditional universities and universities of applied sciences.

background effect. To further quantify the contribution of each explanatory variable to the social background effect, we also disentangled the effects of the variables.

We performed the logistic regression and the effect decomposition in Stata using the *KHB* method (Karlson, Holm, & Breen, 2012; Kohler, Karlson, & Holm, 2011). *KHB* is a decomposition method that is unaffected by rescaling and thus allows researchers to compare the coefficients of nested logistic regression models, which is not the case in conventional logistic regressions. This method holds the explained variance constant in all models by using the residuals (a regression of the independent variables on the missing ones) as additional explanatory variables in the reduced models. The advantages of *KHB* compared to other decomposition methods is that the method is very intuitive, delivers unbiased results, and does not require the variables to be decomposed to be categorical (Karlson & Holm, 2011). The *KHB* method allowed us to identify the total effect of parental education (without mediating variables); the proportion of the effect that is mediated directly via performance, that is, the primary (or indirect) effect of parents' educational background; and the proportion of the direct effect remaining after controlling for performance indicators. *KHB* also offers an option to disentangle the contribution of several explanatory variables to the social background effect (Kohler et al., 2011). The option disentangle is not supported when, as in our case, multiple imputed data are used (see below). However, one can run the analyses for each of the datasets separately and pool the coefficients of each variable afterwards. We report the coefficients of the logistic regression and the effect decomposition as *average marginal effects* (AMEs). These indicate by how many percentage points the probability of entering a doctoral programme increases if the respective independent variable increases by one unit.

Since there were missing values for the variables used, multiple imputations were made using the R-package MICE (Multiple Imputation by Chained Equations; Van Buuren & Groothuis-Oudshoorn, 2011). In the process, we generated twenty complete data sets, which we used in the analyses according to the formulas of Rubin (1987) in order to adequately account for the *between-* and *within-*imputation variance. In addition to the analysis variables, we predicted the imputations using important auxiliary variables such as psychosocial characteristics and class averages of HISEI and performance tests. We considered the hierarchical data structure for the estimation of standard errors in our analyses by using school affiliation as a cluster variable.

6 Results

6.1 Descriptive results

We first aimed at verifying whether tertiary graduates with parents from higher educational backgrounds more often start a doctoral degree. As expected, the percentage of students who enter a doctoral programme varies considerably with the social background (Fig. 1). The share is only 9% for students from families where neither parent has a tertiary degree. If at least one parent has a tertiary degree the share increases to 16% and 31% if at least one parent holds a doctoral degree. The differences between the groups are statistically significant.

As a first indication for the relevance of primary effects (performance) and secondary effects (costs, benefits, and subjective probability of success) of social background (Hypotheses 1 to 4), we differentiated the independent variables based on participation in a doctoral programme (Table 2) and parents' educational background (Table 3). Table 2 shows that tertiary graduates who start a doctoral degree have substantially and statistically significantly better school and tertiary degree marks (Cohens $d = 0.81$ and 0.59) and test results in English ($d = 0.50$), mathematics ($d = 0.42$), and basic cognitive skills ($d = 0.33$). With regard to the various decision-making components, these results only partially confirm our hypotheses. As expected, the doctoral students assess the professional value of a doctorate as higher and the costs⁵ in terms of an extended duration of study as lower. However, the groups do not differ in a statistically significant way with regard to the subjective probability of success – operationalised through the self-efficacy expectations – and the relevance of entering a profession of high standing.

Table 3 shows that, as suspected, the performance of graduates also rises with higher parental education. With a higher educational background, there is significant improvement in school marks, mathematics and cognitive skills assessment scores, and final degree marks. For English performance, the group in which one parent holds a doctoral degree differs significantly from the other two social background groups. In addition, it is evident that graduates with parents holding a doctorate evaluate the cost of a longer study programme as lower than other graduates and ascribe a greater professional value to a doctorate. We found no statistically significant differences according to parents' educational background for the statement regarding how important a profession of high standing is and also regarding the subjective

⁵ Significant differences in the responses to the item can also be seen when considering only the group of traditional university students.

probability of success in the sense of self-efficacy expectations (even if both variables tend to increase with parental education).

