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JOB PERFORMANCE PREDICTORS IN A GROUP OF INFORMATION AND COMMUNICATION TECHNOLOGY SPECIALISTS

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Abstract
Based on the theory of person-environment fit, non-cognitive predictors of job performance were studied in a group of information and communication technology (ICT) specialists. From various potential job and training performance predictors seven psychological attributes (personality, vocational interests, grit, growth mindset, self-efficacy, goal orientation and resistance to change) were chosen and tested as predictors of job performance ratings, as provided by either the supervisor or the study participant. The results indicate that grit, vocational interests, and resistance to change predict job performance in this group of ICT specialists. This study adds to the scientific literature of grit and vocational interests as non-cognitive predictors of job performance. Implications for practice include the recommendation of using grit and vocational interests in personnel management processes such as personnel selection or placement.

Keywords: job performance, non-cognitive predictors, information and communication technology specialists

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At the core of the person-environment fit paradigm is the notion that individuals seek environments where their behavior can manifest itself in the best possible scenario (Su et al., 2015) based on their individual characteristics such as values, personality, interests, etc. These individual characteristics, for example, vocational interests or personality, can be important not only for general life outcomes such as career satisfaction or income, but also for job satisfaction in the workplace setting (Ghetta et al., 2020 or job performance (Rounds & Su, 2014). As job performance is an important criterion for almost any job, the current study investigated what non-cognitive predictors of job performance are important in a group of information and communication technology specialists (ICT) to further understand whether there are individual characteristics that are important specifically for this occupational group, and if they could aid in personnel selection, upskilling and placement processes.

Non-cognitive predictors of job performance

Job performance predictors include various characteristics that are studied in different occupational groups. Besides general mental ability that is the most studied job performance predictor (e.g. Nye et al., 2022; Schmitt, 2014), there are other psychological attributes that may predict job performance. Those include personality (e.g. Lee et al., 2019; Pelt et al., 2017; Salgado & Táuriz, 2014; Schmitt, 2014; Wilmot et al., 2019) or personality attributes (e.g. Kanfer et al., 2010; Keller, 2012; Sackett & Walmsley, 2014), vocational interests (e.g. Nye et al., 2012, 2017; Schmidt, 2014; Van Iddekinge, Putka, et al., 2011; Van Iddekinge, Roth, et al., 2011), and specific knowledge and skills that are important for specific jobs or settings (e.g. Mumford et al., 2008; Neubert et al., 2015).

Other characteristics that have been studied less often include individual attributes that are mostly related to training performance but may be useful in predicting job performance specifically in cases of employee upskilling or reskilling where training is a part of the process. Such related attributes include self-efficacy (Judge et al., 2007; Na-Nan & Sanamthong, 2020; Stajkovic & Luthans, 1998), the persons' belief in their capability to achieve a specific level of performance (Bandura, 1999). Self-efficacy has been studied in the training performance domain as an outcome of training (Heggestad & Kanfer, 2005), and people with higher self-efficacy beliefs may have higher job performance due to their belief about their capabilities. Another individual attribute related to performance is grit (Southwick et al., 2019), the persistence and passion regarding long-term goals (Duckworth et al., 2007). Individuals who are grittier are more successful in various domains (Fawver et al., 2020; Jiang et al., 2019; Rego et al., 2021) and therefore could be with higher job performance.

Growth mindset or implicit theories of self (Dweck et al., 1995) as a belief in the malleability of one's attributes (Dweck, 2019), has been studied in the workplace (Zingoni & Corey, 2017), where more incremental (growth) mindset relates positively to job performance. However, it is not known whether growth mindset is predictive of job performance when various individual characteristics are combined. Goal orientation, an attribute of how individuals develop or validate their ability in achievement settings (Vandewalle, 1997), is related to their job performance (Theis & Bipp, 2020). Specifically, individuals with more mastery (or learning) goal orientation and performance-approach goal orientation are with higher job performance. Finally, from the non-cognitive aspects that are studied in workplace settings, resistance to change as a dispositional tendency (Oreg, 2003; Oreg et al., 2008) to resist change may be related to job performance if the workplace context involves much development and change. As the workplace and the way a job is done may change rapidly due to technological advancements, resistance to change may be an important non-cognitive predictor in workplaces where change is constant and jobs are not routine based (Oreg, 2018).

Despite the previous research of job performance in relation to various individual characteristics, there is a scarcity of research on which of these non-cognitive attributes are most predictive of job performance when studied together, and whether there is some specificity for ICT specialists from the perspective of person-occupation fit.

