Diedrich, Jennifer; Neubauer, Aljoscha C.; Ortner, Anna

The prediction of professional success in apprenticeship: the role of cognitive and non-cognitive abilities, of interests and personality

International journal for research in vocational education and training 5 (2018) 2, S. 82-111

International Journal for Research in Vocational Education and Training (IJRVET)
Vol. 5, Issue 2, August 2018, 82-111
DOI: 10.13152/IJRVET.5.2.1

The Prediction of Professional Success in Apprenticeship: The Role of Cognitive and Non-Cognitive Abilities, of Interests and Personality

Jennifer Diedrich*[1], Aljoscha C. Neubauer[2], and Anna Ortner[2]

[1] *Centre for International Student Assessment (ZIB), TUM School of Education, Technical University of Munich, Arcisstrasse 21, 80333 Munich, Germany*
[2] *University of Graz Department of Psychology, Universitätsplatz 2, 8010 Graz, Austria*

Received: 31.07.2017; Accepted: 10.07.2018; Published: 30.08.2018

Abstract

Context: We addressed the issue of person-job-fit by focussing on both professional success and work satisfaction. Publications studying the predictive validity of (cognitive) ability, personality, or vocational interest alone have shown relationships with professional success or work satisfaction for each predictor separately. Nevertheless, these predictors have rarely been studied simultaneously.

Methods: To this end we tested the incremental validity of abilities, traits, and interests in a sample from diverse occupations: In 648 apprentices and students from five different branches (Food, Tech, People, Office, Craft) the (incremental) contributions of 3 intelligence factors (verbal, numerical, spatial), 3 alternative abilities (social-emotional, creative, practical), 4 conscientiousness facets, other big five factors (O, E, A, N), and of 14 professional interests were analysed regarding prediction of GPA in professional schools and school/job satisfaction.

Results: Intelligence and conscientiousness were best predictors, followed by social-emotional competence and interests, whereas other traits provided marginal contributions. Predictors varied between branches, mostly following expectations. The test battery allowed a very good prediction of apprenticeship success (max. 37%), but for some branches prediction was considerably lower.

*Corresponding author: jennifer.diedrich@edu.uni-graz.at

ISSN: 2197-8646
http://www.ijrvet.net

Conclusion: Criteria for person-job-fit are not swappable, neither are the predictors. Professional success was mostly predicted by a different predictor set—namely ability and the personality dimension of conscientiousness—then satisfaction, which was mostly predicted by non-interest in a certain occupation. As a practical implication, we conclude that choosing the right candidate for a certain branch one needs to use a broad set of predictor variables. Besides cognitive ability also personality and vocational interests had predictive validity for an individuals person-job-fit.

Keywords: VET, Vocational Education and Training, Apprentice, Career Guidance, Job Satisfaction, Secondary School, Vocational School, Personality, Vocational Interest

1 Introduction

When individuals reflect whether their chosen profession were right for them they most likely ask themselves two questions: "Am I good at this?" and "am I happy with this?" Researchers interested in vocational education and training on the other hand reflect which variables of the individual makes her or him both "good at it"—professional success—and "happy with it"—work satisfaction. The three broad individual difference domains of (cognitive) ability, personality, and vocational interests are highly likely candidates for impacting professional success and work satisfaction (Sackett, Lievens, Van Iddeking, & Kuncel, 2017). But what are these domains incremental influence over and above each other in the prediction of professional success and work satisfaction.

The following introduction will first review which contribution to the prediction of professional success and work satisfaction each domain of individual differences–general cognitive abilities, personality, and vocational interests–can make. Next the intercorrelations of these domains are outlined. Finally, we will overview studies which have used these domains congruently and thus provide insides into the incremental validity of each.

1.1 Predictive Validity of Abilities, Personality, and Vocational Interests Individually

For intelligence or general cognitive ability (GCA) typically the highest correlations with professional success can be found, with r's around .50 and higher (Gottfredson, 1997; Schmidt & Hunter, 1998, 2004; Strenze, 2007; Kramer, 2009; Salgado, Anderson, Moscose, Bertua, De Fruyt & Rolland, 2003; Kuncel, Hezlett, & Ones, 2004). And the relationship does not decrease with duration or professional expertise on the job (Hambrick & Meinz, 2011; Schmidt & Hunter, 2004), thus contradicting the criticism that with increasing job experience GCA should become less and less relevant. Another frequently proposed criticism, namely that socio-economic status (SES) is more relevant than intelligence and controlling for it should substantially reduce any GCA*success relationship, has been discredited for two of three success indicators in the meta-analysis by Strenze (2007); solely for predicting the criterion of income SES had a somewhat higher correlation than GCA.

The predictive power for professional success has been studied meta-analytically also

for classical personality traits, mostly following the Five Factor Model (FFM, Costa, & McCrae, 1992). In a meta-analysis Barrick, Mount and Judge (2001) have found the trait conscientiousness to be the most valid and most universal predictor of professional success; this trait plays an important role for almost all (analyzed) professions, although r's between .21 and .33 are lower than for GCA. The other big five traits are not as universally predictive, they correlate with success only in some of the analysed professions and for the whole sample they give mean r's between .07 and .15 only. Furthermore, motivation as assessed by general self-efficacy plays a vital role in the prediction of professional success (Abele & Spurk, 2009; Abele, Stief, & Andrä, 2000; Judge & Bono, 2001).

For the predictive power of (professional) interests regarding job success two rather recent meta-analyses are available: Van Iddekinge, Putka and Campbell (2011) showed that (mostly Holland's RIASEC) interest scales are good at predicting training performance (.26), and less so, but still they are valid for intended and actual turnover (.19 and .15), whereas the prediction of job performance was lowest (.14). These results hold for single interest scales that come mostly from the general RIASEC model, but prediction can be improved through the use of special scales designed to measure interests for particular jobs. In addition, generally somewhat higher validities are found for regression-based composites (up to .37). The latter finding demonstrates that multiple scales produce higher validities than single scales. Another meta-analysis on this question (Nye, Su, Rounds, & Drasgow, 2012) complements these results by reporting that correlations between congruence indices and professional criteria are higher (.21 to .30) than for interest scores alone (.05 to .14, for task performance; the other analysed criteria gave mostly similar findings).

1.2 Intercorrelations of Abilities, Personality, and Vocational Interests

The validity generalizations reported so far, however, provide no information about overall prediction of professional/job success and related criteria, and of incremental validities of one group of predictors over the other(s). The issue of incremental validities depends mostly on the intercorrelations of these predictor groups. These are usually rather low: Abilities correlate rather low with interests; mostly between .10 and .20, in few cases up to .30 (Ackerman & Heggestad, 1997; Pässler, Beinicke, & Hell, 2015; Proyer, 2006). Cognitive abilities are mostly not correlated (r's <.10) with big five traits; with only two exceptions: Furnham, Moutafi and Chamorro-Premuzic (2005) found openness correlated at .21 with fluid intelligence, and Ackerman and Heggestad, 1997 observed a negative correlation (-.15) of intelligence with Neuroticism.

Relatively the highest but few correlations can be found between big five personality traits and RIASEC interests: An older meta-analysis by Barrick, Mount and Gupta (2003) shows that extraversion and Enterprising correlate at .41, openness with Artistic and Investigative at r = .39 and .25, respectively; all other relations were below .20. When regressing each RIASEC type on FFM scores partially high R's (.47 for Enterprising and .42 for Artistic) as well as medium sized R's can be found (between .27 and .31 for Social, Conventional and Investigative). Realistic interest gave the lowest R of

.11. Short time later, another meta-analysis by Mount, Barrick, Scullen and Rounds (2005) showed that out of the 30 correlations (5 FFM variables * 6 RIASEC variables) only four were significant: Extraversion correlates with Social and Enterprising interests, openness correlates with Artistic and Investigative, thus largely confirming the former findings (cf. also Larson, Rottinghaus & Borgen, 2002). A more recent study that included also the HEXACO model could show similar findings for the FFM but partially higher R's for the HEXACO that was superior in predicting Realistic, Enterprising and Conventional interests (.18 to .40, depending also on sex; McKay & Tokar, 2012).

1.3 Incremental Validities of Abilities, Personality, and Vocational Interests

There is only little research looking at all three groups of individual differences variables simultaneously, and that comes mostly from one researcher, Phil Ackerman. By and large, his findings are reflected in the above mentioned meta-analyses, additionally he reported conscientiousness correlated with Conventional interests; regarding openness also relations with Investigative and Artistic were reported, but additionally openness was related with Social interests.

On the basis of these relations and those with personality traits Ackerman formulated his intelligence as process, personality, interests and intelligence as knowledge (PPIK) theory, in which he postulated four so-called "trait complexes": A – The "Social" complex combines Enterprising and Social interests with extraversion, social potency and well-being. B – the "Clerical/Conventional"-complex with perceptual speed as ability, Conventional as interests and the personality traits control, conscientiousness and traditionalism. C – the "Science/Math"-complex with math reasoning, visual perception, and Realistic and Investigative interests and D – the "Intellectual/Cultural"-complex with Gc and ideational fluency as investigative and Artistic interest and openness and typical intellectual engagement as traits (Ackerman, 1996; Ackerman & Heggestad, 1997).

