

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

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Job Characteristics and Job Satisfaction: a Test of Warr's Vitamin Model in German Horticulture

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Abstract

Personnel costs are accountable for 40% of all expenses in German horticulture. The importance of human resources management and leadership is growing through demographic change and social sustainability issues. The aim of this study was to investigate the relationships between job characteristics and job satisfaction and the shapes of their utility functions, in German horticulture. A study was conducted, with a paper-and-pencil and web-based questionnaire, using a modified Kunin-Scale and items representing nonlinear relationships. Responses from 280 employees (average age 35) from different business lines were analyzed. In conclusion, this study supports the assertion of Warr's vitamin-model (1987, 2007) that nonlinear relationships exist between job characteristics and job satisfaction and presents a detailed view of these relations in German horticulture. A linear regression of job satisfaction on 28 job features attained a high R^2 of .64 and covariance structure modelling (CSM) with full-information maximum likelihood (FIML) reported a reasonable model fit (RMSEA .08). The highest correlations were found with items measuring good future prospects ($r_s=.58$), work-home-conflict ($r_s=.51$), the availability of adequate equipment ($r_s=.51$) and organization's morality in society ($r_s=.50$). This identifies potential to increase job satisfaction and social sustainability and, most notably, that nonlinear evaluations of job features are superior to the assumption of linearity.

Keywords: job satisfaction, social sustainability, human resources management, employee well-being, horticulture

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Job Characteristics and Job Satisfaction: a Test of Warr's Vitamin Model in German Horticulture

Personnel costs are accountable for approximately 40% of all expenses in German horticulture (own calculation based on the farm comparison statistic in October 2012 of the Centre for Business Management in Horticulture and Applied Research). The importance of human resources management will increase through the demographic change in most industrialized countries, which often imply a war-for-talents and a more diverse workforce (Bauernschuster, 2011; Montén, 2011). People-focused-topics have been forecast to be initiators for fundamental business transformation processes in German companies for the next two decades in general (Claßen and von Kyaw, 2007, p.17) and as a key-issue for the future success of horticulture in Germany (Schreiner et al. 2013, pp.73–76). Another aspect is the increasing awareness of customers and society as a whole for the social dimension of sustainability (Lacy, Cooper, Hayward, and Neuberger, 2010, pp.46 ff.), which has potential, that is not yet addressed by a variety of sustainability evaluation systems in agriculture (Meyerding, 2014b, p.23). The indicator *subjective job satisfaction* can be used as a key indicator for social sustainability and has many advantages compared to objectively measured indicators (Meyerding, 2014a).

“In essence, stable wellbeing is when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge. When individuals have more challenges than resources, the see-saw dips, along with their wellbeing, and vice-versa.” (Dodge, Daly, Huyton, and Sanders, 2012, p.230). Subjective well-being can be measured context free as life satisfaction, context based as, for example, job satisfaction (a facet of employee well-being) and facet specific, for instance, as satisfaction with payment. Job satisfaction can be seen as

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an indicator for social sustainability (Meyerding, 2014a) and measuring this supports companies by providing valuable information to cope with changes in their business environment (Meyerding, 2014b, p.23).

There are different approaches regarding how to think about and measure psychological well-being at work (for a general overview see Eid and Larsen, 2008 and von Rosenstiel, Kehr, and Maier, 2000). If job satisfaction is measured through a variety of facets the decision as to which facets are included in the evaluation model is critical, in particular whether environmental features alone, or additional personal characteristics should be examined (Warr, 2013, 2012). One way of evaluating job satisfaction is by using Herzberg's two-factor-model (Herzberg, 1966 and Herzberg, Mausner, and Synderman, 1959). For example, Bitsch (2007) and Bitsch and Hogberg (2005) used parts of the Herzberg-model for a qualitative study in US horticulture based on 31 interviews, and more recently Reiche and Sparke (2012) performed a quantitative study among 446 vocational school and technical college students in Germany, partly based on Herzberg's model but with an innovative analytical approach.

Even though Herzberg's model (Herzberg, et al., 1959) is common in business management research (and human resources literature) it is not state of the art in psychology and has almost no empirical backing (von Rosenstiel, et al., 2000). To the author's knowledge, there is no quantitative research in the field of German horticulture that examines the nature of employee well-being and reports the impact of different job facets on job satisfaction. Furthermore, the shape of the utility function of these job attributes is also unknown in German horticulture. It can be assumed that the utility functions are not linear (Warr, 1987) but empirical evidence for nonlinearity is still lacking.

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As outlined, the aim of the present study was to examine the relationship between 28 job features, which were carefully chosen from the literature, and job satisfaction. These job features can be assigned to Warr's 12 vitamins and their associated utility function (additional decrement (AD) or constant effect (CE), see Figure 1 and Table 1). Previous studies in horticulture (e.g. Reiche and Sparke, 2012 and Bitsch, 2007) were based on Herzberg's model (Herzberg, 1966 and Herzberg, et al., 1959) and assumed a linear relationship between job characteristics and job satisfaction. During the past decades, two theoretical frameworks have been successful in guiding empirical research: The job characteristics model (Hackman and Oldham, 1980) and the demand-control-support model (Karasek and Theorell, 1990 and Johnson and Hall, 1988). Although these models differ in scope and complexity, they also assume linear relationships. Cross-sectional studies have investigated the proposed patterns of the vitamin-model (e.g. Rydstedt, Ferrie, and Head, 2006; de Jonge, Reuvers, Houtman, Bongers, and Kompier, 2000; de Jong and Schaufeli, 1998; de Jong, Schaufeli, and Furda, 1995; Xie and Johns, 1995; Fletcher and Jones, 1993; Parkes, 1991 and Warr, 1990). (see also de Jong and Schaufeli, 1998) But for example De Jonge and Schaufeli (1998) who tested the vitamin-model used an early version of the model with nine vitamins (Warr, 1994), the current model includes 12 vitamins (Warr, 2007). To date a comprehensive empirical test of this vitamin-model is still owing and little can be said about the validity of the model. Therefore, the current article presents also an overall test of Warr's model.

This paper presents a quantitative study that examines the relationship between 28 job attributes, job and life satisfaction in German horticulture. Additionally, Warr's (2007, 1987) vitamin-model is tested. The theoretical background and the methodology of the study is based on Warr's latest version of the vitamin-model (Warr, 2007), which

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provides 12 job features (vitamins) and their hypothetical utility functions describing the nature of the relationship of the job features and forms of happiness (job satisfaction is one of them). The vitamin-model and further literature was used to generate a paper-and-pencil, and web-based questionnaire. The collected data were then analyzed using descriptive statistics, calculating correlations between job aspects and job and life satisfaction. Covariance structure modelling (CSM) with full-information maximum likelihood (FIML) estimation was used to assess the fit of the proposed vitamin-model and its operationalization in this study. To evaluate the nature of the assumed utility functions, different parts of the features' characteristics were analyzed, as well as linear and nonlinear regressions were calculated. The main findings show that 27 of the 28 attributes are significantly correlated with job satisfaction. The highest correlation coefficient is found for good future prospects and job satisfaction. Job satisfaction (context specific well-being) is significantly related to life satisfaction (context free well-being). The data supports Warr's (2007) vitamin-model, as nonlinear regressions with the assumed utility functions lead to a greater or equal coefficient of determination (R^2) than linear regressions. Further the covariance structure modelling (CSM) reported a reasonable model fit (RMSEA .08).

