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Pfeifer, Christian; Yang, Phillip; Janssen, Simon; Backes-Gellner, Uschi

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by

Christian Pfeifer, Simon Janssen, Philip Yang and Uschi Backes-Gellner

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Christian Pfeifer

Leuphana University Lueneburg, Institute of Economics; and IZA

Simon Janssen

University Zurich, Institute for Strategy and Business Economics

Philip Yang

Leibniz University Hannover, Institute of Labor Economics

Uschi Backes-Gellner

University Zurich, Institute for Strategy and Business Economics

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Corresponding author: Pfeifer, Christian, Prof. Dr., Institut für Volkswirtschaftslehre, Abteilung Arbeits- und Personalökonomik, Leuphana Universität Lüneburg, Scharnhorststr. 1, 21335 Lüneburg. Tel. +49-4131-677-2301, Fax +49-4131-677-2026, pfeifer@leuphana.de.

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Abstract

We evaluate the effects of employer-provided formal training on employee suggestions for productivity improvements and on promotions among male blue-collar workers. More than twenty years of personnel data of four entry cohorts in a German company allow us to address issues such as unobserved heterogeneity and the length of potential training effects. Our main finding is that workers have larger probabilities to make suggestions and to be promoted after they have received formal training. The effect on suggestions is however only short term. Promotion probabilities are largest directly after training but also seem to be affected in the long term.

JEL Classification: J24, M53

Keywords: Human capital; Insider econometrics; Productivity; Promotions; Training

1. Introduction

Returns on human capital investments have received large attention in policy and research over recent decades (e.g., Bartel, 1995; Bishop, 1997; Bartel, 2000; Asplund, 2005; Frazis and Loewenstein, 2005). Next to schooling, human capital accumulation after entry into the labor market is considered key to economic performance at both the micro and the macro level. Research however faces some problems when studying the impact of employer-provided formal training on workers' productivity. Problems include the aggregation of heterogeneous training types across industries and firms as well as the lack of adequate variables to proxy productivity. For example, survey data of workers compare individuals across firms with different training programs and often use workers' wage increases as a proxy for productivity increases. Whereas wages might indeed be good proxies for productivity in perfect labor markets, they are obviously not so in imperfect labor markets. Survey data of firms, on the other hand, comprise only information about aggregated productivity (e.g., sales), which allows a comparison between firms but not between workers. Moreover, survey data often suffer from imprecise or even false statements about wages, training, and other variables. To overcome some of these problems, researchers have recently used personnel records of single firms. Although personnel data sets are not representative and are only econometric case studies ('insider econometrics'), they have the advantage of comparing workers in the same environment (firm, job, training) and of unbiased information about wages, productivity, and training.

Another potential problem when evaluating causal effects of training is that training participation is likely to be non-random. Thus, if participation depends on unobservable characteristics, a cross-section comparison between workers who participate in training and workers who do not participate is likely to suffer from omitted variable or selection bias. Panel data that exploit within variances can help to deal with this problem, because first differences or conventional fixed effects estimators address the issue of unobserved heterogeneity. More precisely, outcomes such as wages or productivity of a specific worker are compared before and after training. A number of empirical studies have recently used longitudinal data to close the research gap, but most attempts still suffer from measurement and aggregation biases in survey data. Moreover, few datasets provide sufficient long panels to be able to exploit the time dimension in more detail. But the length of training effects in particular is important to get an understanding of actual depreciation rates of human capital investments, which are largely unexplored.

In this paper, we evaluate the causal effects of training at the lowest micro level by using personnel records from one German company. The data allows us to follow 415 male blue-collar workers, who entered the company during the late 1970s, over the majority of their working life, i.e., for more than twenty years. In addition to information about participation in formal training courses, our data set provides unique information about employee suggestions that are of productive value for the firm. Although we cannot calculate returns on investments (ROI) due to missing information about training costs, actual benefits and costs of the implementation of suggestions, we think that the analysis of training effects on the probability to make suggestions is still important. First, employee suggestions have not been used previously to study training effects and are an interesting alternative to the often used supervisors' performance ratings in personnel data, which might suffer from subjectivity bias. Second, employee suggestions are important for firms to permanently improve the efficiency of their production processes. Although training and suggestion systems are often idiosyncratic to firms, the question as to whether training increases the probability of making suggestions for productivity improvements is of a general nature.