Apart from developing "trait complexes" the relationships between abilities, personality traits and interests are also of interest from the viewpoint of incremental validities. Studies on this classical question of the incremental validity are rare. Still the main finding of the seminal meta-analyses by Hunter and Hunter (1984) and Schmidt and Hunter (1998) has not been challenged today: That –apart from work samples– nothing correlates as high with job success as intelligence. According to these meta-analyses from the tested 18 predictor variables it was only three (four) other assessments/traits that provided a substantial (>10% explained variance) enhancement of prediction of overall job performance: work samples, structured interviews and integrity tests (the conceptually related conscientiousness variable provided 9% additionally explained variance).

Besides from these meta-analyses only single studies on incremental validities of personality, interests and other psychological variables over and above intelligence can be found. These mostly focussed on "alternative intelligences" like "multiple intelligences", emotional intelligence, practical intelligence, but could not show any convincing evidence that these "alternative intelligences" can provide incremental validity over and above intelligence, personality and interests (a review of this literature can be found in Rost,

2013). Apart from this rather specific literature there is little research on incremental validities; in fact, we could not locate any single study on the prediction of job success that included all three groups of predictor variables (abilities, personality traits, interests). Austin and Hanisch (1990) used Project TALENT data to predict occupational attainments and using abilities and interests, but personality traits were not assessed. Illiescu, Ispas, Sulea and Ilie (2015) assessed the prediction of counter-productive work behaviour on the basis of vocational fit (assessment of interests) and personality traits (Big Five, Dark Triad, and others) but abilities were not assessed. Ziegler, Dietl, Danay, Vogel and Bühner (2011) predicted apprentices' training success using general mental ability and structured vs. unstructured interviews, and found incremental validity for structured but not for unstructured interviews over and above GCA, but personality traits and interests were not assessed.

1.4 Specifics of the Sample

Why should one study apprenticeship success? Apprenticeship is an alternative dual-track model of vocational education for 15-19 year olds in domains of craftsmanship and other non-academic fields (see below), where students spend most of their time in a company and go to school only about 20% of their work time, either one day a week or in a blocked mode (a good description of the apprenticeship system in Austria is given in Hamilton & Lempert, 1996). Although being implemented in only few countries worldwide, especially in recent years of economic crises it has received high praise in politics and economy as the economic success of those countries in spite of crises has also been attributed to this dual-track system. Advantages listed are: lower unemployment rates in youth, high success rates in competitions like "Worldskills", and at the same time there is flexibility with respect to higher (academic) careers. Psychological research on apprenticeship is rare; and it mostly focusses on aspects of career choice (e.g. Heckhausen & Tomasik, 2002; Dumfart, Krammer, & Neubauer, 2016), effects on socialization and personality development (Hamilton & Lempert, 1996). An exception is the study by Volodina, Nagy and Köller (2015): comparing first-year-apprentices of two professions they found abilities to be unimportant in the prediction of success and satisfaction, whereas vocational interest explained variance in the success over and above personality.

1.5 The Present Study

From the literature reviewed here so far, we would derive that cognitive abilities/intelligence correlate highest with job success (.5 and higher), personality traits—mostly from the FFM—up to .30, and interests usually around .2, maximum .3. But how is the prediction if, as usual in work and organizational psychology or human resources applications, measures from these domains are being combined; can the prediction be improved and what kind of psychological variables can provide incremental validity over the other? For example, does it make sense to combine intelligence measures with classical personality traits or with interest scales? Or does a combination of all three measures still improve the prediction of job success. And which group of specific predictors works best in which

class of (apprenticeship) jobs?

In the present study, we sought to address these questions on the basis of a broader than usual assessment of abilities, traits, and interests by employing/developing new (enhanced) taxonomies especially for abilities and for interests:

(1) an ability taxonomy including the domains of verbal, numerical and figural abilities as well as three "alternative abilities": social-emotional competencies, divergent thinking ability and practical-scientific competence;

(2) the big five taxonomy was administered in the classical form for extraversion, neuroticism, openness, and agreeableness, but—because of its pervasive importance for professional success and on the basis of findings from pilot studies—conscientiousness was assessed on the facet level;

(3) on the basis of the (Austrian version of) International Classification of Occupations (Statistik Austria, 2011) we developed an updated and enhanced interest taxonomy that should reflect better the modern professional world. The following professional domains are considered here: Office, Business administration, Personal services, IT, Leadership, Gastronomy, Craft, Law, Art, Farming, Assembly, Social, Sales, and Science.

Accordingly, we hypothesized, that grade point average (GPA) will be predicted better by (cognitive) abilities than by personality and interest. In contrast, we expect job and school satisfaction to be predicted better by the personality and interest scales.

2 Methods

2.1 Sample

Consisting of apprentices from twelve occupations as well as students of six higher vocational schools the sample covered the major occupational groups (Table 1); it should be noted, though, that Branch 4 also included AHS which is the usual high school leading to academic studies. The occupations covered here account for the majority of 65.37% of Austrian apprentices, in that the top 10 of all apprenticeship branches are represented (Wirtschaftskammer Österreich, 2015). From the total of 648 participants, 17 had to be excluded due to excessive missing data. The age of the remaining 631 participants ranged from 15 to 44 (Mean=17.92; SD=3.08) with 98% being younger than 26 years; 65.5% of this sample were male.

Table 1: Description of Investigated Groups

Branch	Profession/school type	*N*	Age	Male	Female
1	Agricultural school	51	16.32	6	45
(N = 130)	Baker	33	17.74	16	17
	Cook	13	17.38	6	7
	Gastronomy	33	16.81	16	17
2	Engineering school	42	15.40	29	13
(N = 156)	Metal Engineering	48	19.28	47	1
	Electrical Engineering	47	17.56	47	-
	IT	19	19.31	17	2
3	Nursing	32	25.27	4	28
(N = 102)	BAKIP (Kindergarden t.)	26	16.52	2	24
	Hairdresser	19	18.53	3	16
	Florist	25	17.80	2	23
4	AHS	20	17.30	4	16
(N = 115)	HAK	47	17.17	16	31
	Office	9	18.11	-	9
	Sales	39	18.95	11	28
5	Joiner	41	17.74	31	10
(N = 128)	Bricklayer	39	17.87	39	-
	Installations	48	17.79	47	1

Note. AHS = academic secondary school upper level; BAKIP = training institution for early childhood education; HAK = commercial academy; HLW = upper level institute for tourism and commercial professions; HTL = upper level technical institute; nursing = school for healthcare and nursing.

2.1.1 Branches

Having small (N=9; office) to medium (N=51; agricultural school) sample sizes per occupation we decided to cluster occupations into branches. Clustering was performed according to the requirement analysis of Bergner, Saurugg and Neubauer (2014), who extracted the requirements of over 6000 occupations from two major occupational databases (European Dictionary of Skills and Competences; DISCO; Berufs-Informations-Computer; BIC). Branches were configured by grouping occupations of similar requirements according to Bergner et al (2014). The five branches are:

1. Food: cook, gastro, baker, agricultural school
2. Tech: engineering school, IT, electrician, metal technician
3. People: nurse, kindergarten teacher, hairdresser, florist
4. Paper: high school, trade school, office, sales
5. Craft: plumber, carpenter, bricklayer

2.2 Measures

2.2.1 Cognitive and Alternative Abilities

Cognitive abilities were measured with the Talente Check (Neubauer, Ortner, Weienbacher, Katholnig, & Diedrich, 2016) – a test battery constructed as a screening tool measuring three cognitive (verbal, numerical, and spatial intelligence) and three non-cognitive (social-emotional competence, creative potential, practical-scientific competence) abilities with one subtest each.

Verbal intelligence was assessed with a similarities task consisting of 15 items to be solved in three minutes. The test of numerical intelligence used 20 number series items to be solved in twelve minutes. Figural intelligence was evaluated with 24 figures to be mentally assembled in eight minutes. All cognitive test showed sufficient internal consistency (Cronbach's Alphas: similarities α=.58; number series α=.88; figure assembling α=.69). The internal consistency of similarities was low, but this test proved to be Rasch-homogenous according to the criteria of median (LRT p=.3) and mother tongue (LRT p=.138; Neubauer et al., 2016).

Social-emotional competence was measured by a situational judgement test ("Situativer Test für Emotionale Kompetenz"; STEK; Neubauer et al., 2016). This test presents students with 19 vignettes for which they had to choose their typical reaction to a situation which evokes emotions in themselves (intrapersonal-) or others (interpersonal competency). Adequacy of the four alternative responses was rated beforehand by experts such as psychotherapists or teachers. Having no time constraints, the STEK takes students around 15 to 20 minutes to complete. Internal consistency, as assessed by Cronbach's Alpha was .72 and the facets of intra- and interpersonal competency correlated at r=.46 allowing for the calculation of a common mean value.