Method

The Vitamin-Model

To examine the relationship between different job attributes and job satisfaction, a survey was carried out among employees of various German horticulture companies. A questionnaire was designed and implemented both on paper and in a web-based format (using the online survey tool Lime Survey) to ensure as many different distribution channels as possible whilst allowing flexibility to include different groups of participants. The survey covered German horticultural companies but the design

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could also be used in other countries and industries. The theoretical background of the present study is Warr's (2007) vitamin-model, which uses two different types of utility functions when it comes to job features. As shown in Figure 1, the first type presents an inverse U-shape (additional decrement), and is seen mostly in intrinsic job features like job autonomy. At low levels of these features, the satisfaction (context based and/or context free) is also low and increases as the level of the feature increases. However, after a moderate level (subjective optimum) is achieved, the vitamin becomes toxic and a further increase in the level of the job feature leads to a decrease in well-being (AD). In Figure 1 moderate levels of job features are labeled "subjective optimum", because the feature level at which the optimum is attained is determined by individual preferences. The second form of utility function tends to apply to extrinsic job features such as payment. At low levels of these features, satisfaction is also low and increases as the level of the feature does. Beyond a moderate level (subjective optimum) the marginal utility decreases (constant effect). These vitamins do not become toxic at very high levels but their additional effect on subjective well-being (including job satisfaction) becomes very small, to almost zero. They show a constant effect (CE) on subjective well-being for high levels of these kind of features.

(place Figure 1 here)

The present study contains 28 job features (job aspects), which can be assigned to Warr's 12 vitamins (Meyerding, 2014a). These job features are used to operationalize the vitamins and are chosen from the literature. In addition, overall subjective job satisfaction and life satisfaction were collected. Table 1 shows the vitamins, their related aspects in the present study and the underlying utility function.

(place Table 1 here)

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Questionnaire Design

The questionnaire consists of four sections. The first section asks the employee about their dream job and the importance of all 28 job features, to detect individual preferences. The response options in this section are 1 *unimportant*, 2 *somewhat important*, 3 *important*, 4 *very important*, 5 *extremely important*, and 6 *essential*. The second section asks about the feature characteristics of their current job. The participants were requested to evaluate these features based on the past four weeks. In order to assess the features a modified Kunin-Scale (Kunin, 1955) was used, to make it easier for the participants to grasp the nature of the values of the feature in question. This is particularly necessary because the values are often assumed to be linear (more is better). The Kunin-Scale uses faces with emotions to represent the evaluations in each cell. A description of the value can still be found in the top of each column. The symbols (smileys) used were adopted from Salcher and Hoffelt (1995, p.95). Response options in these section were 1 *extremely low*, 2 *very low*, 3 *quite too low*, 4 *about right*, 5 *quite too high*, 6 *very too high*, 7 *extremely too high*; for features with an additional decrement (AD) effect. For constant effect (CE) features the following response options were given 1 *extremely too low*, 2 *very too low*, 3 *quite too low*, 4 *about right*, 5 *quite acceptable*, 6 *very acceptable*, and 7 *extreme acceptable*. For the features 3d and 3e (CE inverse) *extreme too low* to *quite too low* were replaced by *extreme too high* to *quite too high* but coded inversely, indicating that lower levels of conflicts are more desirable than higher ones. The third section contains characteristics of the company such as the line of business it belongs to, the size in terms of staff employed and whether the farm produces in a greenhouse or on open field area etc. The last section of the questionnaire includes personal demographics like gender, age and level of education.

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Participant Characteristics and Research Design

After cognitive testing and five interviews, the cross-sectional survey was conducted between August 2013 and September 2014 so that different seasons were covered, which might differ significantly in terms of the workload on employees. Due to budget and organizational constraints, it was not possible to generate a set of panel data, which would have allowed for fully attenuating these seasonal effects. To collect the data at different times in the year is particularly important in horticulture because the workload for employees can differ a lot through the year. To fully attenuated seasonal effects longitudinal data would be desirable, the cross-sectional nature of the present design is one of its shortcomings. Participants were recruited through presentations of the research on a horticultural trade fair (IPM 2014 in Essen, Germany), at growers' meetings and a national farm consultants' meeting (Gartenbautag Mecklemburg Vorpommern) in Güstrow (Germany), 2013; the First Symposium of Economics in Horticulture in Göttingen (Germany), 2014 and in front of the expert conference meeting of the Center for Business Management and Applied Research in Hannover (Germany), 2013. In addition, there were two reports published in the horticultural trade press (TASPO, Meyerding, 2014c and Meyerding, 2014d) and through social networks. The different channels were used to generate a diverse sample as possible. In total, 503 employees participated in the survey. Only records with more than ten completed questions were considered in the analysis. So that 280 questionnaires could be used for the analysis (171 were filled out completely).

The map in Figure 2 shows the origin of the participants based on their zip code, indicating that participants come from all over Germany with a higher amount from the west than from the east, which is in line with the distribution of horticultural activity in Germany.

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(place Figure 2 here)

The majority of participants work for horticulture service companies (35%), followed by floriculture (18%), multi-line companies (12%), tree nurseries (12%), fruit farms (6%), retail horticulture companies (8%), vegetable farms (4%) and wholesale (4%, $N=154$). These shares are close to those in the population at the most recent horticultural census date (Gurrath, 2006) except for vegetable farms, which are underrepresented. Their employers had in most cases less than 20 employees (without seasonal labor) (78%, $N=181$) and less than five seasonal workers (78%, $N=180$), which is nearly the same as the population means (Statistisches Bundesamt, 2006). Of the sample, 42% were women ($N=160$) (28% in the population, Statistisches Bundesamt, 2006, p.144) and 18% were self-employed ($N=161$). Most participants were fulltime employees (81%, $N=129$) (51% in the population where seasonal laborers are included, Statistisches Bundesamt, 2006, p.144) and had a permanent employment contract (76%, $N=117$). Only 6% were seasonal workers ($N=125$). The level of education is distributed as follows: 1% had no professional graduation, 20% were apprentices, 30% had a completed apprenticeship, 23% an advanced training and about 25% graduated from college ($N=151$). 61% of the participants had a kind of managerial responsibility ($N=151$). The youngest participant was 17 and the oldest 69 years old (average 35, standard deviation 12, $N=159$). There is a slight accumulation of participants between the age of 20 and 30, which might be caused by the use of social media as a distribution channel. Information about the educational and age structure of the employees in German horticulture is not available for the population.

After the survey was conducted, the paper-and-pencil based questionnaires were entered into the online interface (Lime Survey). Afterwards the structure and the data were transferred to IBM SPSS and IBM SPSS AMOS for statistical analyses. The data

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were tested for completeness and consistency and only records with more than ten completed questions were considered in the analysis.

Methodological Limitations

Providing the questionnaire as a paper and web-based version increased flexibility and possible distribution channels, but responses might differ because the web-based questionnaire can possibly be answered in more privacy. Another limitation of this survey is that participants may not always fully understand the differences between particular attributes. Even if there are examples for some situations occurring at the workplace, an interviewer could provide more detailed information to the participant. The focus of this research is on the environmental features, the characteristics of the job that can generally be influenced by the organization. To fully understand employee well-being it would be necessary to also examine personal characteristics such as age, gender, personal judgment processes and the levels of psychoticism, extraversion, and neuroticism etc. (Warr, 2013). A bigger data set would be desirable to take a detailed look at for example the differences between business lines or groups of people. As a large share of employees in German horticulture are seasonal workers, the questionnaire should also be translated into Polish and Romanian to address these important labor groups. Job satisfaction is only one dimension of the broader concept of subjective employee well-being, which also contains levels of anxiety and exhaustion (Warr, 1985, 2007, p.22 and De Jong and Schaufeli, 1998). Two of the vitamins (4 Variety and 7 Money) and the dependent variable of job satisfaction are based upon a single questionnaire item, more items for each construct would produce a more stable image. In the last 15 years the psychological literature has moved beyond job satisfaction and focused on employee engagement since employee engagement has been demonstrated to relate to organizational success and/or profitability. A strong analytical approach to

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employee engagement was first outlined by Maister (2003). A broader conceptual framework as subjective employee well-being or employee engagement would probably lead to more significant findings. One of the major limitations is the cross-sectional design. Constructs such as subjective well-being, job satisfaction or employee engagement should not only be captured at one point in time (Mulinge, 2000). This constructs need to be collected over time and on a regular basis.