ICT specialists and non-cognitive predictors of job performance

Research on ICT specialists in general and their personality profiles specifically is scarce. A meta-analysis of professionals that included also engineers (Barrick & Mount, 1991) showed that a predictor of job performance was higher Conscientiousness. Salgado (1997) reported that for professionals predictors of job performance were Conscientiousness, Emotional Stability and Agreeableness. In another study (Lounsbury et al., 2014) the personality profiles of 12 695 IT professionals were compared to those of other employees. From the Big Five traits, the following differences in personality profiles were found: IT professionals indicated higher levels of Agreeableness, lower Extroversion, lower Conscientiousness and lower Emotional Stability than non-IT professionals. In relation to job satisfaction in the IT specialists' sample (Lounsbury et al., 2007), Emotional Resilience, Extraversion, Openness and Teamwork disposition were positively related to job satisfaction. As no research has been conducted specifically for ICT specialists' personality-job performance relations, and considering that IT professionals' personality differs from other employees, the following research question was proposed:

Q1) Are there personality traits other than Conscientiousness and Neuroticism that are related to job performance in an ICT specialists' group?

As for the other variable, namely, vocational interests, ICT specialists differ from other occupation groups with a predominance of Investigative and Realistic interests (Berga & Austers, 2021a). The nature of the employment – specifically, working in an Investigative environment – is predicted by the Realistic and Investigative interests (De Fruyt & Mervielde, 1999) they were requested to describe their labor market positions and jobs, using the Position Classification Inventory (PCI; Gottfredson & Holland, 1991. The choice of an IT career is predicted by higher Realistic interests and lower Enterprising interests (Rosenbloom et al., 2008). Additionally, the US National occupation database reports that those working in the Information Technology career cluster (*O*NET Information Technology Cluster*, 2022) should be with dominating Investigative, Realistic, sometimes Conventional or Social interests. Combining previous research results and the profile of vocational interests of ICT specialists, the proposed research question was:

Q2) Are Investigative and Realistic interests related to job performance in an ICT specialists' group?

As for other psychological attributes, no specific research is available with samples of ICT specialists. Overall grit could be predictive of job performance, as it has been predictive of job performance in other occupational groups (Berga & Austers, 2021b), and it could be encouraged in order to improve the job performance of employees (Southwick et al., 2019). Growth mindset has not been fully studied in the context of job performance across occupations but in the sales occupation it is related to job performance (Zingoni & Corey, 2017). Resistance to change in an environment of constant development and change may be related to job performance, as those who are resistant of various changes in the workplace may not as fully adjust to their job as those who are lower on the scale of resistance to change. Goal orientation, specifically, learning goal orientation and performance-prove goal orientation may be related to job performance as individuals seek out goals that improve their performance. Finally, self-efficacy, previously studied with different employee samples (Judge et al., 2007), may be related to job performance across different occupations, however, no information is available, whether it is important for ICT specialists as well. Therefore, the third proposed research question was:

Q3) Are grit, growth mindset, resistance to change, goal orientation and self-efficacy related to job performance in an ICT specialists' group?

And overall, as no research has been conducted to study in combination these non-cognitive characteristics in an ICT specialists' group, the final question of the research was:

Q4) Which of these non-cognitive predictors are important for job performance in the sample of ICT specialists?

Method

Sample

Questionnaires were completed by 101 ICT specialists from four technology organizations in Latvia. As the supervisor's ratings were not available for 13 of the specialists, the final sample consisted of 88 ICT specialists, 28 (32%) women and 59 (67%) men, age ranging from 22 to 62 years, M = 37.80 (SD=9.42). 70,4% reported higher education (18% did not want to specify their level of education), they were working at the current job for M = 6.16 years (SD = 5.88), and working in the current organization for M = 8.90 years (SD = 9.04, Me = 5.07). The sample of ICT specialists included programmers, engineers, system analysts, web developers, and others.

Instruments

Personality was measured by a Latvian forced-choice multidimensional personality inventory (LFMI) (Berga et al., 2020) that consists of 18 forced-choice blocks of four statements, whereby respondents choose one item that characterizes them the most and one that characterizes them the least (MOLE format quads). The LFMI items are from the Latvian personality inventory (Perepjolkina & Reņģe, 2013) and measure six personality dimensions – Conscientiousness, Neuroticism, Agreeableness, Openness to Experience, Extroversion and Honesty-Humility. Each dimension is measured by 12 items, and each item is scored either in a positive or negative direction, and the respondent's choice (e.g., for the item "I am an accurate person", if rated as 'most like me', the respondent receives 2 points in the Conscientiousness dimension, while if rated as 'least like me' – 0 points. If the item is not rated, the respondents get 1 point). Sample quad items and scoring based on the item standing and the choice of respondent is shown in Table 1. Test-retest reliability of LFMI dimensions are as follows (Berga et al., 2020): Conscientiousness .78, Neuroticism .75, Agreeableness .75, Openness to Experience .64, Extroversion .87 and Honesty-Humility .64.