The test of creative potential encompassed three divergent thinking tasks: a figure completion task, an alternate uses task, and an instances task. Each task was constrained to three minutes and instructions asked to "find as many ideas possible, that will work but aren't found by all people". All ideas were judged according to their originality by three independent persons on a four-point scale (1= "common, not useful or new" to 4= "very uncommon, new and useful") (Diedrich, Benedek, Jauk, & Neubauer, 2015). Interrater reliability was sufficient for all tasks (figure completion α=.56; alternate uses α=.48; instances α=.48; Neubauer et al., 2016). Originality ratings of each idea were averaged within tasks and z-standardized. These standardized z-scores for each task

were then averaged across tasks and finally z-standardized to obtain a single creative potential score for each participant.

Practical-scientific competence was assessed with 18 items asking for the application of (natural-)science-principles to everyday problems. Correct response should be given either in the single-choice format or in open-ended questions. The latter were coded according to a strict coding scheme for each item. No time constraints apply, but the 18 items need on average about 20 minutes to complete. Internal consistency was Cronbach's α=.65 (Neubauer et al., 2016).

As mentioned above these cognitive and alternative abilities belong to the "Talente Check". This test battery has proven its reliability and validity in several pilot studies (Neubauer et al., 2016; Schwab, 2009).

2.2.2 Personality and Motivation

Being constructed especially for the prediction of school- and vocational success the personality and motivation scale (Persönlichkeits- und Motivationsscreening für die Bildungs- und Berufswahl; PMBB; Dumfart & Neubauer, 2016) encompasses all big five factors: openness to experiences, emotional stability, extraversion, and agreeableness at the factor-level and conscientiousness at the facet-level. Conscientiousness facets included ambition, self-discipline, thoughtfulness, and dutifulness; these were the facets that proved to be predictive in pilot studies for the development of this test (Dumfart & Neubauer, 2016). General self-efficacy was assessed as the most reliable predictor of school- and vocational success in the domain of motivation (vocational success: Abele & Spurk, 2009; Abele, Stief, & Andrä, 2000; Judge & Bono, 2001; school success: Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; Richardson, Abraham, & Bond, 2012). For both, the big five and the self-efficacy questionnaires responses were to be given on a four-point Likert-type scale from 1 (= I agree) to 4 (= I do not agree; sample item of conscientiousness "My room is always tidy."). Internal consistency ranged from .60 to .85 for all scales and Rasch-homogeneity can be assumed for the split-criteria of gender (all LRT's ns) and mother tongue (all LRT's ns). General self-efficacy, the facets of conscientiousness, and the factors of the remaining big five traits all yielded separate scores calculated as the average of all items in the respective domain.

2.2.3 Vocational Interests

As explained in the introduction, the construction of the vocational interest scale aimed at using practical operations as items which are known by students of that age, and that are typical of the respective branch. If feasible, also less favourable operations of that branch were chosen in item construction (e.g. "craming cows for meat production" for the domain of farming; Interessenstest für die Bildungs- und Berufswahl; IBB; Katholnig, Krammer, & Neubauer, 2015). IBB allowed for the assessment of 14 branches adapted from the ÖISCO (Austrian adaptation of the International Standard Classification of Occupations; Statistik Austria, 2011): Office, leadership, assembly, art, farming, craft, personal services, law, science, gastronomy, sales, social, business administration, and IT.

Each scale consisted of eight to ten items for which students had to decide whether they were "interesting" or "uninteresting" for them. The number of "interesting"-responses were summed for each branch. Internal consistencies ranged from .71 to .90 and Rasch-homogeneity can be assumed for the split-criteria median (all LRT ns, except for art, $p<.01$) and mother tongue (all LRT ns).

2.2.4 Job/School Satisfaction

Satisfaction with school or job was assessed separately for the students of higher vocational schools and apprentices. The job satisfaction questionnaire was adapted from the "Profilanalyse der Arbeitszufriedenheit" (profile analysis of job satisfaction; PAZ; Jimènez, 2010) and studies from adolescents' values. Köcher, Hurrelmann and Sommer (2013) and Scharinger and Ehetreiber (2014) found the following criteria to be the most important for job satisfaction: good payment, interesting tasks, a safe employment, good social surrounding, enough leisure time, low achievement pressure, and enough freedom of choice. These criteria were assessed with 17 items (including one overall and one open-ended item).

The school satisfaction questionnaire for students paralleled that of apprentices' job satisfaction – e.g. social surrounding was assessed with "how satisfied are you ... with the contact to your colleagues" in apprentices vs. "how satisfied are you ... with the contact to your classmates" in students. The student's questionnaire totaled 16 items.

Both questionnaires used four-point Likert-type scale from 1 (= very unsatisfied) to 4 (= very satisfied). In both questionnaires satisfaction-items were averaged and achievement motivation items were summed. Internal consistencies were .90 for job- and .85 for school satisfaction and both scales showed one factor solutions in exploratory factor analysis.

2.2.5 Sociodemographics and Grades

All participants provided their sex, date of birth and mother tongue (plus age at which they started learning German, if applicable). Furthermore, we asked them for several grades conditional to the school they were attending or the occupation they were learning – e.g. prospective florists were inquired after their botany grade. Grade point averages were computed by adding all grades of that domain and dividing across the number of grades of that domain. In order to achieve comparability between domains these average grades (GPA) were z-standardised within each domain.

2.3 Procedure and Statistical Analysis

Classes volunteering for the participation in this study received €50.- in total and were tested by psychologically-trained and experienced teachers in winter 2015. All students provided written consent—either in person or by their parents in advance. The whole study was conducted in paper-and-pencil format and took three hours per class: two hours for cognitive and alternative abilities and one hour for the other questionnaires

listed in the measures section. All tests and questionnaires were digitalized and automatically coded, except for practical-scientific competence, which was manually coded, and for creative potential that was judged for ideational originality by three independent judges.

Sum or mean scores of all measures were calculated as described in the respective manuals (Dumfart & Neubauer, 2016; Katholnig, Krammer, & Neubauer, 2015; Neubauer et al., 2016). To account for the differing variances among occupations grade point averages were calculated and z-standardized within each occupation.

Aiming at the assessment of the incremental validities of alternative abilities, personality and motivation, and vocational interests over and above intelligence hierarchical regression analyses were calculated for each branch individually. To this end, we used GPA as well as JSS as the criteria to be predicted by five sets of predictors: First, the three intelligence dimensions; second, the three alternative abilities; third the facets of conscientiousness; fourth, the other four big five factors; and fifth, the 14 domains of vocational interest. For each branch, only predictors showing significant bivariate correlations with the criterion were included in the regression analysis, thus yielding varying numbers of predictors in the regression analyses (Table 3). The order of steps was chosen on two bases: First, taking into account the average correlations of the respective predictor groups (on the bases of meta-analyses, where possible, cf. the introduction): Intelligence correlates highest with professional success, followed by conscientiousness, followed by the other big five, and finally by interests that moreover are the most (domain) specific predictors. For alternative abilities, no meta-analyses are available but here the rationale was to enter them in the second step because of their performance-type nature, whereas the measures in steps 3 to 5 are of self-report nature.

Each of these hierarchical regression analyses was run twice, once with GPA and once with JSS as criterion variable. Contrasting the "hard" achievement criterion of GPA with the "soft" criterion of JSS allows for a broader assessment of the predictors incremental power over and above each other.

3 Results

3.1 Descriptive Statistics and Correlations

Descriptive Statistics of all predictors and the criteria can be found in Table 2. Distributions exceeding the |Skew|>1 should be regarded as skewed (Blumer, 1973; Tabachnik & Fidell, 2007). This is the case only for interest for personal services (right-skewed).

Analysing correlations of gender (1=female, 2=male) with intelligence, alternative abilities, personality and interests meaningful (r>.3) relationships existed between gender and emotional stability (r= .31; p<.01) and also agreeableness (r= -.30; p<.01) as well as interests in personal service (r= -.44; p<.01), IT (r= .31; p<.01), gastronomy (r= -.41; p<.01), crafts (r= .52; p<.01), arts (r= -.49; p<.01), assembling (r= .53; p<.01), and social (r= -.42; p<.01). The intercorrelations of all variables are given in the appendix A1. Intelligence domains showed the highest correlations amongst themselves (r= .30 to .42; p<.01) whereas alternative abilities correlated low with each other