Results

The model was tested by performing covariance structure modelling (CSM) with full-information maximum likelihood (FIML) estimation and comparing different specifications. One specification only includes the increasing part of utility function values whereas another includes the decreasing part. There should be a positive correlation below the subjective optimum (Figure 1, left side) and a negative correlation above the optimum (Figure 1, right side). In a second specification, the CE-features were transformed so that values above the feature's optimum were recoded to the corresponding values of the increasing part. The correlation between the transformed variables is expected to be stronger than without the transformation. Finally, a linear regression of each feature was compared to a nonlinear specification, where the nonlinear model is expected to show a higher R^2 than the linear one.

Relationships Between Job Features and Job and Life Satisfaction

Table 2 shows the spearman correlation for all 28 job features with job and life satisfaction. Note that for the CE features (7a, 8a, 8b, 8c, 3d, 3e, 9a, 9b, 10a, 10b, 11a, 11b, 12a and 12b) the transformed variables, as mentioned earlier, are listed.

(place Table 2 here)

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As can be seen in Table 2, the vast majority of job features (27 out of 28) has a significant relationship with job satisfaction. As expected, the relationships are stronger with context based than with context free well-being. Job features are also interrelated, as can be seen, for example, between influence on work content (1a task discretion), conflicts between tasks (3d, $r_s=.31$, $p<.01$), workload (3a, $r_s=.29$, $p<.01$), task difficulty (3b, $r_s=.20$, $p<.01$) and less work-home-conflict (3e, $r_s=.25$, $p<.01$). The strongest relationship with job satisfaction among employees of horticultural companies participating in this study were reported for items measuring good future prospects (11b, $r_s=.58$, $p<.01$), work-home-conflict (3e, $r_s=.51$, $p<.01$), the availability of adequate equipment (8c, $r_s=.51$, $p<.01$), the organization's morality in society (12b, $r_s=.50$, $p<.01$), pleasant environment (8a, $r_s = .50$, $p<.01$) and the job's significance to self (9b, $r_s=.48$, $p<.01$). Job satisfaction is highly correlated ($r_s=.52$, $p<.01$) with life satisfaction, which is in line with values reported by McFarlin and Rice (1992) ($r=.49$) and Heller, Judge, and Watson (2002) ($r=.46$).

Covariance structure modelling

Covariance structure modelling (CSM) with full-information maximum likelihood estimation was used to assess the model fit of the vitamin-model and the aspects in the present study. CSM is a multivariate instrument which combines methodological and statistical contributions from psychometric as well as econometric theory (Diamantopoulos, 1994). CSM represents an integration of two models (Backhaus, Weiber and Erichson, 2013, pp.63-118): (1) the measurement or confirmatory factor-analytic model, which examines the contributions of the performed measures (aspects) to the hypothetical latent vitamins and (2) the structural equation model, which defines (causal) relationships among these latent factors (the vitamins and job satisfaction). The corresponding analyses were performed using IBM SPSS AMOS.

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Missing observations were handled by listwise deletion. Figure 3 shows the path diagram of the performed structural equation model. The intercorrelations between the vitamins are not shown in this diagram for reasons of readability; they can be seen in Table 3. The Vitamins 1-12 are latent variables which are operationalized by the 28 aspects in the present study. The factor loadings (printed on the arrows from the vitamins to the aspects in Figure 3) indicate the contribution of each aspect to the factor (vitamin). As the factor loadings are mostly above .63 they can be seen strong (Comrey and Lee, 2013, p.243). The hypothetical vitamins are then associated with job satisfaction. In this model the transformed variables for the additional decrement (AD) features were used. In other words, nonlinearity is not tested. The model is recursive (N=227), it is identifiable with degrees of freedom of 302. The assessment of normality reported acceptable values of kurtosis > 2 and skewness > 7 (Weiber and Mühlhaus, 2014). This is essential to perform maximum likelihood estimation.

(place Figure 3 here)

(place Table 3 here)

The factor loadings of all aspects of the vitamins are significant as the Critical Ratios (C.R.) are all above 1.96 (Backhaus et al., 2013, p.141). Chi-square (CMIN) equals 779,369 for the default model divided by the degrees of freedom (D.F. 302) equals 2.58 (CMIN/DF), which represents a good model fit for the whole structural equation model (Backhaus et al., 2013, p.147). Because chi-square is problematic especially for complex models (Reinecke, 2005, pp. 116 ff.), the root-mean-square-error of approximation (RMSEA) was calculated, which measures how well the model fits to the “reality” of the empirical data. A value of about .08 or less for the RMSEA would indicate a reasonable error of approximation, a value of .10 and above represents an

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insufficient model fit (Browne and Cudeck, 1992). The RMSEA of the default model is .084.

Linear and Nonlinear Relationships of Job Features with Job Satisfaction

A linear regression, with all job features (see Table 1 and 2, AD were transformed as described earlier) as explanatory variables was able to explain job satisfaction to a substantial extent as expressed by an R^2 of .64. The remainder may be explained by personal characteristics of the employees, like age or neuroticism, and judgment processes in the experience of subjective well-being Warr (2013). Additional explanations include measurement error, difficulties in understanding survey questions and other methodological issues, such as mixed modes of survey delivery (paper-and-pencil and web-based). Table 2 shows the relationship between job features and job satisfaction in German horticulture – the main objective of this study. A further question that was investigated was whether the shapes of the utility functions assumed by Warr can be supported. If this is the case then the vitamins with an additional decrement effect should have a positive relationship with job satisfaction below the subjective optimum and a negative correlation with job satisfaction above the subjective optimum (above a moderate level of the vitamin, see Figure 1). In addition to the correlations, linear and nonlinear regressions were calculated for all job features (and job satisfaction). For the nonlinear regressions the following functional forms were fitted:

Concave with saturation limit (exponential model, CE features):

$$job\ satisfaction = M - a \cdot e^{(-b \cdot x)}$$

Where x is the value of the job feature and starting values were selected as follows

$$a = 1; b = 0.5; M = 10$$

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Concave with downturn (quadratic model, AD features)

$$job\ satisfaction = a + b \cdot x - c \cdot x^2$$

Where x is the value of the job feature and starting values were

$$a = 5.6, b = 5.3, c=10.0$$

A higher R^2 of the nonlinear regression compared to those of the linear ones would provide support to the assumed nonlinear relationship (Backhaus et al., 2013, p.35 and 38). It has to be noted that using the R^2 for nonlinear regressions can be problematic especially for higher parametrized models (Spiess and Neumeyer, 2010), in our case the nonlinear regressions include only three parameters. Therefore the comparison of R^2 is supplemented by other methods. For that reason also the results of linear regressions including the original variables and squared variables explaining job satisfaction as the dependent variable are provided. A negative β value for the squared variables implies a CE or AD effect of the variable in question (Thornhill and Gangestad, 1994). This is the case for 25 out of 28 job features. Table 4 summarizes the spearman correlations of all features with job satisfaction, without transformation, and for the transformed variables in the case of the AD features. For the AD features the split correlations for low and high values (left side and right side of Figure 1) are also presented. As mentioned earlier, the R^2 of the linear and nonlinear regressions are shown in column six and seven. The standardized β as well as the standard error are shown in the two rightmost columns for the original and squared variables (aspects).