We further analyze training effects on promotions, which are defined as upward movement from one wage group to another and are hence associated with a wage increase. Promotions are important from the point of view of both employer and employee. Employees benefit from promotions by monetary gains and higher reputation, whereas employers can use promotions to make efficient job assignments. On the one hand, training can serve as a screening device without increasing individual productivity, i.e., the firm learns about abilities and skills of workers and can promote the best fitting (most productive) worker to the next job in the hierarchy. On the other hand, training might indeed increase individual productivity by teaching skills and knowledge that are important to fulfill tasks at higher job levels.

In order to estimate the causal effects of formal training on the likelihood of workers making suggestions and getting promotions, we use individual fixed effects linear probability and logit models. Our fixed effects approach helps to mitigate problems stemming from unobserved heterogeneity and non-random training participation. We further exploit the length of the panel by constructing four lagged training variables that allow us to analyze the length of training effects. Thus, we are able to identify whether the effects of training on productivity and promotions are short term or long term. The main findings of our econometric case study are that past training participation has significant positive effects on present suggestion and promotion probabilities. Training has the largest impact on suggestion and promotion probabilities in the year directly after participation. The further in the past the training participation has been, the more the training effect decreases in size and significance. This finding emphasizes the importance on the provision of employer-provided training throughout working life and not only in the early years of employment.

This paper is structured as follows. The next section summarizes previous empirical findings on the effects of employer-provided training. Section 3 informs about the personnel data set, provides descriptive statistics, and discusses the econometric framework. Section 4 presents the estimation results. The paper concludes with a short summary and a discussion of the results in Section 5.

2. Literature Review

Following the pioneering contributions by Becker (1962) and Mincer (1974), a substantial body of economic literature on human capital investments has addressed the determinants[1] and outcomes of training. A reason for the continuously growing number of empirical studies on the outcomes of training is rooted in recent advancements in overcoming methodological challenges and new data when trying to identify a causal effect of training participation.

The methodological problem in the attempt to evaluate training effects is based upon the potential endogeneity of the training variable. One source of this endogeneity stems from the concern about selection bias. Training participation is expected to be unevenly distributed across workers with different abilities. Workers and firms are likely to select those workers for training, for whom the expected returns are most favorable (Leuven and Oosterbeek, 2002). Endogeneity of the training variable might lead to omitted variable bias. If training represents one of many determinants of wages and productivity, the training effects could be over- or underestimated (Barron et al., 1989). To correct for endogeneity, recent empirical training literature mainly draws on methodological approaches such as a Heckman-type selection (Lynch, 1992; Veum, 1995), instrumental variables (Leuven and Oosterbeek, 2002), or fixed effects estimation (Booth, 1993; Barron et al., 1999).

Despite the improved methodological approaches to correct for endogeneity, data availability still represents a major problem for three main reasons. First, few studies find instruments which arguably affect training, yet not the outcome variable (Leuven and Oosterbeek, 2004). Second, most panel data sets are relatively short so that either variation is low or training cases are rare (Dearden et al., 2006). Short panels also do not allow inference about the length of training effects through the use of lagged variables (Frazis and Loewenstein, 2005). Third, despite increased efforts to find adequate measurements of training participation, few studies obtain distinct outcome variables, which unambiguously denote promotions in hierarchy and productivity on the individual level (Bartel, 2000).