Table 2: Descriptive Statistics of all Predictors and Criteria

	M	*Md*	*SD*	*Min*	*Max*	*Skew*	*Kurt*
VA	9.39	10.00	2.16	1	13	-0.50	-0.25
NA	11.93	12.00	4.86	0	20	-0.22	-0.68
SA	9.65	10.00	3.22	2	18	-0.06	-0.66
SEC	2.85	2.87	0.44	1.60	3.87	-0.22	-0.18
Crea	2.01	2.01	0.14	1.60	2.73	0.10	1.18
PSC	6.74	7.00	1.91	0	12	-0.37	-0.05
Th	3.10	3.00	0.53	1	4	-0.52	0.36
Am	3.14	3.14	0.46	1	4	-0.58	0.57
Du	2.90	2.86	0.53	1	4	-0.28	-0.19
Sd	2.94	3.00	0.46	1.29	4	-0.61	0.67
A	3.02	3.13	0.44	1.13	4	-0.70	1.29
E	2.71	2.75	0.46	1	4	-0.19	0.37
ES	2.74	2.75	0.53	1	4	-0.40	0.40
O	2.65	2.63	0.50	1.38	4	0.21	-0.28
SE	3	3.00	0.49	1	4	-0.36	0.82
Off	2.61	2.00	2.13	0	8	0.59	-0.44
Bad	4.37	4.00	3.09	0	10	0.16	-1.16
Per	1.91	1.00	2.39	0	10	1.23	0.45
IT	3.03	3.00	2.52	0	7	0.28	-1.32
Lead	4.15	4.00	2.54	0	8	-0.01	-1.19
Gast	2.95	2.00	2.51	0	8	0.47	-1.02
Craft	3.84	3.00	3.25	0	10	0.41	-1.22
Law	3.77	3.00	2.63	0	8	0.19	-1.23
Art	3.02	2.00	2.99	0	10	0.83	-0.47
Farm	2.66	2.00	2.95	0	10	0.96	-0.25
Ass	4.33	4.00	3.40	0	10	0.23	-1.35
Soc	3	2.00	2.82	0	8	0.43	-1.28
Sal	2.78	2.00	2.49	0	8	0.54	-0.89
Sci	4.23	4.00	3.01	0	10	0.33	-1.06
JSS	2.99	3.00	0.57	1.19	4	-0.32	-0.33
Grades	0	-0.09	0.98	-2.19	3.09	0.26	-0.40

Note. M =mean; Md = median; SD = standard deviation; Min = minimum; Max = maximum; Skew = s kewness; Kurt = Kurtosis; VA = Verbal Ability; NA = Numerical Ability; SA = Spatial Ability; SEC = Social-Emotional Competence; Crea = Creativity; PSC = Practical-Scientific Competence; Th = Thoughtfulness; Am = Ambition; Du = Dutifulness; Sd = Self-discipline; A = Agreeableness; E = Extraversion; ES = Emotional Stability; O = Openness to experience; SE = Self-Efficacy; Off = Office; Bad = Business Administration; Per = Personal Service; Lead = Leadership; Gast = Gastronomy; Farm = Farming; Ass = Assembly; Soc = Social; Sal = Sales; Sci = Science; JSS=Satisfaction (students filled out the students questionnaire, apprentices filled out the apprentices questionnaire).

(r= .04; ns. to r=.15; p<.01) and low to medium (r=-.03; ns. to r=.36; p<.01) with cognitive abilities. Correlations between facets of conscientiousness were moderate to high (r= .29 to .61; p<.01); the other big five factors were either not or lowly/moderately correlated (r= .00; ns. to r=.27; p<.01). The motivational variable of self-efficacy showed positive correlations with all personality dimensions, especially emotional stability (r= .45; p<.01) and the conscientiousness facet of ambition (r= .45; p<.01). Ranging from r=.0 (ns; science*personal service, office*assembly and leadership*farming) to r=.84 (p<.01; assembly*crafts) domains of vocational interest showed the broadest spectrum of correlations.

3.2 Regression Analyses

In order to reduce the large number of predictors and avoid potential suppressor effects as best as possible we decided to use in each step only those predictors that showed a significant correlation with the respective criterion (Table 3). For the sake of brevity only the beta weights (and their significance) for the significant regression steps will be displayed in the regression tables.

3.3 Criterion GPA

Considering the Food-branch (agricultural school, cook, baker, gastronomy; **branch 1**) intelligence, the facets of conscientiousness, and vocational interests were the significant predictor steps (Table 4). Among intelligence it was verbal ability (β=.23; p<.05), among conscientiousness it was dutifulness (β=.25; p<.01), and among vocational interest it was the non-interest in IT (β=-.18; p<.05) which significantly explained variance in the GPA. In total 37% variance could be explained by these steps.

The GPA of apprentices and students in the Tech branch (engineering school, metal engineering, electrical engineering, IT; **branch 2**) could be predicted significantly only by intelligence, especially verbal intelligence (β =.21; p<.05). Only 10% variance could be explained by this step 1 and further steps did not significantly improve the prediction.

Success in kindergarten teacher school, nursing school, hairdresser, and florist – all working mainly with people (**branch 3: People**) – was predicted by intelligence and alternative abilities. Although the step of cognitive abilities as a whole reached significance, none of the individual predictors reached significance, a phenomenon that will be dealt with in the discussion. Therefore, only social-emotional competence in step 2 significantly predicted success in the People branch (β=-.29; p<.01). In total 15% variance could be explained.

GPA in the Paper branch (**branch 4**), consisting of High school, trade school, office, and sales was predicted by intelligence (numerical intelligence: β=.29; p<.05) in step 1; in step 2 – conscientiousness (facet ambition: β=.34; p<.01) and in step 3 by vocational interests (science: β=.20; p<.05). In total 37% variance could be explained. It was interesting to observe that in steps 2 and 3 verbal ability instead of numerical ability became significant.

Occupational success in the Crafts branch (carpenter, bricklayer, installation; **branch**

Table 3: Bivariate correlations of predictors and criteria separate for the branches

	Branch 1 (Food)		Branch 2 (Tech)		Branch 3 (People)		Branch 4 (Paper)		Branch 5 (Craft)	
	GPA	JSS	GPA	JSS	GPA	JSS	GPA	JSS	GPA	JSS
VA	.33**	-.14	.28**	.03	.13	.02	.24*	-.02	.28**	-.20*
NA	.30**	-.18*	.25**	.15	.23*	.05	.33*	.16	.31**	-.01
SA	.20*	-.15	.18*	.16*	.22*	-.02	.10	.03	.18*	-.24**
SEC	.15	.32**	-.04	.08	.33**	.26**	.11	.20*	.11	.22*
Crea	.07	-.04	.07	.04	.16	.11	.09	.22*	.12	.11
PSC	.18*	-.02	.09	-.08	-.04	.05	.15	-.06	.16	-.12
Th	.11	-.01	-.09	.13	.14	-.04	.03	.03	.10	.10
Am	.30**	.14	.16	.40**	.05	.35**	.46**	.29**	.30**	.17
Du	.36**	.21*	-.03	.29**	.09	.20*	.22*	.19*	.08	.14
Sd	.28**	.23**	.03	.32**	.15	.34**	.33**	.27**	.24**	.24**
A	.02	.18*	-.03	.21*	.16	.15	.16	.08	-.04	.20*
E	.25**	.13	.10	.15	-.09	.08	-.02	.04	.22*	.06
ES	.13	.19*	.01	.23**	.14	.15	.02	.22*	.12	.13
O	.15	-.02	.11	.18*	-.06	.08	.10	-.04	.08	.10
SE	.27**	.26**	.12	.25**	-.07	.20*	.06	.04	.12	.25**
Off	-.04	.10	-.08	.09	-.06	-.03	-.04	.14	-.07	.13
Bad	-.11	.02	-.03	.02	-.13	-.25*	.17	.12	.14	.20*
Per	-.09	-.09	.10	-.10	.02	.05	-.05	.02	-.12	.02
IT	-.21*	-.11	-.07	-.02	.10	-.02	-.07	.22*	-.11	.03
Lead	.05	.11	.02	.10	-.15	-.02	.09	.02	.10	.21*
Gast	.18*	.27**	-.02	-.09	-.04	.03	.08	.06	-.05	-.03
Craft	-.22*	-.06	-.01	.21*	-.01	.08	-.03	-.13	-.01	.47**
Law	-.03	-.09	-.06	-.08	-.09	-.27**	.20	-.03	.03	-.05
Art	.04	-.06	.02	-.07	.06	-.13	.07	-.22*	-.01	-.23*
Farm	.11	.19*	.04	-.02	-.01	.04	.16	-.06	.13	.09
Ass	-.16	.13	-.07	.13	.05	.09	.07	.08	-.05	.39**
Soc	-.07	.01	-.04	-.19*	.08	-.09	.15	.11	-.13	-.05
Sal	.03	.17	-.07	.00	.05	.03	.07	.31**	-.19*	.11
Sci	-.11	-.05	.13	-.06	-.15	.11	.23*	.01	.04	.08

Note. GPA= Great point average; JSS= job/school satisfaction; VA = Verbal Ability; NA = Numerical Ability; SA = Spatial Ability; SEC = Social-Emotional Competence; Crea = Creativity; PSC = Practical-Scientific Competence; Th = Thoughtfulness; Am = Ambition; Du = Dutifulness; Sd = Self-discipline; A = Agreeableness; E = Extraversion; ES = Emotional Stability; O = Openness to experience; SE = Self-Efficacy; Off = Office; Bad = Business Administration; Per = Personal Service; Lead = Leadership; Gast = Gastronomy; Farm = Farming; Ass = Assembly; Soc = Social; Sal = Sales; Sci = Science.