(place Table 4 here)

It is evident from the results that the assumed curves describing the relation of the job features and job satisfaction provide a better description of their true nature than a linear relationship (see Table 4). In all cases, using nonlinear regression results in a

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greater or equal R^2 than using the linear regression. The transformed variables for the additional decrement vitamins provide much higher and more significant Spearman correlations than their non-transformed counterparts (first column). If the additional decrement features are split into two variables each, one for the left and one for the right side of Figure 1, they show the expected directional effect on job satisfaction.

Increasing a specific feature to a moderate level is related to higher job satisfaction, but after a subjective optimum, the reported correlations become negative. This indicates that at high values the vitamin becomes toxic and related to a decrease in job satisfaction. In linear regressions with job satisfaction, squared variables show the expected negative sign of the β estimate, which also supports the hypothesized concave functional form (Thornhill and Gangestad, 1994). De Jong and Schaufeli (1998) also showed that the fit of the nonlinear model is superior to that of the linear model for aspects of three vitamins (i.e. job demands, job autonomy, and workplace social support). The results presented here support this approach for aspects of all 12 vitamins.

Spearman's rho and linear and nonlinear regressions were used to analyze the data, where subjective job satisfaction is the dependent variable. In the present study job satisfaction was operationalized through a single question. Other researchers as de Jong and Schaufeli (1998) used more characteristics (i.e. job satisfaction, job-related anxiety, and emotional exhaustion), which may lead to a deeper understanding of the job features effect on context based and context free subjective well-being. As Table 4 reports, additional decrement features show a less strong relationship with job satisfaction than most constant effect features. This could indicate that even though a Kunin-Scale was used, not every participant fully understood the nature of the items.

Nevertheless, these results support the assertion of the vitamin-model that nonlinear relationships exist between job characteristics and employee well-being whereas

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traditionally linear relationships are assumed. Furthermore, the results offer a detailed impression regarding the relationship between job features and job satisfaction, which can be an advantageous indicator for social sustainability (Meyerding, 2014a).

Discussion

The major aim of this study was to identify the relationship of job characteristics and job satisfaction in German horticulture. Traditionally, linear relations are assumed in psychological research. Warr (1987) challenged this belief by presenting the nonlinear vitamin-model.

Prior work in horticulture is partly based on Herzberg's model (Herzberg, 1966, and Herzberg, et al., 1959), which is criticized by many authors (e.g. Gebert and Rosenstiel, 2002; von Rosenstiel, et al., 2000; Locke and Henne, 1986 and Vroom, 1967). Furthermore former work is either qualitative (Bitsch, 2007 and Bitsch and Hogberg, 2005) or the sample is constrained to apprentices in a more advanced quantitative study (Reiche and Sparke, 2012). Both studies in horticulture did not consider nonlinear relationships. De Jong and Schaufeli (1998) and de Jong, et al. (1995) tested three vitamins, a comprehensive empirical test of the latest version of the vitamin-model (Warr, 2007) was pending up to this date. The present study investigated the possibility of nonlinear relationships between job characteristics and job satisfaction and all participants were employees of horticulture companies, differing in age, hierarchy level, origin of business line and level of education.

In this study 28 job aspects, which representing the 12 vitamins of Warr's model, were analyzed and their relationship with job satisfaction were investigated. The model was tested by performing covariance structure modelling (CSM) with full-information maximum likelihood estimation. As the factor loadings of the 28 aspects

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are mostly above .63 they can be seen as strong (Comrey and Lee, 2013, p.243), which supports the usage of the measures in the present study. The assumed latent vitamins and job satisfaction showed a reasonable model fit with further potential for improvement. Comparisons between the results of linear and nonlinear regressions, as well as between the correlation coefficients for different sections of the curves of additional decrement features, were undertaken to examine the true nature of the relationship between the job aspects and job satisfaction. In virtually all cases the assumed nonlinear shapes were superior to the linear model. A linear regression, with transformed additional decrement features for the whole model used in this study, reported a high R^2 of .64. These findings extend those of de Jong and Schaufeli (1998) to all vitamins of Warr's (2007, pp. 239–240) model (with some adjustments).

In addition, most job aspects were significantly correlated with job satisfaction. This study provides a detailed picture of job characteristics and job satisfaction in German horticulture. The highest significant correlation with job satisfaction was good future prospects (excluding job tenure), $r_s=.58$, $p(\text{two-tailed})<.01$, which indicates the importance of informing and communicating future plans to employees, as well as align the goals of the company and the employees. Having the feeling that one is doing progress towards a better future has a major influence on job satisfaction. There was a significant relationship between the organization's morality in society and job satisfaction ($r_s=.50$, $p(\text{two-tailed})<.01$). This result presents a link between job satisfaction and sustainability. It might be the case, that the more sustainable the employees believes the company they are working in is, the higher their job satisfaction is.

The significance of the job to self was significantly related to job satisfaction ($r_s=.48$, $p(\text{two-tailed})<.01$). This indicates the importance of communicating the

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significance of every job to the employees. It might be helpful to give them an understanding of how their work fits into the whole production process, and the effects of their work on the next in line, and who is directly reliant on their work. In this study in German horticulture a lack of work-family-conflicts is strongly significantly related to job satisfaction ($r_s=.51$, $p(\text{two-tailed})<.01$). Improving this job feature in German horticultural companies could therefore lead to higher job satisfaction and could also be of importance for attracting new qualified employees. Another interesting result is the highly significant and relatively strong correlation of adequate equipment and job satisfaction ($r_s=.51$, $p(\text{two-tailed})<.01$). This feature has been identified previously as especially important in jobs where primarily physical work has to be done (Salvendy, 2012, p.708 and Wyatt and Langden, 1938).

Most notably, this is the first quantitative study to the author's knowledge to investigate the relationship of job characteristics and job satisfaction in German horticulture, with participants who differ in age, hierarchy level, origin of business line and level of education. Additionally, it is the first study to the author's knowledge to test all vitamins of the latest version of Warr's vitamin-model. The results provide compelling evidence of the superiority of nonlinear models in the field of psychological research when it comes to subjective job satisfaction. The results of this study provide a deeper understanding and new insights into job satisfaction in German horticulture. They also support the approach of using employee subjective well-being as a key indicator for social sustainability in German horticultural companies (Meyerding, 2014a).

Some limitations however, are worth noting. Although 27 out of 28 job aspects were found to be related to job satisfaction in German horticulture a larger sample of participants would be desirable. Additionally, it is clear that job satisfaction depends on

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both jobs and job-holders (Warr, 2013), therefore future research will analyze the impact of personal characteristics on job satisfaction in German horticulture. It is also evident, that the importance of job features differ between individuals. Future work will therefore compare the relationship with job satisfaction, and the preferences of different groups. It is essential to know, what is important for the next generation of employees in German horticulture. One additional decrement feature (3b, Difficulty of job demands) in this study is not significantly correlated with job satisfaction and the correlations of additional decrement features were not as high as in the cases of constant effect features. This is maybe because that not every participant fully understood the meaning of the items even though a modified Kunin-Scale was used. Future work should therefore help to improve the questionnaire design used to collect data for nonlinear, especially inverted U-shaped utility functions. One of the major limitations of the present study is the cross-sectional design. A construct such as job satisfaction or employee well-being cannot be fully captured at one point in time. Those constructs might change over time and should ideally be collected repeatedly. One of the future areas of research would be collecting longitudinal data. Research opportunities also lie in the identification of differences between objective measurements of job characteristics and the subjective evaluations reported in this study.