6.2 Multivariate results

6.2.1 Effect decomposition – quantification of primary effects

The descriptive results provide evidence that differences in performance (marks and standardised tests) according to social background (primary origin effects) should be relevant for the transition to doctoral programmes. By means of effect decomposition, we examined what proportion of the social background effect is mediated by differences in performance in sum and what proportion of the social background effect remains unexplained. Table 4 illustrates the total effects of parents' educational background based on a logistic regression analysis, the effects that can be explained through the performance indicators as well as the ones that remain after controlling for performance. The total effect of parents' educational background on beginning a doctoral degree is 7 percentage points ($b = .070, p < 0.001$) for a parental tertiary degree and almost 22 ($b = .217, p < 0.001$) percentage points for a parental doctoral degree. That means that compared to tertiary graduates whose parents did not complete university, having one parent with a university degree increases the probability of starting a doctorate by 7 percentage points, and having a parent with a doctoral degree increases the likelihood by even 22 percentage points (cf. Fig. 1). The effects of the parental education categories that are mediated by the performance characteristics – 2.7 percentage points and 10.7 percentage points – can be understood as the indirect effects, that is, the primary effects of parents' educational background. This corresponds to a share of 39% and 49% of the total effects of social background. If we average the shares of both parents' educational background categories, 41% are due to primary effects (weighted average; 44% if we compute a simple, unweighted average; see also Karlson & Holm, 2011). The main explanatory power of the performance indicators can be traced back to the final marks. However, excluding the standardised test scores would lead to a – small – reduction of primary effect for tertiary graduates with a parent with a doctoral degree (from 49% to 42%, no table).

6.2.2 Disentangling the social background effects

The decomposition of the social background effect showed that, taken together, primary effects in the form of marks and test performance account for nearly half of the parents' educational background effect during transition to doctoral studies (Hypothesis 1). In the next step, we tested to what extent variables of the cost-benefit analysis as well as educational biographical factors are also relevant for the explanation of the social background effect (Hypotheses 2–5). For these purposes, in Table 5, we integrated in a stepwise manner the explanatory factors of performance (marks and test results, Model 2), the components of the cost-benefit analysis (costs, professional returns, status maintenance, and probability of success, Model 3), and the educational biographical factors (subject group, tertiary institution type, and job as student assistant, Model 4) and tested them together in Model 5. Gender served as a control variable in all models.

Model 1 (cf. Table 4) underscores the finding that graduates from more educated family backgrounds have an increased probability of transitioning to a doctoral degree. Integrating the performance features in Model 2 results in a significant reduction in the effects of parents' educational background. The main effects come from the final school and university degree marks. English language skills also have a positive effect. To explain the secondary effects, in Model 3, we included indicators for the cost-benefit analysis of a decision to begin a doctorate in addition to the performance characteristics. These contribute to an explanation of the remaining social background effect, as the decline of the coefficient of the parental doctoral degree demonstrates. A one standard deviation increase in expected returns increases the probability of beginning a doctorate by 4.1 percentage points. By contrast, a one standard deviation increase in the relevance of costs due to a longer time spent in a tertiary institution reduces it by 3.9 percentage points. The variable of the self-efficacy expectations, however, has a small, marginally significant, negative impact. As Model 4 demonstrates, the educational biographical factors notably help to explain the effect of social background, which loses its statistical significance. Further, it should be noticed that they also partially mediate the primary effect, their inclusion causes the coefficient of English performance to lose statistical significance and the effect of Abitur mark to decrease (compared to Model 2). Medical students have a higher probability of almost 19 percentage points of starting a doctorate compared to students of STEM subjects. Students of economics, social, and cultural sciences, in contrast, have a lower probability by 10 percentage points compared to STEM students. Not being a student at a traditional university also reduces the probability of transitioning to a doctoral degree by 17 percentage points, while having a job as a student assistant or tutor raises the probability of beginning doctoral studies by 5 percentage points, although the effect is reduced

and only marginally significant. In a final joint model (Model 5), it is evident that the effects of the final school and university degree marks, the perceived professional returns of a doctorate and the subject and institution type selected on the transition to a doctoral degree remain statistically significant.⁶