5) were significantly predicted by steps 1 (intelligence) and incrementally by step 2 (conscientiousness) and by step 4 (vocational interest). In step 1, verbal abilities reached significance (β=.23; p<.05), and among conscientiousness facets self-discipline (β=.21; p<.05) and ambition (β=.20; p<.05) contributed significantly. In the last step of vocational interest non-interest in sales incrementally added to the prediction of success (β=-.18; p<.05). In total 29% variance could be explained after step 4.

Table 4: Hierarchical regression predicting GPA

Branch 1 (Food)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.15	.15 F(3, 122)=7.13**		
Step 2 (Alt)	.15	.00 F(1, 121)=0.01		
Step 3 (Con)	.29	.14 F(3, 118)=7.95**		
Step 4 (oB5)	.32	.03 F(2, 116)=2.65		
Step 5 (Int)	.37	.05 F(3, 113)=2.83*		
	Step 1	VA^+	.23	2.50*
	Step 3	VA^+	.24	2.62**
		Du	.25	2.32*
	Step 5	SA	.17	2.09*
		Du	.28	2.51*
		IT	-.18	-2.17*
Branch 2 (Tech)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.10	.11 F(3, 146)=5.60**		
	Step 1	VA^+	.21	2.34*
Branch 3 (People)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.07	.07 F(2.89)=3.27*		
Step 2 (Alt)	.15	.08 F(1,88)=8.09**		
	Step 2	SEC	.29	2.84**

Branch 4 (Paper)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.13	.13 F(2,82)=5.87**		
Step 2 (Con)	.34	.21 F(3,79)=8.34**		
Step 3 (Int)	.37	.04 F(1,78)=4.59*		
	Step 1	NA^+	.29	2.54*
	Step 2	VA	.22	2.14*
		Am	.34	3.18**
	Step 3	VA	.24	2.39*
		Am	.28	2.56*
		Sci	.20	2.14*
Branch 5 (Craft)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.13	.13 F(3,115)=5.84**		
Step 2 (Con)	.25	.22 F(2,113)=8.37**		
Step 3 (Alt)	.26	.01 F(1,112)=1.60		
	Step 2	VA	.23	2.43*
		Am	.20	2.23*
		Sd	.21	2.22*
	Step 4	VA	.21	2.24*
		Am	.19	2.02*
		Sd	.21	2.30*
		Sal	-.18	-2.10*

Note. * = p<.05; ** = p<.01; + = no signficant β in the last significant regression step; Branch 2 NA tendency β = 0.17, p = .057; Branch 3 & 5 no significant β in Step 1; Cog = Cognitive Abilities; Alt = Alternative Abilities; Con = Conscientiousness Facets; oB5 = other Big Five factors; Int = Interests; VA = Verbal Ability; NA = Numerical Ability; SA = Spatial Ability; SEC = Social-Emotional Competence; Am = Ambition; Du = Dutifulness; Sd = Self-discipline; Sal = Sales; Sci = Science.

3.4 Criterion Job/School Satisfaction

In the Food branch (**branch 1**) cognitive abilities (Step 1), alternative abilities (Step 2) and other traits (Step 4) could predict JSS (Table 5). In Step 1 it was low numerical ability (β =-.18; p<.05), in Step 2 high social-emotional competence (β =.32; p<.01), and in Step 4 self-efficacy (β =.20; p<.05) which contributed to the prediction of satisfaction. With Step 4 in total 20% variance could be explained.

Apprentices' and students of technical occupations (**branch 2**) satisfaction was predicted by cognitive abilities (spatial ability: β=.21; p<.05) and conscientiousness (ambition: β=.30; p<.01). In Step 4 (vocational interest) non-interest in social occupations reached significance (β=-.25; p<.05). In total 34% of the variance in satisfaction could be explained.[1]

Predicting satisfaction in occupations working with people (**branch 3**) the predictor sets of alternative abilities (here step 1; R^2=.07; p<.05; with social-emotional ability, β=.26, p<.01) and conscientiousness facets (here step 2; ΔR^2=.09; p<.05; with ambition, β=.22, p<.05) could explain 16% variance in the criterion. Step 4 (vocational interest) reached significance as a whole (and rose variance explained to 25%) but surprisingly individual predictors did not (this phenomenon will be dealt with in the discussion).

Regarding paper based occupations (**branch 4**) alternative abilities, facets of conscientiousness, big five factors, and vocational interests explained variance in JSS. Specifically, social-emotional competence (β =.19, p<.05), creativity (β =.21, p<.05), ambition (β=.22; p<.05), emotional stability (β=.20; p<.05), as well as the interest in sales (β=.24; p<.01) and the non-interest in arts (β=-.23; p<.01) contributed. In total 33% variance could be explained.

Finally, apprentices of Craft (**branch 5**) satisfaction could be predicted by intelligence, alternative abilities, other big five, and vocational interests (steps 1, 2, 4, and 5). In the first step spatial ability contributed, but surprisingly negatively (β=-.21, p<.05). In the second step social-emotional competence provided a positive contribution (β =.19, p<.05). The fourth step yielded self-efficacy as a significant predictor (β=.21; p<.05). In the final step only interest in crafts (β=.40; p<.01) and non-interest in arts (β=-.28; p<.01) provided contributions; all other predictors lost their explanatory power. The total variance explained was 35%.

[1]Please note that although step 3 (other big five) showed only a tendency and is thus not reported in the table 5. Nevertheless, agreeableness emerged as a predictor in step 4.

Table 5: Hierarchical regression predicting JSS

Branch 1 (Food)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.03	.03 F(1,127)=4.03*		
Step 2 (Alt)	.13	.10 F(1,126)=14.70**		
Step 3 (Con)	.14	.01 F(2,124)=0.59		
Step 4 (oB5)	.20	.06 F(3,121)=3.00*		
Step 5 (Int)	.23	.03 F(2,119)=2.67		
	Step 1	NA	-.18	-2.01
	Step 2	NA	-.18	-2.11*
		SEC	.32	3.83**
	Step 4	NA	-.21	-2.55*
		SEC	.26	2.42*
		SE	.20	1.99*
Branch 2 (Tech)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.04	.04 F(1,142)=6.41*		
Step 2 (Con)	.23	.19 F(3,139)=11.10**		
Step 3 (oB5)	.28	.05 F(4,135)=2.42		
Step 4 (Int)	.34	.05 F(2,133)=5.49**		
	Step 1	SA	.21	2.53*
	Step 2	SA	.20	2.73**
		Am	.30	3.03**
	Step 4	SA	.18	2.51*
		Am	.25	2.48*
		A	.21	2.79**
		Soc	-.25	-3.26**
Branch 3 (People)				
	R^2	ΔR^2	β	t
Step 1 (Alt)	.07	.07 F(1,100)=7.25**		
Step 2 (Con)	.16	.09 F(3,97)=3.44*		
Step 3 (oB5)	.16	.00 F(1,96)=0.42		
Step 4 (Int)	.25	.09 F(2,94)=5.69**		
	Step 1	SEC^+	.26	2.69**
	Step 2	Am+	.22	1.85*

Branch 4 (Paper)				
	R^2	ΔR^2	β	t
Step 1 (Alt)	.08	.08 F(2,111)=5.10**		
Step 2 (Con)	.15	.07 F(3,108)=2.93*		
Step 3 (oB5)	.19	.03 F(1,107)=4.54*		
Step 4 (Int)	.33	.14 F(3,104)=7.13**		
	Step 1	SEC^+	.19	2.03*
		Crea	.21	2.35*
	Step 2	Crea	.20	2.24*
		Am+	.22	2.15*
	Step 3	Crea	.20	2.30*
		ES^+	.20	2.13*
	Step 4	Crea	.24	2.85**
		Art	-.23	-2.65**
		Sal	.24	2.72**
Branch 5 (Craft)				
	R^2	ΔR^2	β	t
Step 1 (Cog)	.08	.08 F(2,116)=4.83*		
Step 2 (Alt)	.11	.04 F(1,115)=4.59*		
Step 3 (Con)	.13	.02 F(1,114)=2.16		
Step 4 (oB5)	.18	.05 F(2,112)=3.20*		
Step 5 (Int)	.35	.18 F(5,107)=5.87**		
	Step 1	SA^+	-.21	-2.20*
	Step 2	SEC^+	.19	2.14*
	Step 4	SA^+	-.19	-2.00*
		SE^+	.21	2.21*
	Step 5	Craft	.40	3.11**
		Art	-.28	-3.12**

Note. * = p<.05; ** = p<.01; = p<.10; + = no signficant β in the last significant regression step; Branch 2 NA tendency β = 0.17, p = .057; Branch 3 & 5 no significant β in Step 1; Cog = Cognitive Abilities; Alt = Alternative Abilities; Con = Conscientiousness Facets; oB5 = other Big Five factors; Int = Interests; NA = Numerical Ability; SA = Spatial Ability; SEC = Social-Emotional Competence; Crea = Creativity; Am = Ambition; A = Agreeableness; ES = Emotional Stability; SE = Self-Efficacy; Soc = Social; Sal = Sales; Sci = Science.