Most empirical studies on training outcomes have addressed the wage effects of training participation (Bishop, 1997; Bartel, 2000; Asplund, 2005). The investigation of the effects of training on workers' promotions in hierarchies and on productivity has not received as much attention. The main explanation is that wages, according to traditional human capital theory, serve as an adequate proxy for hierarchy and productivity. In perfect labor markets, wages are equal to the value of marginal products of workers (Becker, 1962). Accordingly, promotions serve as recognitions of workers' increased productivities (Frazis and Loewenstein, 2005). However, in imperfect labor markets, employers are able to pay employees below their marginal product (Acemoglu and

Pischke, 1998). Increased wages from training participation would then fail to proxy the enhanced productivity of workers. Also, several empirical studies find significant variations of wages within job levels (Baker et al., 1994a, 1994b; Lazear and Oyer, 2007). Hence, a wage increase is not necessarily associated with more responsibility at work or a shift to higher job levels. For this reason, recent empirical literature emphasizes the need to distinguish between wages, promotions, and productivity (Asplund, 2005).

Frazis and Loewenstein (2005) use survey data of the National Longitudinal Study of Youth and the Employer Opportunity Pilot Project to evaluate the effect of training on subsequent promotions. Promotions are self-reported by workers and indicate if they have received a promotion in hierarchy or whether their job responsibilities have increased. The authors estimate fixed effects regressions and find positive effects of current and past training participation on promotion probabilities. Surveys entail, however, subjective responses of individuals, which are likely to be subject to measurement errors (Bartel, 1995). Furthermore, the training variable underlies significant heterogeneity so that questions remain as to how adequate the aggregation of different training types is, despite the effort to enhance the informational value of training measures through the observation of hours spent on training spells.

Krueger and Rouse (1998) examine the impact of workplace education programs for one blue-collar and one white-collar company. They limit training heterogeneity by observing one standardized type of training form, which is partially governmentally financed and undertaken at the local community college between 1991 and 1995. By estimating an ordered probit model, the authors find that trained workers are much more likely to make job bids and to receive job upgrades in comparison to untrained workers.

Yet, the results suffer from a relatively low number of observations and insufficient panel length. Instead of using econometric approaches to limit selection bias, they have to assume that selection is controlled for by sufficient information on observed characteristics.

Most empirical studies on training effects on productivity use industry data or matched employer–employee data (Bartel, 2000). This slowly growing branch of literature typically makes use of the standard Cobb–Douglas production function and observes firms over several years.[2] In general, most of these studies find positive effects of the share of trained workers on labor productivity, which diminishes with the inclusion of human resource management characteristics. Few empirical studies have, however, looked at productivity effects of training participation at the individual worker level.

Pischke (2001) uses data from the German Socio Economic Panel from 1986 to 1989. He observes detailed information on workers’ participation in formal training programs. As a training outcome, the author makes use of workers’ responses on benefits from training participation. He finds support for a positive effect of formal training on self-reported performances of workers and interprets this finding as increased productivity. Despite the comprehensive design of the training variable, his results are questionable with respect to the implication for productivity.

Bartel (1995) recommends the use of data from personnel records of a single firm (econometric case study) for three main reasons. First, personnel records provide exact training time and type. Second, training of workers is done by the same firm, corresponding to more homogeneous training measures. Third, workers’ outcomes are more comparable if they work for the same firm. Bartel (1995) uses personnel records from a large manufacturing company from 1986 to 1990. To determine the effect of training on productivity, she uses information on performance evaluations by supervisors. Formal training has a positive and significant effect on the performance evaluations of workers, from which she draws the conclusion that formal training has a productivity-increasing effect. The short panel does not, however, allow any implications on the length of training effects, and supervisors' performance ratings might suffer from potential biases such as subjectivity. A recent study by Breuer and Kampkötter (2010) uses three years of personnel records from a German multinational company and fixed effects methods. The main finding is that training only has a positive effect on several performance-related outcomes in the same year that training participation takes place. The research design might however suffer from the short panel length.

In sum, the potential endogeneity of the training variable demands sophisticated econometric methods in order to determine the causal effects of training participation on distinct outcomes such as wages, promotions, and productivity. Although several approaches to estimate causal effects exist, data availability represents a major problem. Panels are usually rather short so that the variation of training and outcomes is low. Furthermore, few data sets offer persuasive information with regard to training and outcome variables. The training variable in survey data is usually aggregated through heterogeneous training types across firms and industries. As training outcomes, most empirical papers use wages to proxy hierarchy or productivity, and those which actually observe hierarchy and productivity rely on either heterogeneous outcomes or subjective evaluations. We complement existing studies by using an insider econometric approach with long balanced panel data for one firm, which comprise unique information about training and outcomes such as employee suggestions and promotions. The data set allows us to apply fixed effects estimation techniques with lagged training variables to make inference about the length of training effects.