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References

- Backhaus, K., Weiber, R. & Erichson, B. (2013). *Fortgeschrittene Multivariate Analysemethoden. Eine anwendungsorientierte Einführung*. Heidelberg: Springer Gabler.
- Bauernschuster, S. (2011). Altenquotient und Alterspyramide: Warum wird Deutschland immer älter? In G. Milbradt, G. Nerb, W. Ochel, & H.-W. Sinn (Eds.), *Der ifo Wirtschaftskompass. Zahlen - Fakten - Hintergründe* (pp. 80–81). München: Hanser, Carl.
- Browne, M. W. & Cudeck, R. (1992). Alternative Ways of Assessing Model Fit. *Sociological Methods & Research*, 21(02), 230–258. doi: 10.1177/0049124192021002005
- Bitsch, V. (2007). *Job Satisfaction in Horticulture: New Insights* (Acta Horticulturae No. 762). Leuven.
- Bitsch, V. & Hogberg, M. (2005). Exploring Horticultural Employees' Attitudes Toward Their Jobs: A Qualitative Analysis Based on Herzberg's Theory of Job Satisfaction. *Journal of Agricultural and Applied Economics*, 37(03), 659–671. doi: 10.1017/S1074070800027152
- Comrey, A. L. & Lee, H. B. (2013). *A first course in factor analysis*. New York: Psychology Press.
- Claßen, M. & Kyaw, F. von. (2007). *Change Management-Studie 2008: Business Transformation – Veränderungen erfolgreich gestalten*. Berlin: Capgemini.
- Diamantopoulos, A. (1994). Modelling with LISREL, a guide for the uninitiated, *Journal of Marketing Management*, 10, 105-136. doi:10.1080/0267257X.1994.9964263

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

This article may not exactly replicate the final version published in the APA journal. It is not the copy of record. The copy of record is under copyright of the APA. <http://dx.doi.org/10.1037/mgr0000029>

- Dodge, R., Daly, A., Huyton, J., & Sanders, L. (2012). The challenge of defining wellbeing. *International Journal of Wellbeing*, 2(3), 222–235. doi:10.5502/ijw.v2i3.4
- Eid, M., & Larsen, R. J. (2008). *The science of subjective well-being*. New York: Guilford Press.
- Fletcher, B., & Jones, F. (1993). A refutation of Karasek's demand – discretion model of occupational stress with a range of dependent measures. *Journal of Organizational Behavior*, 14(4), 319–330. doi:10.1002/job.4030140404
- Gebert, D., & Rosenstiel, L. (2002). *Organisationspsychologie: Person und Organisation* (5th ed.). *Kohlhammer-Standards Psychologie*. Stuttgart: Kohlhammer.
- Gurrath, P. (2006). *Ergebnisse der Gartenbauerhebung 2005*. Wiesbaden: Statistisches Bundesamt.
- Hackman, J. R., & Oldham, G. R. (1980). *Work redesign. Organization development*. Salem, Or: Oregon State Library.
- Heller, D., Judge, T. A., & Watson, D. (2002). The confounding role of personality and trait affectivity in the relationship between job and life satisfaction. *Journal of Organizational Behavior*, 23(7), 815–835. doi:10.1002/job.168
- Herzberg, F. (1966). *Work and the nature of man*. New York: Thomas Y. Crowell.
- Herzberg, F., Mausner, B., & Synderman, B. B. (1959). *The motivation to work* (2nd ed.). New York: Wiley.
- Johnson, J. V., & Hall, E. M. (1988). Job Strain, Work Place Social Support, And Cardiovascular Disease: A Cross Sectional Study Of A Random Sample Of The Swedish Working Population. *American Journal of Public Health*, 78, 1336-1342. doi:10.2105/AJPH.78.10.1336
- Jong, J. de, & Schaufeli, W. B. (1998). Job characteristics and employee well-being: a test of Warr's Vitamin Model in health care workers using structural equation

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

This article may not exactly replicate the final version published in the APA journal. It is not the copy of record. The copy of record is under copyright of the APA. <http://dx.doi.org/10.1037/mgr0000029>

modelling. *Journal of Organizational Behavior*, 19, 387–407. doi:

10.1002/(SICI)1099-1379(199807)19:4<387::AID-JOB851>3.0.CO;2-9

Jong, J. de, Schaufeli, W. B., & Furda, J. (1995). `Werkkenmerken: psychologische arbeidsvitamines? [Job characteristics: psychological work vitamins?]. *Gedrag en Organisatie*, 8(4), 231–248.

Jonge, J. de, Reuvers, M. M. E. N., Houtman, I. L. D., Bongers, P. M., & Kompier, M. A. J. (2000). Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes, and sickness absence: Baseline results from SMASH. *Journal of Occupational Health Psychology*, 5(2), 256–268. doi:10.1037/1076-8998.5.2.256

Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life*. New York: Basic Books.

Kunin, T. (1955). The construction of a new type of attitude measure. *Personnel Psychology*, 8, 65–77.

Lacy, P., Cooper, T., Hayward, R., & Neuberger, L. (2010). *A New Era of Sustainability: CEO reflections on progress to date, challenges ahead and the impact of the journey toward a sustainable economy*. New York: UN.

Locke, E. A., & Henne, D. (1986). Work motivation theories. In C. L. Cooper & I. T. Robertson (Eds.), *International review of industrial and organizational psychology 1986* (pp. 1–35). Chichester: Wiley.

Maister, D. H. (2003). *Practice what you preach: What managers must do to create a high achievement culture* (2nd ed.). New York, London: Free.

McFarlin, D. B., & Rice, R. W. (1992). The role of facet importance as a moderator in job satisfaction processes. *Journal of Organizational Behavior*, 13(1), 41–54.
doi:10.1002/job.4030130105

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

This article may not exactly replicate the final version published in the APA journal. It is not the copy of record. The copy of record is under copyright of the APA. <http://dx.doi.org/10.1037/mgr0000029>

Meyerding, S. (2014a). *Mitarbeiterzufriedenheit als Kernindikator sozialer*

Nachhaltigkeit (in press), Hannover.

Meyerding, S. (2014b). Nachhaltigkeitsindikatoren als Instrument der strategischen

Unternehmensentwicklung. In Deutsche Gartenbauwissenschaftliche Gesellschaft

e.V. (DGG) und Bundesverband der Hochschulabsolventen/Ingenieure Gartenbau

und Landschaftsarchitektur e.V. (BHGL) (Ed.), *BHGL - Schriftenreihe: Vol. 30. 49.*

Gartenbauwissenschaftliche Jahrestagung, 5.-8. März 2014 in Dresden.

Nachhaltigkeit und Gartenbau (p. 23). Dresden.

Meyerding, S. (2014c, March 7). Worauf es wirklich ankommt: Arbeitsmoral und

Mitarbeiterzufriedenheit entscheiden mit über die Zukunftsfähigkeit des Gartenbaus.

Taspo, p. 3.

Meyerding, S. (2014d, June 13). Worauf es wirklich ankommt: Arbeitsmoral und

Mitarbeiterzufriedenheit entscheiden über die Zukunftsfähigkeit des Gartenbaus.

Taspo, p. 3.

Montén, A. (2011). Arbeitskräftemigration in Europa: Es könnten viele kommen. In G.

Milbradt, G. Nerb, W. Ochel, & H.-W. Sinn (Eds.), *Der ifo Wirtschaftskompass.*

Zahlen - Fakten - Hintergründe. München: Hanser, Carl.