To further quantify the explanatory power of the variables, Fig. 2 displays the contribution of the variables to the reduction of the social background effects in percent.⁷ Taken together, 70% and 82% of the social background effects can be explained. The results confirm that performance features, namely final school and tertiary degree marks, strongly contribute to social background differentials. Around 22% of the social background effects can be explained by final marks. The strongest explanatory power can be traced back to the type of tertiary institution which explains 43% resp. 38% of the social background effects. The decision-making components, in particular the professional returns, explain around 5% of the transition gap between tertiary graduates without a parent with a tertiary degree and tertiary graduates with at least one parent with a doctoral degree.⁸ The subject area mediates 7% of the social background effect between tertiary graduates without a parent with a tertiary degree and tertiary graduates with at least one parent with a tertiary degree, and 13% of the effect between tertiary graduates without a parent with a tertiary degree and tertiary graduates with at least one parent with a doctoral degree. The explanatory power of the job as a student assistant or tutor is relatively low with around 1%. To sum up, the effect of parents' educational background can thus mainly be explained by final marks and the selection into particular fields of study and types of higher education institutions. These results are in line with our hypotheses 1 and 5. The perceived professional benefit of a doctorate is a relevant factor at least for the social background effect between the lowest and the highest educational background group (Hypothesis 4).

⁶ We also estimated a logistic regression that excluded medical students, as they constitute a special group with a high transition rate to doctoral studies. The initial effect of having a parent with a doctorate slightly decreases when we exclude this group, but the principal findings in the full model remain.

⁷ It should be noted that the social background effects to be decomposed (0.082 and 0.185) are slightly different compared to the ones presented in the logistic regression (0.075 and 0.216) as the disentangle option with AME coefficients implemented in Stata does not integrate the social background variable as a factor variable, but with independent dummy variables. However, the difference in modelling of the social background variable should not be of greater relevance for the decomposition results.

⁸ Decision-making components and test performance have a low negative impact on the reduction of the social background effect between graduates with no parent with a tertiary degree and graduates with at least one parent with a tertiary degree with -0,7% and -2,0%, meaning that they do not contribute to the explanation. Such effects are discussed in the literature as suppressor effects (see Lörz, 2013).

7 Summary and discussion

The aim of the present study was to investigate the influence of parents' educational background on transitions to doctoral degrees and to expand the state of the research by performing an effect decomposition, which includes standardised test performance in addition to final marks, as well as to model the secondary effects of social background. Even for the comparatively late educational transition to a doctorate, parents' educational background effects still emerged and almost half of them can be traced back to differences in performance. On closer examination, social background effects are mainly mediated by final marks, the subject area and the type of tertiary institution. In summary, the predictors in our models can explain a considerable part of social background effects in the transition to doctoral studies.

The descriptive analysis revealed that, as expected, tertiary graduates from higher educational backgrounds were more likely to start doctoral studies. This corroborates findings from other national and international studies (e.g., Jaksztat, 2014; Mullen et al., 2003). In addition, the analysis confirmed that doctoral students perform better in tests and have better final marks, a pattern that is also evident for higher parental education groups. Doctoral students and tertiary graduates with a parent who holds a doctorate also estimate the cost of a doctoral degree, operationalised via the duration of studies, as lower, and rate the professional benefits of a doctorate as higher than do other graduates. However, the importance of a profession with high prestige (status maintenance motive) and the subjective probability of success in the form of self-efficacy did not differ between students who embarked on a doctorate and those who did not, or between different parents' educational background groups.