3. Personnel Data, Variables, and Econometric Method

We analyze the personnel records of a large company from the energy sector located in Western Germany. The company is subject to a collective contract and has a works council. Due to data protection reasons we are neither allowed to name the company nor to give detailed information. The data comprise yearly information about a subsample of 438 blue-collar workers in the company's mining business, who entered the firm in four subsequent cohorts from 1976 until 1979 and stayed in the company over the entire observation period up to the year 2002. The sample represents a share of about a quarter of all employees in the company's operation unit and 3.5 percent of the company's entire workforce.

For our analysis, we restrict the sample to German male blue-collar workers without missing values in the used variables. This restriction reduces our sample by 5 percent to 415 different workers. As we are interested in the long term effects of training, we use four lags of training participation so that the first four yearly observations of every worker are dropped from the estimation sample. Moreover, all observations from the last observation year 2002 are dropped from the estimation sample, because no promotion variable can be constructed. The final sample contains 8,469 yearly observations of 415 different workers.[3] Nearly 20 percent of these blue-collar workers do not have any secondary school degree, about 72 percent have the lowest secondary school degree (*Volks-/Hauptschulabschluss*), and about 8 percent have at least successfully completed medium secondary school (*Realschule*). We further know that about a quarter of these workers have no apprenticeship qualification, about a quarter have completed their apprenticeship in the analyzed company, and the remaining 50 percent have performed their apprenticeship in other firms.

Formal employer-provided training in the company is divided in four different types: (1) short training course (*kurze Schulung*) (one or two days); (2) longer training course (*längere Schulung*) (up to several weeks); (3) longer vocational re-training (*längere Umschulung*) (up to several weeks); and (4) longer academy of vocational training (*Berufsakademie*) (up to several weeks). We observe a total of 626 training cases. More than two thirds are short training courses, whereas the other training types are nearly equally distributed. Due to the rather small number of cases in most training types, we use a binary variable that takes the value one if a worker participated in any kind of training. To reduce heterogeneity in the training courses, we also analyze the effects of short training courses separately. Unfortunately, we do not have information about the direct and indirect costs of these training courses or about their actual contents. We know however that workers are paid during the training period and do not have to cover any direct costs. Thus, all costs are covered by the employer.

In order to evaluate the effects of formal training in the company, we use two outcome variables. The first outcome is a binary variable that indicates if a worker makes a suggestion. These suggestions are of productive value for the firm and workers receive monetary rewards for them. Unfortunately, we do not know more about the value of the suggestions and of potential implementation costs. As we analyze blue-collar workers in the mining business, it seems likely that most suggestions are about more efficient work arrangements. Formal training courses might teach new aspects in work arrangements or stimulate thoughts about the current work arrangements so that workers might have larger probabilities to make suggestions after such training. We observe 356 suggestions by workers, which results in a yearly average of about 4 percent. The second outcome variable to assess the training effects is a binary variable that indicates if a worker gets promoted from one wage group in a given year (*t*) to a higher wage group in the subsequent year (*t+1*). The underlying wage groups are obtained from the collective contract and promotions are by definition associated with a significant wage increase, which might be explained by a productivity increase due to training. We observe 511 promotions, which results in a yearly average of about 6 percent.