Mulinge, M. M. (2000). Toward an Explanation of Cross-Sector Differences in Job

Satisfaction and Organisational Attachment Among Agricultural Technicians in

Kenya. *African Sociological Review*, 4(1), 55-73. doi: 10.4314/asr.v4i1.23174

Parkes, K. R. (1991). Locus of control as moderator: An explanation for additive versus

interactive findings in the demand-discretion model of work stress? *British Journal*

of Psychology, 82(3), 291–312. doi:10.1111/j.2044-8295.1991.tb02401.x

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

This article may not exactly replicate the final version published in the APA journal. It is not the copy of record. The copy of record is under copyright of the APA. <http://dx.doi.org/10.1037/mgr0000029>

- Reiche, S. & Sparke, K. (2012). Managing Job Commitment of young Professionals in Germany's green Industry. *DGG-Proceedings*, 2(3), 1-5. doi: 10.5288/dgg-pr-02-03-sr-2012
- Reinecke, J. (2005). *Strukturgleichungsmodelle in den Sozialwissenschaften*. München: Oldenbourg Wissenschaftsverlag.
- Rosenstiel, L. von, Kehr, H. M., & Maier, G. W. (2000). Motivation and Volition in Pursuing Personal Work Goals. In J. Heckhausen (Ed.), *Motivational psychology of human development. Developing motivation and motivating development* (pp. 287–305). Amsterdam, Netherlands; New York: North-Holland; Elsevier.
- Rydstedt, L. W., Ferrie, J., & Head, J. (2006). Is there support for curvilinear relationships between psychosocial work characteristics and mental well-being? Cross-sectional and long-term data from the Whitehall II study. *Work & Stress*, 20(1), 6–20. doi:10.1080/02678370600668119
- Salcher, E. F., & Hoffelt, P. (1995). *Psychologische Marktforschung* (2nd ed.). *Marketing Management: Vol. 4*. Berlin: Walter de Gruyter.
- Salvendy, G. (2012). *Handbook of human factors and ergonomics* (4th ed.). Hoboken: John Wiley & Sons.
- Spiess, A.-N., & Neumeyer, N. (2010). An evaluation of R^2 as an inadequate measure for nonlinear models in pharmacological and biochemical research: a Monte Carlo approach. *BMC Pharmacol*, 1, 1-11. doi: 10.1186/1471-2210-10-6
- Schreiner, M., Altmann, M., Stenger, M., Korn, M., Dirksmeyer, W., Ludwig-Ohm, S., ... (2013). *Zukunftsstrategie Gartenbau: Abschlussbericht zum Zukunftskongress Gartenbau am 11./12. September 2013 in Berlin*. Bonn.
- Statistisches Bundesamt (2006). *Gartenbauerhebung 2005*, Wiesbaden: Statistisches Bundesamt.

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

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- Thornhill, R., & Gangestad, S. W. (1994). Human Fluctuating Asymmetry and Sexual Behavior. *Psychological Science*, 5(5), 297-302. doi:10.2307/40063121
- Vroom, V. H. (1967). *Work and Motivation*. New York: John Wiley & Sons.
- Warr, P. (1987). *Work, unemployment and mental health*. Oxford science publications. Oxford: Oxford Univ. Pr.
- Warr, P. (1990). Decision latitude, job demands, and employee well-being. *Work & Stress*, 4(4), 285–294. doi:10.1080/02678379008256991
- Warr, P. (1994). A conceptual framework for the study of work and mental health. *Work & Stress*, 8(2), 84–97. doi:10.1080/02678379408259982
- Warr, P. (2012). How to Think About and Measure Psychological Well-Being. In R. R. Sinclair, M. Wang, & L. E. Tetrick (Eds.), *Research methods in occupational health psychology. Measurement, design, and data analysis* (pp. 76–90). New York: Psychology Press.
- Warr, P. (2013). Jobs and Job-Holders: Two Sources of Happiness and Unhappiness. In S. A. David (Ed.), *Oxford library of psychology. The Oxford handbook of happiness* (pp. 733–750). Oxford: Oxford Univ. Press.
- Warr, P. B. (2007). *Work, Happiness, and Unhappiness*. Mahwah, N.J: Lawrence Erlbaum Associates.
- Weiber, R., & Mühlhaus, D. (2014). *Strukturgleichungsmodellierung: Eine Anwendungsorientierte Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS und SPSS*. Heidelberg: Springer Gabler.
- Wyatt, S., & Langden, J. N. (1938). *The Machine and the Worker: A Study of Machine-Feeding Processes* (Industrial Health Research Board No. 82). London.
- Xie, J. L., & Johns, G. (1995). Job Scope and Stress: Can Job Scope be too High? *Academy of Management Journal*, 38(5), 1288–1309. doi:10.2307/256858

JOB SATISFACTION: A TEST OF WARR'S VITAMIN MODEL

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Table 1

The 12 Vitamins of Warr's Model and their 28 features to be rated by job-holders

Vitamins	Job features in the present study	Utility function
1 Control (AD)	1a Task discretion	AD
	1b Influence over the wider organization	AD
2 Skill (AD)	2a Skill use	AD
	2b New learning	CE
3 Goals (AD)	3a Number of job demands	AD
	3b Difficulty of job demands	AD
	3c Task coherence	CE
	3d Conflict between job demands	CE (inverse)
	3e Conflict between work and home	CE (inverse)
	3f Emotional dissonance (inverse)	AD
4 Variety (AD)	4a Range of different tasks	AD
5 Clarity (AD)	5a Future predictability (excl. job tenure)	AD
	5b Clear role requirements	AD
	5c Availability of feedback	AD
6 People (AD)	6a Amount of social contact	AD
	6b Quality of social contact	AD
7 Money (CE)	7a Pay level	CE
8 Physical Security (CE)	8a Pleasant environment	CE
	8b Safe work practices	CE
	8c Adequate equipment	CE
9 Significance (CE)	9a Value to society	CE
	9b Significance to self	CE
10 Supervision (CE)	10a Supervision behave considerate	CE
	10b Supervision is supportive	CE
11 Career (CE)	11a Job security	CE
	11b Good future prospects	CE
12 Fairness (CE)	12a Fair treatment of employees	CE
	12b The organization's morality in society	CE

Note. There are two possible utility functions for the vitamins and features, additional decrement features (AD) and constant effect (CE). The vitamins and most of their features are from Warr (2007, pp. 239–240).

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Table 2

Spearman correlations of all 28 job features and job- and life satisfaction (N=190)