In the multivariate analyses, a substantial effect of parental education emerged, especially if at least one parent also had a doctorate. This shows that, contrary to assumptions based on the selection and life course hypothesis (Blossfeld & Shavit, 1993), there are still significant social differences in transitions to doctoral degrees. This is remarkable since the graduates are an already heavily selected group and have been exposed to various selection mechanisms throughout school and university. Hence, this should suggest substantial homogenisation with respect to skills and motivation (however, the lack of differences in the importance attributed to a profession with a high prestige and the self-efficacy could hint at that direction). An effect of parents' educational background remained even after controlling for performance measures. This is consistent with most other studies on the transition to a doctorate in which the social background effect was also only partially mediated by performance (see e.g., Jaksztat, 2014; Lörz & Schindler, 2016; Mastekaasa, 2006; Mullen et al., 2003). The effect decomposition

showed that final marks and test performance can explain 39% to 49% of the effect of parents' educational background in sum. Studies on the transition to tertiary institutions that undertook an effect decomposition mostly found significantly higher secondary than primary effects and assumed decreasing primary effects over educational careers through a homogenisation of the performance level via selection in the education system (see Erikson, 2007; Schindler & Reimer, 2010). The findings from this German study suggest that, especially for the more strongly selected group of tertiary graduates, performance characteristics are once again relevant in access to doctoral positions and the associated entry into the labour market. In contrast to access to undergraduate degree courses for which, with the exception of courses with restricted entry, there is a relatively large choice in Germany, access to doctoral studies involves applying to a faculty member in a university and hence more competition, meaning that performance criteria seemingly gain in importance as signals in the selection process. Moreover, this reveals the relevance of a (above-average) first degree mark for enrolling in a doctorate (see also Enders & Bornmann, 2001). However, it also should be noticed that the effect of test scores in English, and partly the effect of Abitur mark, were reduced when we considered the selection into type of tertiary institution and field of study. Thus, performance in school also has an impact on where and what students study (see also Jaksztat, 2014).

The mediation analysis revealed that, besides the final marks, the field of study and especially the type of tertiary institution are important for the explanation of social background effects. For the promotion of social equality at the transition to doctoral studies, this means that it is important to consider the relevance of the selection at the beginning of tertiary studies (see Lörz & Schindler, 2016). The recent tendencies to broaden the possibilities of graduates from universities of applied sciences to enter doctoral studies in Germany (Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2017) could weaken path dependencies and open the door to students especially from lower social backgrounds to enter an academic career. Further, the increasing relevance of structured doctoral programmes in Germany (Federal Statistical Office, 2016) might help to lower the impact of social background at the transition to doctoral studies, since the finding of de Vogel (2017) indicates that social background effects are lower for structured doctoral programmes than for individual doctorates.

One strength of our study is that the primary effects could be operationalised extensively using both final marks and standardised test performance. This means that, in addition to final school and degree marks, the study had access to test results in mathematics, English, and

cognitive skills, which are objective measures of performance that, in contrast to marks, are not influenced by non-objective components, like the evaluation of teachers or reference-group effects. As a limitation, it must be noted that standardised test performance scores were collected before test participants finished school and that the skills such tests capture may be of differing relevance to the doctoral field of study. The advantage of using marks is that they are a visible measure of the tertiary graduates' performance (see Erikson & Rudolphi, 2010), that they have a signalling effect for university faculty members in indicating a student's ability, and that those degree marks are the performance measures that are recorded nearest to the start of the doctorate in temporal terms and also in terms of subject specificity. Although there were significant differences in the test scores between doctoral students and other graduates of tertiary institutions, and shares of primary and secondary effects partly changed to a certain degree including the standardised performance measures, they had little or no positive additional power to explain the social background effect above school and university marks and educational biographical factors.