Since we have introduced our main variables, we can turn to our econometric framework that is described in equation (1). In principal, we estimate the impact of lagged training participation *T* of worker *i* on his outcomes *Y* in year *t*, which are worker suggestions and promotions. We further include a set of time variant control variables *X* (age in years, squared age divided by 100, wage groups as continuous variable), time fixed effects λ_t, and worker fixed effects ν_i. ε_{it} is the usual error term. The parameters to be estimated are denoted with β and δ. Descriptive statistics of the variables are presented in Table 1.

$$Y_{it} = \beta_1 T_{i,t-1} + \beta_2 T_{i,t-2} + \beta_3 T_{i,t-3} + \beta_4 T_{i,t-4} + \delta X_{it} + \lambda_t + \nu_i + \varepsilon_{it} \quad (1)$$

- *insert Table 1 about here*

The coefficients of interest are the βs, which are the effects of formal employer-provided training on the probability that a worker makes a suggestion or gets promoted. Using the lags of training participation has the advantage of estimating the correct causal direction, because past training participation has to affect current outcomes. Moreover, a comparison of the βs allows inference about the length of training effects. The inclusion of time and worker fixed effects reduces efficiency of the estimates but makes it more likely that estimates of the βs are consistent because omitted variable biases are reduced. Since worker fixed effects are jointly significant in all estimated specifications and Hausman tests reject the null hypothesis of no systematic differences with random effects estimates, we choose to use only fixed effects models. Because of potential problems in fixed effects probit and logit models, we prefer to estimate fixed effects linear probability models (LPM) using ordinary least squares. As a robustness check, a fixed effects (conditional) logit model is applied, which supports the findings from the linear models. According to Angrist (2001) linear models can be appropriate even for limited dependent variables if the main objective is to estimate causal effects and not structural parameters.

In order to provide consistent effects for the βs, the $T_{i,t-1}$ to $T_{i,t-4}$ must be strictly exogenously conditional on our variables in X_{it} and the unobserved effects υ_i, i.e., $T_{i,t-1}$ to $T_{i,t-4}$ must be uncorrelated not only with ε_{it} but also with $\varepsilon_{i,t-1}$ and $\varepsilon_{i,t+1}$. In our case, one might argue that the firm selects a worker for training because the worker made a particularly good suggestion in the former period, which signals his ability to the employer. If this were the case, $T_{i,t-1}$ to $T_{i,t-4}$ should be correlated with $\varepsilon_{i,t+1}$ and, consequently, our estimates of β would not be consistent. Therefore, we carried out a test of strict exogeneity proposed by Wooldridge (2002, p. 285). The test is performed by incorporating $T_{i,t+1}$ into regression equation (1). Under strict exogeneity, the coefficient of $T_{i,t+1}$ should not be significantly different from zero. As we cannot find a significant effect of $T_{i,t+1}$ in any of our specifications, we are confident that the assumption of strict exogeneity is fulfilled in our fixed effects regressions.

4. Estimation Results

The estimation results for the probability of employee suggestions are presented in Table 2. The first four specifications are estimated using fixed effects linear regressions (LPM) for the complete sample. Specification one includes only the first lagged training participation variable and no time fixed effects (year dummies). The predicted probability to make a suggestion for an average worker without training is about 4 percent and for an average worker, who has received training during the last year, it is about 6.6 percent. The absolute marginal effect of 2.6 percentage points is of statistical significance (p=0.011) and of economic importance (relative marginal effect is 2.6/4=65 percent). Specification two includes additional time fixed effects, which are jointly significant in an F-test. The estimated training effect is only slightly reduced to 2.4 percentage points. Specification three includes the complete four lags of training participation and no time fixed effects, and specification four also includes the time fixed effects. It can be seen that the marginal effect of the first lag is slightly reduced to 2.4 and 2.2 percentage points but is still highly significant. The other three lags, i.e., training participation at least two years ago, have no significant effect on the suggestion probability.

- *insert Table 2 about here*

The last column in Table 2 includes a robustness check concerning the method and sample. A fixed effects (conditional) logit model for the complete specification (all lags of training and time fixed effects) is estimated on a subsample of workers who have actually made a suggestion in the observation period. The estimated coefficients support the findings from the linear estimates that only the first training lag has a significant effect. A noteworthy result of the estimates in Table 2 is the inverted u-shape effect of age on the suggestion probability, which has its maximum around the ages 35 to 40 years. If suggestions are related to productivity, this finding is consistent with concave productivity-age profiles known from other studies. In combination with the result that the training effect on suggestions as proxy for productivity is only short term, one might conclude that it is important for the employability of aging workers to invest more in their human capital.