	J	L	2b	3c	3f	7a	8a	8b	8c	9a	9b	10a	10b	11a	11b	12a	12b	3d	3e	1a	1b	2a	3a	3b	4a	5a	5b	5c	6a	
J Job satisfaction	1																													
L Life satisfaction	.52**	1																												
2b New learning	.40**	.20**	1																											
3c Task coherence	.37**	.17*	.58**	1																										
3f Emotional dissonance	.45**	.28**	.47**	.59**	1																									
7a Pay level	.45**	.26**	.28**	.30**	.36**	1																								
8a Pleasant Environment	.50**	.25**	.35**	.33**	.32**	.36**	1																							
8b Safe work practices	.44**	.24**	.36**	.34**	.29**	.41**	.58**	1																						
8c Adequate equipment	.51**	.20**	.34**	.35**	.38**	.40**	.56**	.65**	1																					
9a Value to society	.44**	.24**	.36**	.34**	.42**	.34**	.37**	.41**	.34**	1																				
9b Significance to self	.48**	.29**	.45**	.57**	.46**	.26**	.37**	.45**	.41**	.63**	1																			
10a S.vision behave considerate	.44**	.18*	.43**	.41**	.44**	.38**	.34**	.34**	.37**	.36**	.48**	1																		
10b Supervision is supportive	.45**	.24**	.41**	.40**	.39**	.31**	.30**	.27**	.37**	.37**	.51**	.81**	1																	
11a Job security	.46**	.24**	.24**	.31**	.30**	.33**	.38**	.32**	.39**	.38**	.46**	.40**	.38**	1																
11b Good future prospects	.58**	.38**	.41**	.32**	.36**	.27**	.39**	.37**	.31**	.46**	.52**	.34**	.34**	.54**	1															
12a Fair treatment of employees	.47**	.23**	.34**	.40**	.54**	.37**	.33**	.35**	.44**	.36**	.44**	.73**	.72**	.42**	.38**	1														
12b Orga. morality in society	.50**	.25**	.28**	.34**	.41**	.31**	.29**	.40**	.53**	.41**	.49**	.58**	.61**	.43**	.36**	.73**	1													
3d Conflict between job demands	.42**	.23**	.24**	.36**	.33**	.29**	.24**	.34**	.35**	.33**	.34**	.32**	.35**	.24**	.27**	.40**	.41**	1												
3e Work-Home-Conflict	.51**	.34**	.24**	.33**	.34**	.42**	.31**	.42**	.33**	.41**	.38**	.40**	.31**	.29**	.34**	.43**	.42**	.56**	1											
1a Task discretion	.33**	.23**	.27**	.23**	.25**	.27**	.26**	.27**	.24**	.38**	.31**	.34**	.38**	.23**	.26**	.33**	.33**	.31**	.25**	1										
1b Influence over the wider orga.	.36**	.20**	.21**	.12	.20**	.22**	.22**	.19*	.23**	.32**	.25**	.26**	.31**	.14	.24**	.26**	.34**	.20**	.29**	.49**	1									
2a Skill use	.34**	.07	.29**	.20**	.18*	.19**	.12	.16*	.20**	.23**	.17*	.29**	.34**	.21**	.19**	.26**	.22**	.26**	.19**	.40**	.36**	1								
3a Number of job demands	.22**	.11	-.04	.08	.13	.22**	.05	.05	.18*	.17*	.06	.07	.10	.04	.08	.12	.17*	.21**	.22**	.29**	.35**	.21**	1							
3b Difficulty of job demands	.06	-.06	.17*	.10	.06	.21**	-.01	.11	.09	.15*	.06	.05	.10	.08	.06	.03	.07	.15*	.03	.20**	.08	.35**	.26**	1						
4a Range of different tasks	.25**	.01	.07	.10	.08	.16*	.12	.15*	.24**	.15*	.12	.20**	.17*	.18*	.16*	.15*	.30**	.15*	.15*	.12	.22**	.25**	.38**	.42**	1					
5a Future predictability	.26**	.19**	.04	-.02	.07	.20**	.11	.08	.22**	.17*	.11	.19**	.19**	.32**	.19**	.18*	.22**	.21**	.19**	.23**	.29**	.21**	.29**	.24**	.34**	1				
5b Clear role requirements	.30**	.08	.13	.13	.27**	.29**	.19**	.19**	.33**	.22**	.19**	.17*	.20**	.17*	.10	.22**	.24**	.20**	.17*	.40**	.29**	.31**	.27**	.13	.19**	.25**	1			
5c Availability of feedback	.29**	.13	.36**	.30**	.18*	.24**	.25**	.17*	.12	.21**	.22**	.30**	.32**	.14	.15*	.28**	.25**	.21**	.28**	.36**	.37**	.31**	.06	.18*	.12	.13	.29**	1		
6a Amount of social contact	.20**	.10	.10	.10	.10	.10	.14	.08	.09	.17*	.18*	.17*	.11	.04	.05	.10	.16*	.22**	.14	.18*	.14	.19**	.17*	.14	.23**	.14	.26**	.35**	1	
6b Quality of social contact	.22**	.00	.11	.18*	.16*	.13	.19**	.12	.23**	.20**	.20**	.21**	.17*	.19**	.11	.13	.15*	.13	.21**	.30**	.28**	.28**	.21**	.16*	.17*	.26**	.20**	.35**	.52**	1

Note. ** the correlation is significant at the 0.01 level (two-tailed) and * the correlation is significant at the 0.05 level (two-tailed).

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Table 3

Correlation matrix for the 12 estimated vitamins

	1	2	3	4	5	6	7	8	9	10	11
1 Control (AD)											
2 Skill (AD)	.88										
3 Goals (AD)	.61	.92									
4 Variety (AD)	.37	.39	.26								
5 Clarity (AD)	.91	.92	.64	.47							
6 People (AD)	.51	.57	.43	.33	.68						
7 Money (AD)	.36	.43	.53	.20	.42	.29					
8 Physical Security (CE)	.49	.75	.73	.15	.47	.38	.51				
9 Significance (CE)	.55	.79	.80	.22	.50	.40	.67	.34			
10 Supervision (CE)	.56	.83	.67	.23	.60	.34	.52	.36	.63		
11 Career (CE)	.55	.82	.68	.27	.58	.29	.43	.63	.77	.58	
12 Fairness (CE)	.53	.75	.74	.18	.57	.28	.40	.58	.59	.87	.63

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Table 4

Comparison of Spearman correlations (r_s) of high and low feature values and R^2 s of the linear and nonlinear regression as well as the standardized β of the original variables and squared variables to support the vitamin-model

job feature	r_s with job satisfaction	r_s transformed (AD)	r_s low (AD)	r_s high (AD)	linear regression R^2	non-linear regression R^2	standardized β original variable (standard error)	standardized β squared variable (standard error)
2b	.40**	-	-	-	.176	.192	1.24** (.34)	-.77** (.04)
3c	.37**	-	-	-	.148	.152	.67 (.41)	-.24 (.04)
3f	.45**	-	-	-	.257	.279	1.40** (.31)	-.88** (.03)
7a	.45**	-	-	-	.219	.233	1.07** (.28)	-.64* (.04)
8a	.50**	-	-	-	.250	.250	.25 (.34)	.21 (.04)
8b	.44**	-	-	-	.193	.201	.80** (.33)	-.36 (.04)
8c	.51**	-	-	-	.258	.263	.51 (.29)	-.02 (.03)
9a	.44**	-	-	-	.207	.213	1.01** (.37)	-.57 (.04)
9b	.48**	-	-	-	.229	.232	1.00** (.43)	-.52 (.04)
10a	.44**	-	-	-	.234	.237	.89** (.25)	-.36 (.03)
10b	.45**	-	-	-	.237	.237	.67** (.22)	-.16 (.03)
11a	.46**	-	-	-	.201	.201	.18 (.29)	.28 (.03)
11b	.58**	-	-	-	.348	.354	1.03** (.26)	-.41 (.03)
12a	.47**	-	-	-	.273	.273	.65* (.23)	-.10 (.03)
12b	.50**	-	-	-	.276	.276	.53 (.29)	-.04 (.03)
3d	.42**	-	-	-	.203	.204	.43 (.34)	.02 (.04)
3e	.51**	-	-	-	.293	.298	.60* (.27)	-.09 (.03)
1a	.27**	.33**	.37**	-.11	.082	.161	1.29** (.39)	-.98** (.05)
1b	.32**	.36**	.39**	-.10	.100	.149	1.12** (.31)	-.79** (.05)
2a	.31**	.34**	.42**	-.09	.081	.173	1.51** (.36)	-1.19** (.05)
3a	-.06	.22**	.20*	-.19*	.000	.070	1.50** (.53)	-1.56** (.06)
3b	.07	.06	.08	.01	.027	.045	.92** (.43)	-.86** (.05)
4a	.05	.25**	.24**	-.17*	.008	.052	1.23** (.58)	-1.16** (.07)
5a	.23**	.26**	.29**	-.06	.053	.092	1.05** (.36)	-.81** (.05)
5b	.18*	.30**	.35**	-.13	.026	.139	1.63** (.43)	-1.44** (.06)
5c	.26**	.29**	.30**	-.07	.049	.084	1.18** (.33)	-1.03** (.05)
6a	.13	.20**	.22**	-.11	.031	.048	1.15** (.54)	-1.02** (.07)
6b	.10	.22**	.20**	-.14	.012	.069	1.22** (.43)	-1.15** (.06)