4 Discussion

In the following we will summarize and discuss the findings. First, we will discuss the different contributions of the five groups of predictors: Intelligence factors, alternative abilities, conscientiousness facets, other big five and self-efficacy traits and finally interests. In a second part, we will turn to the discussion of the overall prediction in general and in the specific branches before naming possible limitations of this study.

4.1 Predictors of Success

Starting with the groups of predictors we can generally see that intelligence factors, which usually are considered the best predictor of professional success, fared well in predicting the hard criterion GPA (in all five branches sig., with 7 to 15% variance explanation). Relatively the lowest but still significant contribution was found in the "People" branch: For this group (nurse, kindergarten teacher, hairdresser, florist) cognitive intelligence seems to be of lower importance, here rather the social-emotional competence seems important for success (providing 15% variance explained, 8% incremental over the contribution of intelligence factors). This was the only branch where any of the alternative abilities could provide a substantial contribution to the prediction of the educational-professional success as reflected in GPAs.

The second best group of predictors for the GPA criterion are the conscientiousness facets that contribute incrementally on three (Food, Paper, Craft) of five branches and give even higher validity increments (12 to 22%) as compared to intelligence. The combination of intelligence with conscientiousness seems to be a kind of "all-purpose" set of predictors that is then enhanced through the additional inclusion of some specific interests (partially "non-interests").

Broadly speaking, the other big five traits plus self-efficacy play no role in predicting success in terms of GPA.

As mentioned interests can in three of five branches enhance the prediction of GPA with contributions of 3 to 8% of explained variance. Most interesting is here that in two branches (Food and Craft) it is the "negative" or non-interest for another domain that contributes to the prediction; a positive contribution a relevant interest has only been observed in the "paper branch" for the Science interest, which seems highly plausible.

A special problem arose in two regression analyses with the criterion GPA (Branch 3-People, Branch 5-Craft) where the predictor step of intelligence reached significance but the individual predictors did not. Since none of the conventional indicators showed signs of multicollinearity full interpretability of the analyses can be assumed.

4.2 Predictors of Satisfaction

A different picture is seen when considering the "soft" criterion of job/school satisfaction: Here, intelligence was only in three of five branches significant (Food, Tech, Craft), and explained only 3 to 8% variance (in the first step, not incrementally). On the other hand, alternative abilities provided significant contributions/increments in all branches

except Tech but provided also only moderate 1 to 8% variance contributions/increments (depending on whether it was the first step or not). To determine, which alternative abilities contributed was not as easy here; in the respective step, it was the test of social-emotional competence test (a situational judgment test), which was the best of the "alternative performance tests". But the Beta's of this test remained significant only in one case (Branch Food) when the other (later) steps including the personality traits were included. It seems that the predictive variance of the social-emotional test was later "eaten up" by the personality traits, which makes sense when looking at the intercorrelations (see Appendix 1). The test for creative potential (essentially a divergent thinking measure) contributed in one branch (Paper), whereas the test for practical abilities never provided any independent prediction, which might also be explained by the larger redundancy of this test with the three intelligence tests (see the intercorrelations in Appendix 1).

Conscientiousness (C) facets were also regarding the satisfaction criterion the best predictor with a significant contribution in three of five branches giving 7 to 19% increments. In the "grand picture", i.e. looking at both success criteria together C facets were almost equally predictive (6 out of 10 analyses) as compared to intelligence, which contributed in 7 out of 10 analyses. But with variance explanation of 7 to 21% increments (!) the C facets could be considered even somewhat stronger than the intelligence factors that—entered in the first step—provided between 3 and 15% variance explanation (when significant). In both cases, however, it should be mentioned that it depended on branch and criterion which intelligence factor and which C facet was predictive. While the contributions of the specific intelligence factors could be in most cases reasonably explained from the conceptual validity of the respective intelligence component, it seems much more difficult to explain why it were different C facets (dutifulness, self-discipline, ambition) that provided the respective significant prediction. But some consistency can be seen in the fact that generally the ambition facet was most frequently the best predictor (in 5 of 6 analyses). The fourth C facet "thoughtfulness" never contributed significantly.

The finding that the other big five factors give significant prediction only in some specific branches fits well the meta-analysis by Barrick et al. (2001). Not so plausible, however, is the rare contribution and low prediction from the self-efficacy variable.

Finally, the contributions of interests are incrementally significant in 7 out of 10 analyses (4 of them for the criterion satisfaction) and provided low to partially quite substantial increments: between 5 and 18%. Interests seem somewhat more important for satisfaction than for success (GPA) but it should be mentioned that of totally nine significant beta weights five were negative indicating that "non-interest" for a non-relevant (or even opposite domain, cf. the RIASEC conception) contributes positively to job/school satisfaction. From this one could even conclude that—in spite of their frequent and partially substantial contributions—interests are of rather low practical utility, as it is somewhat hard to imagine how "negative interests" could be implemented e.g. in the practice of counselling.

Also, here we had one case where a predictor step (in this case interests in People branch) reached significance but the individual predictors did not. Again, none of the

conventional indicators showed signs of multicollinearity so that full interpretability of the analyses can be assumed.

4.3 Patterns of the Prediction

In total, the variance explained was in a moderate to high range: The "hard criterion" GPA could be surprisingly explained somewhat worse (with 10 to 37%; average 25.6%) than the "soft" criterion satisfaction with school/job (23 to 35%, average 30%). However, this could be due to the nature of the tests: the larger part of the predictors was self-report tests which—when correlated with other self-reports like job/school satisfaction—can be expected to give higher correlations than with the more performance-like GPA data.

Comparing the branches most of the total predictive variances are in a range that is to be expected from previous findings, meta-analyses etc.; they mostly range between 25% and 30% but also go up to 37%, which can be considered high effect sizes. The only (somewhat surprising) exception is the GPA prediction in the Tech branch where only Step 1 / intelligence contributed and only explained 10%. Our conjecture would be that in this—strongly male dominated group—personality questionnaires but also the social-emotional judgment test are possibly filled out with less conscientiousness, something we have observed before.

Taken together our results are in line with studies showing, that vocational interest play an important role in predicting occupational outcomes (Stoll et al, 2017) especially during the early vocational career (Volodina, Nagy & Köller, 2015). The results also confirm older studies showing that different person-job-fit-criteria (success vs. satisfaction) are predicted by different predictor groups (ability, personality, interests) as found by Gellatly, Paunonen, Meyer, Jackson and Goffin (1991).

4.4 Limitations

Restrictions that might limit the generalizability of our findings are the following:

1. Samples were not small but also not large enough to allow for cross-validation. This must be the aim of future studies in order to ensure stability and replicability.

2. Some of the tests have low reliabilities in terms of the alpha-coefficient but a low alpha only means low homogeneity of the assessed construct and not necessarily that measurement quality must be bad (cf. Schweizer, 2011). We emphasize that in our view Rasch homogeneity is more important and this was ascertained here for all newly developed tests. That a low alpha must not restrain validity expectation can be seen best in the example of the verbal ability test, which contributed significantly most often here (for GPA in 4 of 5 branches) although it has an alpha of only .58!

3. The design is cross-sectional, i.e. psychometric measures and criteria have been assessed at around the same time, mostly in higher adolescent and early adult age

(mostly 15 to 26). All the tests employed here have been developed to be used for counselling purposes in 13 to 14 year-olds, i.e. when they have to make a career decision regarding their further education (apprenticeship or continuing school, cf. Dumfart, Krammer, Neubauer, 2016). The tests have been demonstrated to be reliable and valid for this younger group but their prospective validities have been demonstrated so far only in some pilot studies (e.g. Schwab, 2012; cf. also Neubauer & Opriessnig, 2014). The application of the tests that were developed for young adolescents in young adults might in some cases (especially in the ability tests) have led to ceiling effects, although the skewness values (see Table 2) do not support such a conjecture. Moreover, reliabilities did not differ between the sample tested here and our data from a sample of 13-14 year olds.

4. The assessed abilities and traits are not fully comprehensive. Especially regarding the low prediction of GPA in the Tech group (10%) and of 15% in the People branch one might ask whether other constructs might be missing, e.g. technical and manual skills, of which only the former ones were part of the test for practical abilities. On the other hand, we believe that the partially considerably higher amounts of explained variance (29 to 37% in three branches) on all other analyses except GPA prediction in the Tech branch do not support the conclusion that really important predictors might be missing. We think that our study included one of the most comprehensive test batteries including not only classical cognitive abilities, big five traits, self-efficacy, and interests (the latter in a more differentiated way than in the hitherto dominating RIASEC studies) but also alternative abilities like social-emotional competence and creativity. Especially the situational judgment test for the assessment of social-emotional competence seems to have worked well, giving incremental contributions in five of ten analyses.

In spite of these restrictions we point out that this study is one of the few attempts to predict apprenticeship success on the basis of psychometric assessments and to our knowledge it is so far, the most comprehensive one in that former attempts did not include cognitive and "alternative" abilities, personality traits and interests simultaneously.