Vocational interests were measured with a Latvian questionnaire of vocational interests (LQVI) (Berga & Austers, 2021a) that measures six interest domains: R-realistic, I-investigative, A-artistic, S-social, E-enterprising and C-conventional. The questionnaire consists of 57 items that measure one's preference towards different activities, e.g., 'I enjoy teaching and training others' is an item from the Social interest scale. The questionnaire has two parts – in the first part respondents rate each statement on a scale from 1-'do not agree' to 5-'agree' how much they agree with the statement (e.g., 'I like to work with cars' as an item from the Realistic scale), and in the second part respondents rate each item representing an activity on a scale from 1-'do not like very much' to 5-'like very much' (e.g., 'Create new medicine' from the Investigative interest scale). The internal reliability of the scales (in parenthesis is shown the reliability of the questionnaire in the original study, as reported by Berga & Austers, 2021a) was as follows: R-realistic .80 (.77),

Table 1. Sample item of LFMI and scoring procedure

Block 1	Respective personality factor	Scoring If chosen 'most like me'	Scoring if chosen 'least like me'	Scoring if not chosen
I am a very accurate person	Conscien-tiousness	2	0	1
I cannot lie	Humbleness – Humility	2	0	1
I do not take the initiative to meet other people	Extraversion	0	2	1
I sometimes tend to be sarcastic and vitriolic	Agreeableness	0	2	1

Note. LFMI – Latvian forced-choice multidimensional personality inventory.

I-investigative .83 (.81), A-artistic .78 (.83), S-social .78 (.79), E-enterprising .84 (.84) and C-conventional .75 (.77).

Grit was measured with the Short Grit scale (Grit-S) (Duckworth & Quinn, 2009) that consists of eight items. Respondents rated each item in a scale from 1 – 'not like me at all' to 5-'very much like me' (e.g., 'New ideas and projects sometimes distract me from previous ones'). The overall scale internal reliability was .74. Only the overall grit score was used in this study.

Growth mindset was measured by 'Kind of person' Implicit theory scale (Dweck, 1999). The scale consists of eight items that respondents rated from 1-'strongly disagree' to 6-'strongly agree' (e.g., 'The kind of person someone is, is something very basic about them and it can't be changed very much'). The overall growth mindset score was used in this study. The internal reliability of the scale was .91.

Goal orientation was measured by the Goal Orientation Questionnaire (Vandewalle, 1997) that consists of 12 statements measuring three goal orientations: learning goal orientation (e.g., 'I am willing to select a challenging work assignment that I can learn a lot from'), proving-performance goal orientation (e.g., 'I like to show that I can perform better than my co-workers') and avoiding-performance goal orientation (e.g., 'I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others'). Respondents answered how much they agree to the statement in a scale from 1-'strongly disagree' to 5-'strongly agree'. The scale's internal reliabilities were as follows: learning goal orientation .85; proving-performance goal orientation .81; and avoiding-performance goal orientation .85.

Resistance to change was measured with the Resistance to Change scale (Oreg, 2003) consisting of 17 statements that respondents rated om a scale from 1-'strongly disagree' to 6-'strongly agree' (e.g., 'I generally consider changes to be a negative thing'), comprising four subscales (internal reliability in parenthesis): routine seeking (.84), emotional reaction (.73), short-term thinking (.73), and cognitive rigidity (.50). In the final analysis the cognitive rigidity scale was excluded due to low internal reliability results.

Self-efficacy was measured with the General Self-Efficacy scale (Schwarzer & Jerusalem, 1995), whereby respondents rated 10 statements on a scale from 1- 'not at all true' to 5-'exactly true' (e.g., 'I can always manage to solve difficult problems if I try hard enough'). Internal reliability of the scale was .87.

Job performance was measured by either of two ratings– the supervisor's rating of task performance or a subjective job performance rating. The supervisor-rated job performance measure consisted of five items adapted from Williams & Anderson (1991) – e.g., 'Employee completes assigned duties' – that supervisors rated on a scale from 1-'strongly disagree' to 7-'strongly agree'. The internal reliability of the supervisor's rating scale was .83. In situations where the supervisor's ratings were not available, a subjective job performance was used and measured by three statements: 'Overall, how do you / your supervisor / your peers/ rate your job performance during the last 6 months?' on a scale from 1-'unsatisfactory' to 10-'excellent'. The internal reliability of the subjective job performance measure was .84. To calculate a job performance index, mean centering was performed with both the supervisor's ratings and the subjective ratings, and in further analysis the T-score values of job performance was used.