** The correlation is significant at the 0.01 level (two-tailed)

* The correlation is significant at the 0.05 level (two-tailed)

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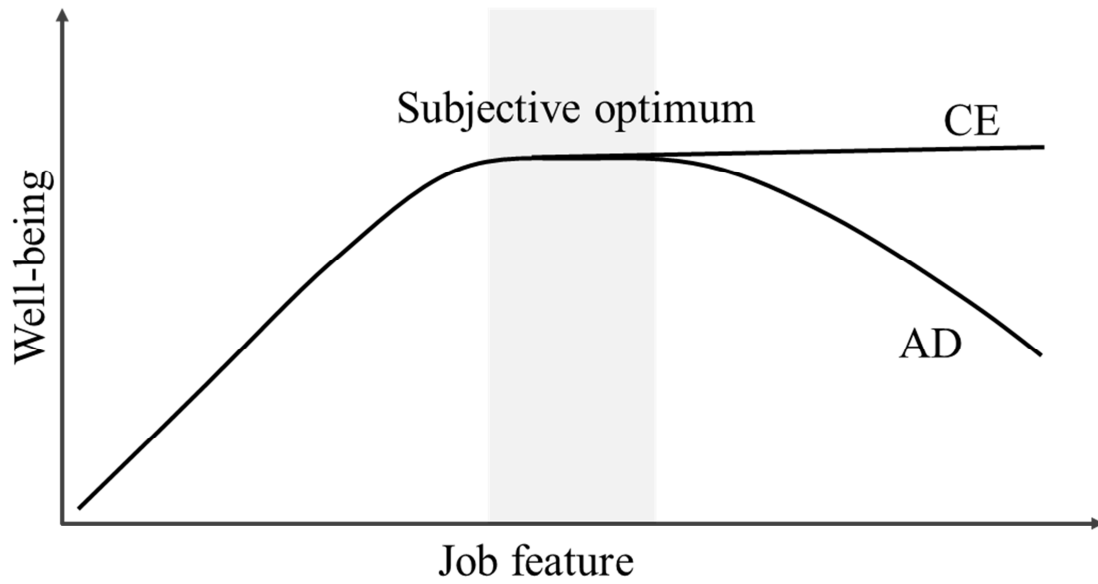


Figure 1. The vitamin analogy: proposed additional decrement (AD) and constant effect (CE) relationships between job features and well-being (context free and/or context based). The figure is a modified version from Warr (2013).

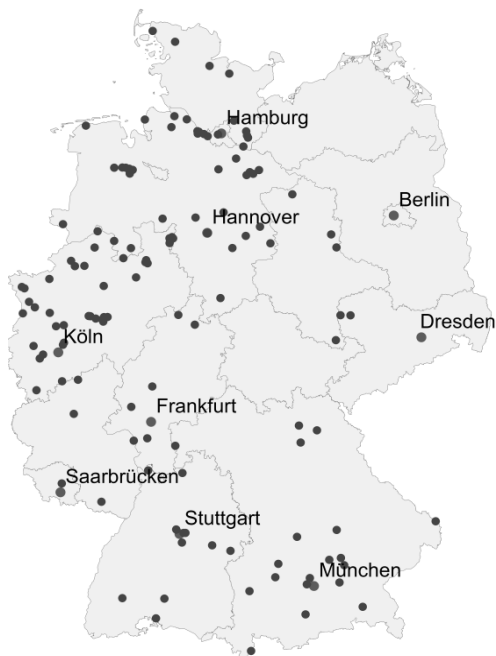


Figure 2. Participants' origin ($N=138$).

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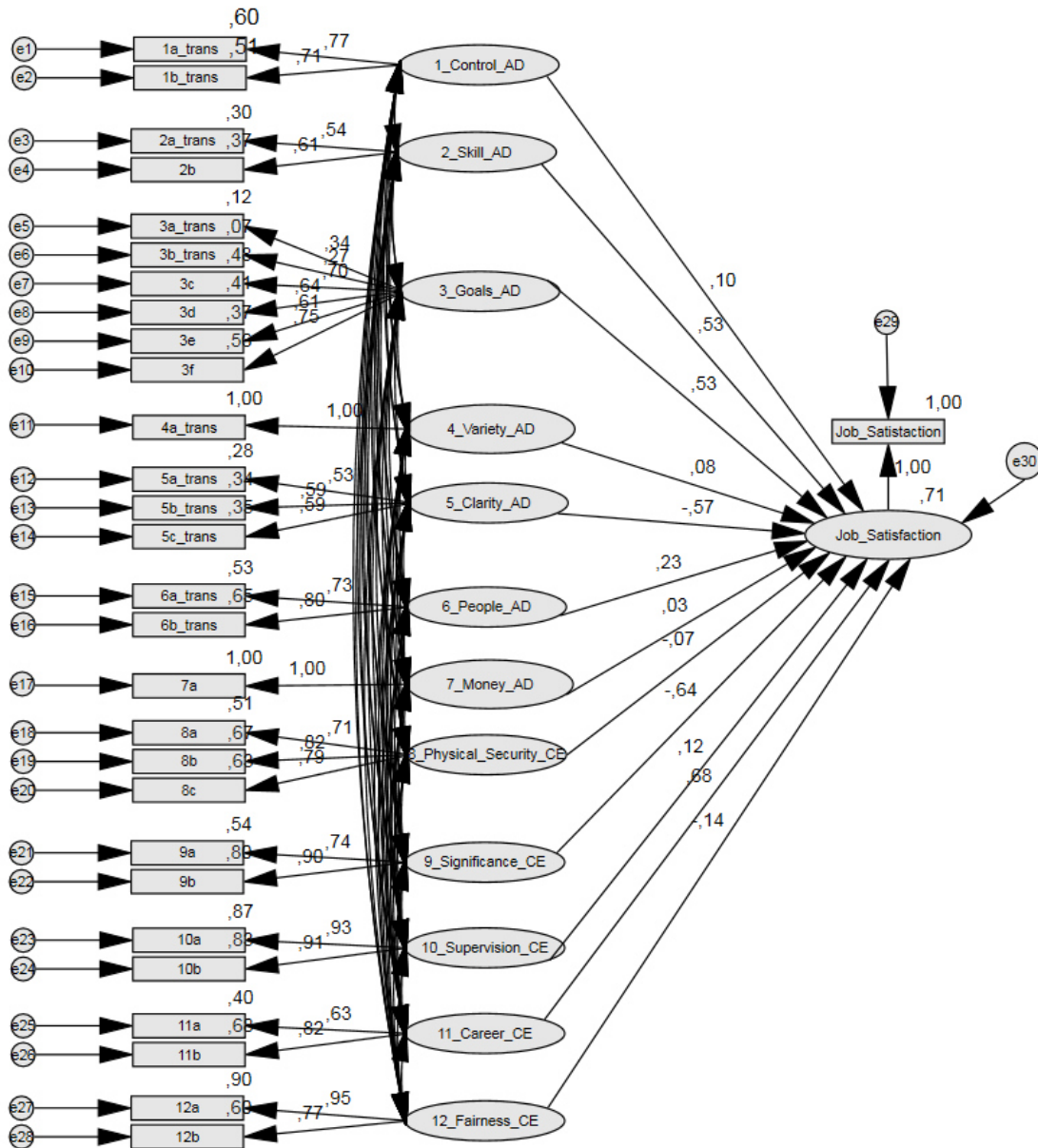


Figure 3. Path diagram of the covariance structure modelling (standardized estimates).

The inter correlations between the vitamins are not shown in this diagram for reasons of readability.