A further limitation of the study is that the number of doctoral students includes only those who had begun a doctoral degree by the time they were in their early thirties on average (the last wave of the BIJU study was collected in 2010). One cannot discount the possibility that some tertiary graduates may have started a doctorate after this point in time and that this late entry into a doctoral programme may be correlated with factors such as performance and social background. Also, the variable for position as a student assistant or tutor was collected in wave 6 during participants' tertiary degree studies. Thus, it is possible that there are students who started the job after the collection of data, which could be a reason why the variable contributed less to a mediation of the social background effect than in the study by Jaksztat (2014). For the purposes of modelling cost-benefit considerations, we were able to rely on the longitudinal design of the BIJU study, which included information from before the start of the doctorate, meaning that we used prospective information and not, as is typically the case, retrospective information. However, one restriction that should be noted in this respect was that there was only one item to operationalise professional returns that specifically related to a doctorate. The items for status maintenance, the subjective probability of success, and the costs – none of which showed effects in bivariate or multivariate terms – only approximate these constructs, which would suggest that the explanatory power of the items would rise if there was a more proximal operationalisation. In particular, the measurement of the subjective probability of success, via items concerning self-efficacy expectations, captures the concept relatively broadly and not specifically with respect to confidence in successfully completing a doctoral

degree. The study of Neumeyer and Alesi (2018) indicates that the expected probability of success could be a relevant mediator for the social background effect at the transition to doctoral studies. Their study is however limited by the variable being collected after the beginning of doctoral studies. For future research, it would be desirable for longitudinal studies to more accurately identify the relevance of the costs, the status maintenance, and the subjective probability of success for starting a doctorate by operationalising these aspects in a more doctorate-specific way, to gain a deeper understanding of the mechanisms behind socially unequal access to doctoral degrees.

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Tables

Table 1: Operationalisation of rational decision-making components.

<i>Construct</i>	<i>Dimension</i>	<i>Item</i>
Benefits	Professional returns	With regard to my professional development, a doctoral degree seems useful to me (1=rather disadvantageous to 4=very useful)
	Status maintenance	Regarding my job it is important to me that I have a job with a high reputation (1=unimportant to 4=very important)
Costs	Duration of study	What were your reasons for studying at your current university/university of applied science? Please indicate how important a short period of study was for your choice (1=not important to 4=very important)
Probability of success	Self-efficacy expectations	<i>Scale (6 items; sample item)</i> I am sufficiently qualified for my job/study programme such that I can handle even the most difficult problems (1=strongly disagree to 4=strongly agree)

Table 2: Mean values of analysis variables by uptake of doctoral studies.

	<i>Graduates not pursuing doctoral studies</i>		<i>Graduates pursuing doctoral studies</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Performance features</i>				
Academic school certificate (<i>Abitur</i>) marks	2.50 _a	0.62	2.00 _b	0.62
Tertiary degree marks	2.10 _a	0.64	1.74 _b	0.57
Test performance English	0.63 _a	0.96	1.12 _b	0.99
Test performance maths	2.33 _a	0.84	2.71 _b	0.96
Basic cognitive skills	2.48 _a	1.16	2.86 _b	1.13
<i>Decision-making components</i>				
Costs	2.45 _a	1.02	2.01 _b	0.92
Professional returns	2.67 _a	0.78	3.08 _b	0.81
Status maintenance	2.53 _a	0.74	2.54 _a	0.78
Probability of success	2.92 _a	0.43	2.96 _a	0.42

Notes: Mean values with different subscripts differ significantly ($p < 0.05$). Standard errors were weighted for unequal group sizes.

Table 3: Mean values of analysis variables by parents' educational background.

	<i>No parent with tertiary degree</i>		<i>At least one parent with tertiary degree</i>		<i>At least one parent with doctoral degree</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>Performance features</i>						
Academic school certificate (<i>Abitur</i>) marks	2.58 _a	0.61	2.36 _b	0.63	2.09 _c	0.64
Tertiary degree marks	2.11 _a	0.64	2.02 _b	0.64	1.90 _c	0.62
Test performance English	0.59 _a	0.94	0.68 _a	0.98	1.27 _b	0.98
Test performance maths	2.25 _a	0.82	2.48 _b	0.87	2.64 _c	0.94
Basic cognitive skills	2.32 _a	1.17	2.68 _b	1.13	2.90 _c	1.09
<i>Decision-making components</i>						
Costs	2.48 _a	1.01	2.38 _a	1.02	2.06 _b	0.98
Professional returns	2.70 _a	0.79	2.68 _a	0.79	3.02 _b	0.79
Status maintenance	2.51 _a	0.74	2.55 _a	0.76	2.56 _a	0.76
Probability of success	2.92 _a	0.41	2.93 _a	0.44	2.94 _a	0.44

Notes: Mean values with different subscripts differ significantly ($p < 0.05$). The p -value was corrected for the significance test according to Bonferroni ($p < 0.0167$). Standard errors were weighted for unequal group sizes.