References

Abele, A. E., & Spurk, D. (2009). How do objective and subjective career success interrelate over time? *Journal of Occupational and Organizational Psychology*, 82(4), 803–824.

Abele, A. E., Stief, M., & Andrä, M. (2000). Zur ökonomischen Erfassung beruflicher Selbsteffizienzerwartungen – Neukonstruktion einer BSEF-Skala. *Zeitschrift für Arbeits- und Organisationspsychologie*, 44, 145–151.

Ackerman, P. L., (1996). A theory of adult intellectual Development: Process, personality, interests, and knowledge. *Intelligence*, 22, 229–259.

Ackerman, P. L. & Heggestad, E. D. (1997). Intelligence, Personality, and Interests: Evidence for Overlapping Traits. *Psychological Bulletin*, 121, 219–245.

Austin, J. T. & Hanisch, K. A. (1990). Occupational attainment as a function of abilities and interests: a longitudinal analysis using project TALENT data. *Journal of Applied Psychology*, 75(1), 77–86.

Barrick, M. R., Mount, M. K., & Judge, T. A. (2001). Personality and Performance at the Beginning of the New Millennium: What Do We Know and Where Do We Go Next? *Personality and Performance*, 9, 9–30.

Barrick, M. R., Mount, M. K., Gupta, R. (2003). Meta-analysis of the Relationship between the Five-Factor Model of Personality and Holland's Occupational Types. *Personnel Psychology*, 56, 45–74.

Bergner, S., Saurugg, J., & Neubauer, A. C. (2014). Competence meets trait: Eine Konzeptanalyse zur inhaltlichen Überschneidung von Berufskompetenzen und psychologischen Eigenschaftskonstrukten. *Wirtschaftspsychologie*, 1, 50–65.

Caprara, G. V., Vecchione, M., Alessandri, G., Gerbino, M., & Barbaranelli, C. (2011). The contribution of personality traits and self-efficacy beliefs to academic achievement: a longitudinal study. *British Journal of Educational Psychology*, 81(1), 78–96.

Costa, P. T. Jr. & McCrae, R. R. (1992). Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) manual. Odessa, FL: Psychological Assessment Resources.

Diedrich, J., Benedek, M., Jauk, E., & Neubauer, A. C. (2015). Are creative ideas novel and useful? (9), 35–40.

Dumfart, B., Krammer, G., & Neubauer, A. C. (2016). Die Rolle von Fähigkeit, Persönlichkeit und Interesse in der Entscheidung zwischen Schule und Berufsausbildung. *Zeitschrift für Pädagogische Psychologie*, 30(4), 187–199.

Dumfart, B. & Neubauer, A. C. (2016). *Persönlichkeits- und Motivationsscreening für die Bildungs- und Berufswahl – PMBB*. Manual. Niederösterreichische Landesakademie.

Furnham, A., Moutafi, J., & Chamorro-Premuzic, T. (2005). Self-Estimated and Psychometric Intelligence. *International Journal of Selection and Assessment*, 13(1), 11–24.

Gellatly, I. R., Paunonen, S. V., Meyer, J. P., Jackson, D. N., & Goffin, R. D. (1991). Personality, vocational interest, and cognitive predictors of managerial job performance and satisfaction. *Personality and Individual Differences*, 12(3), 221–231.

Gottfredson, L. S. (1997). Why g matters: The complexity of everyday life. *Intelligence*, 24, 79–132.

Hambrick, D. Z., & Meinz, E. J. (2011). Sorry, strivers. Talent matters. *The New York Times*. Sunday Review, 12.

Hamilton, S. F. & Lempert, W. (1996). The impact of apprenticeship on youth: A prospective analysis. *Journal of Research on Adolescence*, 6(4), 427–455.

Heckhausen, J., & Tomasik, M. J. (2002). Get an Apprenticeship before School is Out: How German Adolescents Adjust Vocational Aspirations When Getting Close to a Developmental Deadline. *Journal of Vocational Behavior*, 60(2), 199–219.

Hunter, J. E. & Hunter, R. F. (1984). Validity and Utility of Alternative Predictors of Job Performance. *Psychological Bulletin*, 96(1), 72–98.

Iliescu, D., Ispas, D., Sulea, C., & Ilie, A. (2015). Vocational Fit and Counterproductive Work Behaviors: A Self-Regulation Perspective. *Journal of Applied Psychology*, 100(1), 21–39.

Jimènez, P. (2010). PAZ - *Profilanalyse der Arbeitszufriedenheit (PAZ 2000). PSYNDEX Tests Abstract*. Mödling: Schuhfried GmbH.

Judge, T. A., & Bono, J. E. (2001). Relationship of core self-evaluations traits self-esteem, generalized self-efficacy, locus of control, and emotional stability with job satisfaction and job performance: A meta-analysis. *Journal of Applied Psychology*, 86, 80–92.

Katholnig, T., Krammer, G. & Neubauer, A. C. (2016). *Interessenstest für die Bildungs- und Berufswahl IBB*. Manual. Niederösterreichische Landesakademie.

Köcher, R., Hurrelmann, K. & Sommer, M. (2013). Die McDonalds Ausbildungsstudie 2013. Retrieved May 27, 2016, from https://de.scribd.com/document/197702787/090913-Publikationsstudie-McDonalds-Ausbildungsstudie

Kramer, J. (2009). Allgemeine Intelligenz und beruflicher Erfolg in Deutschland. Vertiefende und weiterführende Metaanalysen. *Psychologische Rundschau*, 60(2), 82–98.

Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2004). Academic Performance, Career Potential, Creativity, and Job Performance: Can One Construct Predict Them All? *Journal of Personality and Social Psychology*, 86(1), 148–161.

Larson, L. M., Rottinghaus, P. J. & Borgen, F. H. (2002). Meta-analyses of Big Six Interests and Big Five Personality Factors. *Journal of Vocational Behavior*, 61, 217–239.

Mckay, D. A. & Tokar, D. M. (2012). The HEXACO and five-factor models of personality in relation to RIASEC vocational interests. *Journal of Vocational Behavior*, 81(2), 138–149.

Mount, M. K., Barrick, M. R., Scullen, S. M., & Rounds, J. (2005). Higher-order dimensions of the big five personality traits and the big six vocational interest types. *Personnel Psychology*, 58(2), 447–478.

Neubauer, A. C. & Opriessnig, S. (2014). Der Talente Check: Ein Begabungsscreening schreibt Geschichte. *Journal für Begabtenförderung*, 1, 7–14.

Neubauer, A.C., Ortner, A., Weissenbacher, B., Katholnig, T. & Diedrich, J. (2016). Talente Check. Ein Begabungsscreening fr Jugendliche 2016 [Talent Check: An aptitude screening for youth 2016]. Unpublished manual.

Nye, C. D., Su, R., Rounds, J., & Drasgow, F. (2012). Vocational Interests and Performance. A Quantitative Summary of Over 60 Years of Research. *Perspectives on Psychological Science*, 7(4), 384–403.

Pässler, K., Beinicke, A., & Hell, B. (2015). Interests and intelligence: A meta-analysis. *Intelligence*, 50, 30–51.

Proyer, R. T. (2006). The relationship between vocational interests and intelligence: Do findings generalize across different assessment methods? *Psychological Science*, 48(4), 463–476.

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: a systematic review and meta-analysis. *Psychological Bulletin*, 138(2), 353–387.

Rost, D. H. (2013). Handbuch Intelligenz. Weinheim: Beltz.

Sackett, P. R., LIevens, F., Van Iddeking, C. H., & Kuncel, N. R. (2017). Individual differences and their measurement: a review of 100 years of research. *Journal of Applied Psychology*, 102(3), 254–273.

Salgado, J. F., Anderson, N., Moscoso, S., Bertua, C., De Fruyt, F. & Rolland, J. P. (2003). A Meta-Analytic Study of General Mental Ability Validity for Different Occupations in the European Community. *Journal of Applied Psychology*, 88, 1068–1081.

Scharinger, C. & Ehetreiber, C. (2014). 4. *Steirische Jugendstudie 2014*. Retrieved May 26, 2016, from http://www.argejugend.at/wp-content/uploads/2014/10/Die-4.-Steirische-Jugendstudie-2014.pdf

Schmidt, F. L., & Hunter, J. E. (1998). The Validity and Utility of Selection Methods in Personnel Psychology: Practical and Theoretical Implications of 85 Years of Research Findings. *Psychological Bulletin*, 124, 262–274.

Schmidt, F. L., & Hunter, J. (2004). General Mental Ability in the World of Work: Occupational Attainment and Job Performance. *Journal of Personality and Social Psychology*, 86, 162–173.

Schwab, S. (2009). Entwicklung des Kindergarten-Talente-Tests: Testkonstruktion für die Bereiche Kreativität, Motorik und Emotionserkennung sowie Erprobung der gesamten Testbatterie. Unpublished master thesis, Karl-Franzens-Universität Graz.

Schwab, S. (2012). Erstellung von Anforderungsprofilen für Lehrberufe und Schultypen. Unpublished doctoral dissertation, Karl-Franzens-Universität Graz.