Table 3 informs about the estimation results for the probability that a worker gets promoted, which is associated with a significant wage increase. Specification one (first lag, no time fixed effects) reveals an absolute marginal effect of 7.7 percentage points due to training in the last year, which is highly significant. An average worker without training has a predicted promotion probability of 5.5 percent, whereas an average worker with training has a predicted promotion probability of 13.2 percent. The estimated training effect is with 8.25 percentage points even larger, if time fixed effects are included in specification two. Specifications three and four include all four lags of training participation. The estimated effects for the first training lag do not change significantly. Furthermore, the effect of the second lag is not significant, whereas the effects of the third and fourth lags are significant again. The third lag has a marginal effect of about 4 percentage points and the fourth lag of about 3 percentage points. But if these effects are compared with the effect of the first lag, it emerges that they have only half the size. The last column in Table 3 includes again a fixed effects (conditional) logit model for the complete specification (all lags of training and time fixed effects), which is estimated on a subsample of workers who have actually been promoted in the observation period. The estimated coefficients support the findings from the linear regressions. We further find in all specifications that workers at higher wage groups are less likely to be promoted.

- *insert Table 3 about here*

One might argue that suggestions and promotions are related to each other. For example, supervisors might be more likely to choose a worker for promotion who has recently made a suggestion. Therefore, the linear estimates for the complete specification (all lags of training and time fixed effects) have been repeated with additional control variables that include four lags of promotions in the suggestion regression and vice versa. Because these variables have no significant effects and the results already presented in Tables 2 and 3 virtually do not change, the estimation results of this robustness check are only presented in the Appendix (see Table A.1).

In a next step, we concentrate on short training courses to further reduce heterogeneity in the training variable. Short training courses are one or two day courses and make up about two thirds of all observed training cases in the data. For suggestion and promotion probabilities, we estimate fixed effects linear models for the complete sample as well as fixed effects logit models for subsamples of workers actually making a suggestion or being promoted in the observation period. The results are presented in Table 4 and are in general consistent with our previous findings on aggregated training. But two noteworthy differences arise. First, the effect of short training on suggestions is larger and significant for the last two years. Second, the effect of short training on promotions is smaller. These differences between short training and aggregated training might be explained by different course contents and aims. Short training courses are likely to be more concerned with improvements of current work arrangements and less with teaching completely new skills (e.g., re-training), which might however be important to obtain better paid jobs in the firm's hierarchy. Consequently, career-orientated longer training courses might indeed be more attractive for younger workers. On the other hand, short training courses, which seem to have only short term effects on productivity, are still important for older workers (skill updating, employability) and justified from an economic perspective because shorter amortization periods of old workers should play a minor role if depreciation rates are that large.

- *insert Table 4 about here*

5. Conclusion

In this paper, we have used unique personnel records of a German company to evaluate the effects of formal employer-provided training on employee suggestions and promotions. Following this 'insider econometric approach', we could address issues such as training course heterogeneity and unobserved worker heterogeneity. We have found significant positive but only short term effects of training on the probability to make suggestions, which indicate a high depreciation rate in this dimension. Moreover, we have found that training participation increases the promotion probability. Overall, the results are consistent with the human capital argument that training increases workers' productivities. The rather short term effect raises, however, the question of whether depreciation rates are larger than previously assumed and ROIs smaller than often computed. If this were the case, the often stated argument that old workers receive no training due to short amortization periods would not be that convincing anymore. Because we have used only a sample of blue-collar workers in one single firm and qualitative information about employee suggestions and promotions in an econometric case study, we cannot give concluding answers to this question. But we hope for more studies to come that use long panels of personnel data.

[1] For literature reviews on the determinants of training participation see Becker (1993), Leuven and Oosterbeek (1999), Neumark and Washer (2001), Leuven (2004), and Metcalf (2004).