Table 4: Effect decomposition with *KHB* (average marginal effects).

	<i>b</i>	<i>Share effect (%)</i>
<i>Effect of parents' educational background</i> (Ref. No parent with tertiary degree)		
<i>At least one parent with tertiary degree</i>	0.070	
Direct effect	0.043	61 %
Indirect effect	0.027	39 %
<i>At least one parent with doctoral degree</i>	0.217	
Direct effect	0.110	51 %
Indirect effect	0.107	49 %

Note: Gender as a control variable.

Table 5: Logistic regression for start of doctorate (*KHB, average marginal effects*).

	Model 1		Model 2		Model 3		Model 4		Model 5		
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	
<i>Parents' educational background (Ref.: No parent w/ tertiary degree)</i>											
At least one parent with tertiary degree	0.075 ***	0.016	0.050 **	0.016	0.052 **	0.016	0.022	0.016	0.024	0.015	
At least one parent with doctoral degree	0.216 ***	0.031	0.116 ***	0.027	0.085 **	0.026	0.039	0.025	0.035	0.024	
<i>Performance features</i>											
Abitur marks ¹			0.051 ***	0.008	0.044 ***	0.009	0.031 ***	0.008	0.030 ***	0.009	
Tertiary degree marks ¹			0.052 ***	0.012	0.055 ***	0.012	0.050 ***	0.012	0.049 ***	0.012	
Test performance English			0.030 **	0.011	0.028 *	0.011	0.014	0.010	0.014	0.010	
Test performance maths			0.007	0.010	0.010	0.010	-0.004	0.011	-0.003	0.011	
Basic cognitive skills			-0.002	0.010	-0.002	0.010	-0.007	0.010	-0.006	0.010	
<i>Decision-making components¹</i>											
Costs					-0.039 ***	0.009			-0.002	0.009	
Professional returns					0.041 ***	0.010			0.021 *	0.010	
Status maintenance					-0.004	0.008			-0.004	0.008	
Probability of success					-0.016 +	0.008			-0.003	0.008	
<i>Educational biographical factors</i>											
<i>Subject area (Ref. STEM)</i>											
Medicine							0.188 ***	0.045	0.154 **	0.045	
Law							0.009	0.040	-0.005	0.039	
ESC ²							-0.096 ***	0.020	-0.095 ***	0.020	
Type of tertiary institution (UAS/UE/UCE ³)							-0.166 ***	0.017	-0.163 ***	0.019	
Job as student assistant/tutor							0.047 +	0.027	0.043	0.028	
<i>Control variable</i>											
Female gender	-0.007	0.012	-0.010	0.013	-0.016	0.013	-0.016	0.014	-0.017	0.015	
Pseudo-R ²										0.297	

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$; $N = 2214$; ¹z-standardised; ²Economic, social and cultural studies; ³UAS = University of applied science, UE = University of education, UCE = University of cooperative education; degree marks and Abitur mark are reversed (higher score = better mark).

Figures

Figure 1: Share of tertiary graduates who start a doctoral degree by parents' educational background (in %).