Schweizer, K. (2011). On the Changing Role of Cronbach's [alpha] in the Evaluation of the Quality of a Measure. *European Journal of Psychological Assessment*, 27(3), 143–144.

Statistik Austria (2011). *Systematik der Berufe, ÖISCO-08*. Wien: Verl. Österreich

Strenze, T. (2007). Intelligence and socioeconomic success: A meta-analytic review of longitudinal research. *Intelligence*, 35, 401–426.

Stoll, G., Rieger, S., Lüdtke, O., Nagengast, B., Trautwein, U. & Roberts, B.W. (2017). Vocational Interests Assessed at the End of High School Predict Life Outcomes Assessed 10 Years Later Over and Above IQ and Big Five Personality Traits. *Journal of Personality and Social Psychology*, 113(1), 176–184.

Van Iddekinge, C. H., Putka, D. J. & Campbell, J. P. (2011). Reconsidering Vocational Interest for Personnel Selection: The Validity of an Interest-Based Selection Test in Relation to Job Knowledge, Job Performance, and Continuance Intentions. *Journal of Applied Psychology*, 96, 13–33.

Volodina, A., Nagy, G. & Köller, O. (2015). Success in the first phase of the vocational career: the role of cognitive and scholastic abilities, personality factors, and vocational interests. *Journal of Vocational Behavior*, 91, 11–22.

Wirtschaftskammer Österreich. (2015). Lehrlingsstatistik. Wien: Wirtschaftskammern Österreich.

Ziegler, M., Dietl, E., Danay, E., Vogel, M., & Bühner, M. (2011). Predicting Training Success with General Mental Ability, Specific Ability Tests and (Un)Structured Interviews: A meta-analysis with unique samples. *International Journal of Selection and Assessment*, 19(2), 170–182.

Biographical Notes:

Dr Jennifer Diedrich is a post-doc researcher at the Centre for International Student Assessment (ZIB), TUM School of Education, Technical University of Munich. Her research topics are assessment of creativity, assessment of mathematical literacy, employee motivation, and organizational crisis management.

Dr Aljoscha Neubauer is professor of differential psychology at the University of Graz, Austria. Currently, he is president of the Austrian Psychological Society. His research interests cover prediction of professional success, study admission for prospective teachers, leadership assessment, and neuroscience of intelligence and creativity.

Anna Ortner, BSc MSc studied psychology and business administration at the University of Graz. Her research foci are test construction and recruiting.

Appendix

Appendix 1: Bivariate correlations of all variables

	GPA	gender	age	VA	NA	SA	SEC	Crea	PSC	Th	Am	Du
gender	.095*											
age	-.01	-.06										
VA	-.25**	-.20**	.04									
NA	-.27**	.06	.02	.43**								
SA	-.18**	.00	-.07	.30**	.38**							
SEC	-.11**	-.19**	.17**	.04	.05	-.03						
Crea	-.09*	-.15**	.14**	.24**	.10*	.10*	.14**					
PSC	-.11**	.01	.05	.36**	.33**	.26**	.04	.15**				
Th	-.05	.00	.08	-.04	.01	.05	.23**	.06	.01			
Am	-.24**	.07	.15**	-.05	.05	.04	.33**	.08	.09*	.36**		
Du	-.14**	-.06	.16**	-.17**	-.10*	-.11**	.39**	.09*	-.10*	.37**	.53**	
Sd	-.20**	.03	.14**	-.13**	.00	-.08	.41**	.08*	-.05	.29**	.55**	.61**
A	-0.03	-0.3**	.10*	-0.03	-0.07	-0.06	.47**	.14**	0.01	.15**	.17**	0.21**
E	-.11**	.05	.01	.11**	.08	.05	.06	.08*	.09*	.04	.21**	.08
ES	-.08	.31**	.07	-.05	.06	-.02	-.02	.00	-.01	-.02	.16**	.06
O	-.08	-.19**	.17**	.15**	.02	.08*	.30**	.19**	.12**	.26**	.32**	.17**
SE	-.12**	.09*	.12**	.04	.14**	.08*	.17**	.07	.05	.13**	.45**	.25**
Off	.06	-.17**	.04	-.09*	-.05	-.16**	.21**	.03	-.15**	.16**	.11**	.20**
Bad	-.01	.12**	-.03	.00	.15**	-.01	.08*	.02	.00	.19**	.13**	.12**
Per	.02	-.44**	.07	-.04	-.25**	-.08	.11**	.03	-.14**	.00	.03	.10**
IT	.08	.31**	-.03	-.12**	.10*	.05	.03	-.02	.04	.10*	.05	-.02
Lead	-.03	.10*	.05	-.07	.11**	-.05	.13**	.07	-.03	.22**	.22**	.17**
Gast	-.03	-.41**	.03	.01	-.13**	-.06	.26**	.06	-.09*	.04	.04	.14**
Craft	.05	.52**	-.08	-.30**	-.06	-.01	-.09*	-.14**	-.04	.06	.14**	.05
Law	.00	-.07	-.01	.08	.11**	-.01	.14**	.10*	.03	.18**	.07	.03
Art	-.03	-.49**	.01	.11**	-.13**	.05	.12**	.09*	-.01	-.02	.01	.01
Farm	-.07	-.03	.05	-.09*	-.14**	.00	.08*	-.02	.01	.01	.11**	.07
Ass	.04	.53**	-.05	-.29**	-.05	-.01	-.07	-.08*	.00	.07	.16**	.06
Soc	.02	-.42**	.15**	.01	-.14**	-.10*	.35**	.05	-.10*	.04	.05	.16**
Sal	.03	-.10*	-.02	-.15**	-.09*	-.07	.17**	-.02	-.08*	.11**	.11**	.17**
Sci	-.03	.14**	.03	.05	.07	.10**	.04	.05	.15**	.15**	.16**	.00

Appendix 1 continued

	A	E	ES	O	SE	Off	Bad	Per	IT	Lead	Gast	Craft	Law
gender													
age													
VA													
NA													
SA													
SEC													
Crea													
PSC													
Th													
Am													
Du													
Sd													
A													
E	-0.03												
ES	-0.03	.27**											
O	.26**	.23**	.01										
SE	0.06	.39**	.45**	.26**									
Off	.15**	.05	-.09*	.12**	.04								
Bad	-0.04	.13**	.05	.09*	.17**	.54**							
Per	.17**	.05	-.14**	.14**	-.05	.31**	-.01						
IT	-0.06	.01	.06	.02	.09*	.21**	.36**	-.14**					
Lead	0.01	.18**	.07	.12**	.21**	.53**	.76**	.03	.22**				
Gast	.23**	.04	-.17**	.25**	.00	.40**	.14**	.54**	-.06	.18**			
Craft	-.12**	.02	.19**	-.11**	.13**	-.02	.18**	-.18**	.36**	.14**	-.22**		
Law	.09*	.14**	-.02	.22**	.13**	.37**	.60**	.11**	.24**	.49**	.18**	.01	
Art	.19**	.13**	-.22**	.35**	-.03	.14**	-.08	.56**	-.14**	-.03	.50**	-.19**	.16**
Farm	.08*	.00	.00	.12**	.04	.05	-.01	.20**	-.08*	.00	.34**	.22**	-.08*
Ass	-.12**	.02	.18**	-.13**	.12**	.00	.18**	-.23**	.42**	.15**	-.24**	.84**	.04
Soc	.36**	.03	-.13**	.21**	-.02	.24**	-.05	.50**	-.10**	.02	.56**	-.16**	.17**
Sal	.15**	.06	-.05	.09*	.07	.64**	.42**	.30**	.17**	.41**	.45**	.04	.23**
Sci	0.01	.00	.00	.30**	.11**	.09*	.29**	.00	.43**	.22**	.06	.37**	.35**

Appendix 1 continued

	Art	Farm	Ass	Soc	Sal
gender					
age					
VA					
NA					
SA					
SEC					
Crea					
PSC					
Th					
Am					
Du					
Sd					
A					
E					
ES					
O					
SE					
Off					
Bad					
Per					
IT					
Lead					
Gast					
Craft					
Law					
Art					
Farm	.25**				
Ass	-.26**	.18**			
Soc	.46**	.18**	-.20**		
Sal	.17**	.16**	.07	.25**	
Sci	.18**	.10**	.36**	.04	.07

Note. GPA= Great point average; JSS= job/school satisfaction; VA = Verbal Ability; NA = Numerical Ability; SA = Spatial Ability; SEC = Social-Emotional Competence; Crea = Creativity; PSC = Practical-Scientific Competence; Th = Thoughtfulness; Am = Ambition; Du = Dutifulness; Sd = Self-discipline; A = Agreeableness; E = Extraversion; ES = Emotional Stability; O = Openness to experience; SE = Self-Efficacy; Off = Office; Bad = Business Administration; Per = Personal Service; Lead = Leadership; Gast = Gastronomy; Farm = Farming; Ass = Assembly; Soc = Social; Sal = Sales; Sci = Science.