[2] Empirical literature on the plant level uses mainly survey data of firms in the United States (Black and Lynch, 1996; Black and Lynch, 2001), UK (Dearden et al., 2006), Italy (Conti, 2005), Germany (Zwick, 2002), and Ireland (Barrett and O'Connell, 2001).

[3] The number of workers is n=105 for the entry cohort 1976. The observations included in the estimation sample for entry cohort 1976 ranges from 1980 to 2001, which leads to a panel length in years of T=22. For entry cohort 1977: n=96, T=21. For entry cohort 1978: n=77, T=20. For entry cohort 1979: n=137, T=19.

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Appendix

Table A.1: Trainings effects when controlling for promotion and suggestion

	(1) Suggestion	(2) Promotion
Training in t-1	0.0221**	0.0826***
	(0.0107)	(0.0150)
Training in t-2	0.0102	0.0161
	(0.0101)	(0.0133)
Training in t-3	0.0010	0.0410***
	(0.0088)	(0.0133)
Training in t-4	-0.0037	0.0298**
	(0.0082)	(0.0133)
Age	0.0081**	-0.0003
	(0.0033)	(0.0053)
Age squared / 100	-0.0114**	0.0063
	(0.0049)	(0.0076)
Wage group	-0.0014	-0.0391***
	(0.0014)	(0.0030)
Promotion in t-1	0.0009	
	(0.0092)	
Promotion in t-2	0.0068	
	(0.0092)	
Promotion in t-3	-0.0073	
	(0.0074)	
Promotion in t-4	0.0029	
	(0.0076)	
Suggestion in t-1		0.0129
		(0.0154)
Suggestion in t-2		0.0162
		(0.0162)
Suggestion in t-3		0.0041
		(0.0158)
Suggestion in t-4		-0.0118
		(0.0145)
Year fixed effects	Yes	Yes
Worker fixed effects	Yes	Yes
R^2	0.1891	0.1143
F value	7.5492	9.6402
Number of observations	8469	8469
Number of workers	415	415

Notes: Coefficients of fixed effects linear probability model. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Tables included in text

Table 1: Descriptive statistics

	Mean	Std. dev.	Min.	Max.
Suggestion in t (dummy)	0.0420	0.2007	0	1
Promotion in t (dummy)	0.0603	0.2381	0	1
Training in t-1 (dummy)	0.0661	0.2485	0	1
Training in t-2 (dummy)	0.0653	0.2471	0	1
Training in t-3 (dummy)	0.0634	0.2437	0	1
Training in t-4 (dummy)	0.0582	0.2342	0	1
Short training in t-1 (dummy)	0.0433	0.2036	0	1
Short training in t-2 (dummy)	0.0413	0.1991	0	1
Short training in t-3 (dummy)	0.0367	0.1881	0	1
Short training in t-4 (dummy)	0.0314	0.1744	0	1
Age in t (years)	33.4290	6.5271	19	53
Age squared / 100	11.6010	4.4034	3.61	28.09
Wage group in t	7.0461	2.7482	2	19

Notes: Number of yearly observations is 8469 from 415 blue-collar workers.

Table 2: Effects of training on employee suggestions

	(1) LPM	(2) LPM	(3) LPM	(4) LPM	(5) Logit
Training in t-1	0.0260**	0.0238**	0.0240**	0.0221**	0.4000*
	(0.0102)	(0.0102)	(0.0105)	(0.0104)	(0.2310)
Training in t-2			0.0098	0.0113	0.2354
			(0.0098)	(0.0097)	(0.2448)
Training in t-3			-0.0036	0.0002	-0.0245
			(0.0086)	(0.0086)	(0.2750)
Training in t-4			-0.0107	-0.0036	-0.1174
			(0.0080)	(0.0079)	(0.3034)
Age	0.0221***	0.0080**	0.0221***	0.0080**	0.2367
	(0.0025)	(0.0033)	(0.0025)	(0.0033)	(0.2137)
Age squared / 100	-0.0282***	-0.0113**	-0.0282***	-0.0114**	-0.1575
	(0.0037)	(0.0049)	(0.0037)	(0.0049)	(0.2777)
Wage group	-0.0007	-0.0012	-0.0006	-0.0012	-0.0182
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0734)
Year fixed effects	No	Yes	No	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.1778	0.1888	0.1781	0.1889	
F value	43.7426	9.6093	25.3282	8.5678	
Pseudo R^2 (McFadden)					0.1596
Chi^2 value					255.9914
Number of observations	8469	8469	8469	8469	2979
Number of workers	415	415	415	415	146