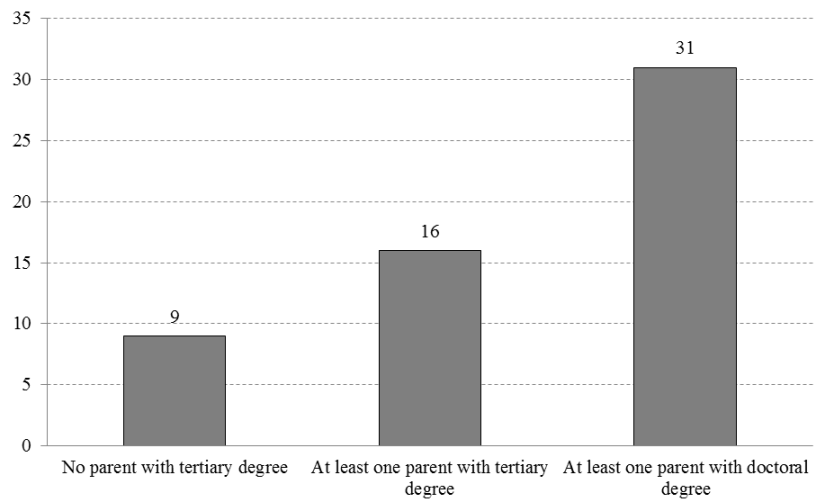
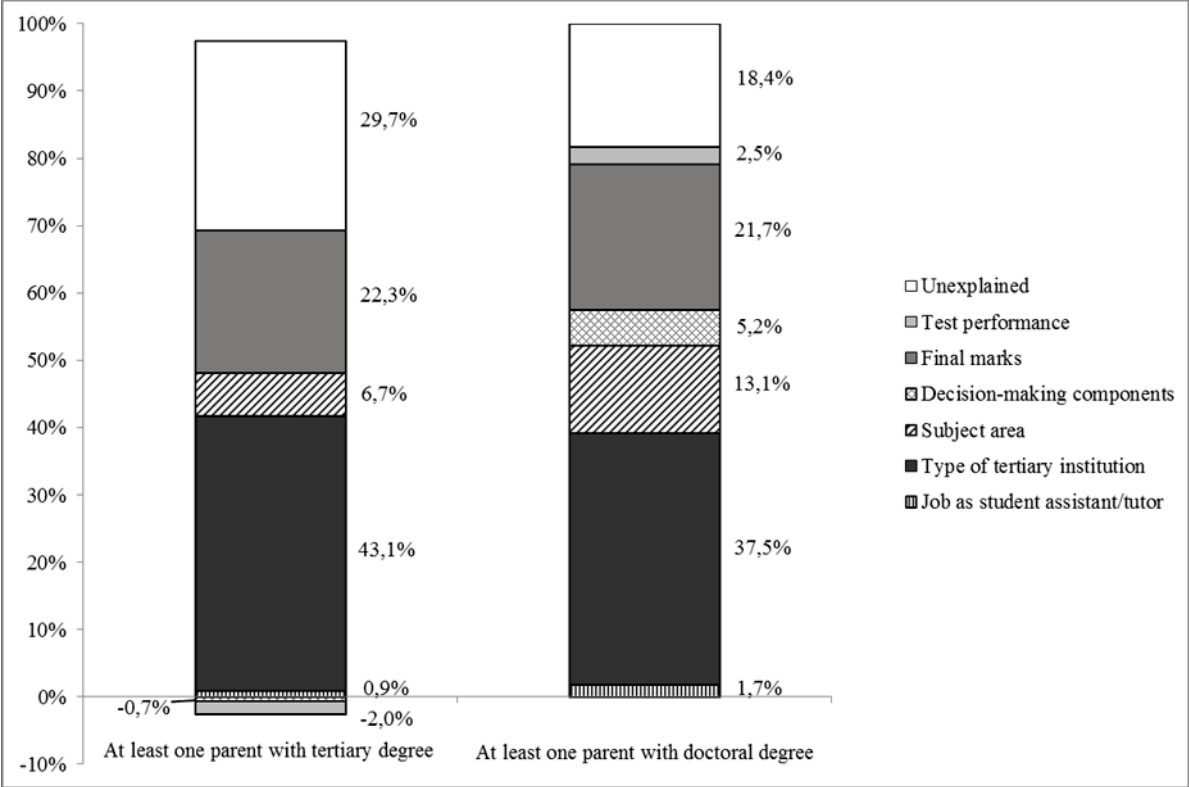


Figure 2: Contribution of explanatory variables to parents' educational background differentials in the transition to doctoral studies.



Notes: Ref. no parent with tertiary degree, gender as a control variable.