Notes: Mean yearly suggestion probability for an average worker without training is approximately 4 percent. Coefficients of fixed effects linear probability model for specifications (1) to (4) and fixed effects (conditional) logit model for specification (5). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 3: Effects of training on promotions

	(1) LPM	(2) LPM	(3) LPM	(4) LPM	(5) Logit
Training in t-1	0.0774***	0.0825***	0.0783***	0.0830***	0.9977***
	(0.0148)	(0.0148)	(0.0150)	(0.0150)	(0.1535)
Training in t-2			0.0124	0.0165	0.2420
			(0.0133)	(0.0133)	(0.1805)
Training in t-3			0.0390***	0.0415***	0.6637***
			(0.0133)	(0.0133)	(0.1746)
Training in t-4			0.0318**	0.0298**	0.4640**
			(0.0132)	(0.0133)	(0.1881)
Age	0.0009	0.0012	0.0019	-0.0001	-0.0640
	(0.0042)	(0.0054)	(0.0042)	(0.0054)	(0.1031)
Age squared / 100	0.0020	0.0044	0.0004	0.0061	0.2671*
	(0.0061)	(0.0076)	(0.0061)	(0.0076)	(0.1552)
Wage group	-0.0383***	-0.0381***	-0.0393***	-0.0392***	-0.4447***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0395)
Year fixed effects	No	Yes	No	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.1023	0.1109	0.1051	0.1139	
F value	47.5890	11.7954	29.4158	11.0083	
Pseudo R^2 (McFadden)					0.1229
Chi^2 value					326.5321
Number of observations	8469	8469	8469	8469	5757
Number of workers	415	415	415	415	281

Notes: Mean yearly promotion probability for an average worker without training is approximately 5.5 percent. Coefficients of fixed effects linear probability model for specifications (1) to (4) and fixed effects (conditional) logit model for specification (5). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 4: Effects of short training

	Suggestion		Promotion	
	(1) LPM	(2) Logit	(3) LPM	(4) Logit
Short training in t-1	0.0375***	0.5419**	0.0299**	0.5092**
	(0.0144)	(0.2556)	(0.0143)	(0.2409)
Short training in t-2	0.0325**	0.5304*	-0.0066	-0.3523
	(0.0140)	(0.2722)	(0.0118)	(0.3074)
Short training in t-3	0.0051	-0.0009	0.0248*	0.4534*
	(0.0121)	(0.3292)	(0.0147)	(0.2694)
Short training in t-4	0.0131	0.2874	0.0160	0.2497
	(0.0122)	(0.3647)	(0.0163)	(0.2844)
Age	0.0077**	0.2196	0.0010	-0.0218
	(0.0033)	(0.2139)	(0.0054)	(0.1014)
Age squared / 100	-0.0112**	-0.1399	0.0045	0.1854
	(0.0049)	(0.2780)	(0.0076)	(0.1527)
Wage group	-0.0020	-0.0356	-0.0387***	-0.4161***
	(0.0013)	(0.0733)	(0.0031)	(0.0378)
Year fixed effects	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	Yes	Yes	Yes
R^2	0.1904		0.1053	
F value	8.7319		10.0131	
Pseudo R^2 (McFadden)		0.1625		0.1017
Chi^2 value		260.6811		270.1058
Number of observations	8469	2979	8469	5757
Number of workers	415	146	415	281

Notes: Coefficients of fixed effects linear probability model for specifications (1) and (3) and fixed effects (conditional) logit model for specifications (2) and (4). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

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Postfach 2440
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