Procedure

Participation in the study was voluntary through an internet-based survey using QuestionPro. Participants were invited to complete the questionnaires by their organizations' Human Resources departments. As an incentive to motivate the completion of the questionnaire, individual feedback in the form of a personality and vocational interest profile was sent to study participants per request. In the data analysis only fully completed questionnaires were used. Those respondents for whom the job performance measure had not been gathered were excluded from the final data analysis.

Results

Means, standard deviations and correlations of variables to job performance ratings are represented in Table 2.

To answer the first three research questions 1 – *Are there personality traits other than Conscientiousness and Neuroticism that are related to job performance in an ICT specialists' group?*; 2 – *Are Investigative and Realistic interests related to job performance in an ICT specialists' group*?; and 3 – *Are grit, growth mindset, resistance to change, goal orientation and self-efficacy related to job performance in an ICT specialists' group?*, Spearmen's correlations were computed. Only two

Table 2. Means, standard deviations and correlations to job performance of studied variables

	M	SD	Job performance
Conscientiousness	12.41	3.99	.12
Honesty-Humility	15.26	2.94	.17
Extroversion	13.25	4.28	.01
Agreeableness	12.97	3.27	.11
Openness to Experience	14.30	2.63	–.14
Neuroticism	10.77	3.49	–.11
Realistic interests	36.84	7.21	.02
Investigative interests	34.34	6.51	.07
Artistic interests	29.57	6.91	–.14
Social interests	33.37	5.95	–.19
Enterprising interests	32.30	7.31	–.23*
Conventional interests	33.50	5.85	–.05
Self-efficacy	3.72	.55	.14
Learning goal orientation	4.01	.67	–.00
Performance-prove goal orientation	3.26	.98	–.14
Performance-avoid goal orientation	2.47	.95	.01
Routine seeking	2.52	.84	–.18
Emotional reaction	3.06	.81	.01
Cognitive rigidity	3.51	.67	.06
Short-term thinking	2.66	.80	–.12
Growth mindset	3.56	.95	–.01
Grit	3.42	.54	.31**

Note. * $p < .05$. ** $p < .01$.

correlations were statistically significant – negative correlation with Enterprising interests ($r_s = –.23$, $p < .05$) and job performance and positive correlation with grit ($r_s = .31$, $p < .01$) and job performance. From the personality traits, no personality trait was significantly related to the job performance measure. From vocational interests, Realistic and Investigative interests were not significantly related to the job performance measure in the ICT specialists' sample. From the other psychological variables, only grit showed positive correlation with job performance.

To answer the fourth research question, which of the non-cognitive attributes predict job performance in the ICT specialists' sample, linear regression analysis with stepwise procedure was performed. From all the variables, three models yielded statistically significant results (see table 3), namely, inclusion of grit, resistance to change-routine seeking, and enterprising interests in the model explained 50% of job performance variance (F (3,23) = 7.69***, $p < .001$, $R^2 = .50$).

Table 3. Linear regression analysis results of job performance with stepwise procedure

Variable	Unstandardized B	Coefficients SE	Standardized coefficients Beta (β)	t	p
		Model 1[a]			
Grit	8.24	3.55	.42	2.32*	.03
		Model 2[b]			
Grit	9.31	3.27	.48	2.85*	.01
Routine seeking	−4.82	1.96	−.41	−2.47*	.02
		Model 3[c]			
Grit	7.77	2.97	.40	2.62*	.02
Routine seeking	−5.45	1.76	−.46	−3.10*	.01
Enterprising interests	−.48	.18	−.41	−2.69*	.01

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.
[a] Constant 24.42*, $p <. 05$ F (1.25) = 5.38*, $p <. 05$, $R^2 = .18$.
[b] Constant 33.92*, $p <. 01$, F (2.24) = 6.28*, $p < .01$, $R^2 = .34$.
[c] Constant 56.73***, $p <. 001$, F (3,23) = 7.69***, $p <. 001$, $R^2 = .50$.

Discussion

The results show that job performance ratings in an ICT sample were positively related to grit and negatively related to Enterprising interests. No personality trait or other types of vocational interests were related to job performance ratings. These were unexpected results, given that the personality traits of Conscientiousness and Emotional Stability or its almost opposite Neuroticism were expected to be correlated with job performance, as based on the meta-analytical findings of personality in relation to job performance (Sackett et al., 2021; Salgado, 1997). There are two reasons this could be the case. First, partially ipsative and normative measures were correlated, and this may have impacted the results. When ipsative measures of both the predictor and criterion are used, then the correlations seemed to be higher than when ipsative and normative measures are correlated (Bartram, 2007). Second, this study was underpowered to detect small effects- post hoc power analysis using G*Power calculator yielded only 47.35% power for the study to detect .2 effect. Therefore, the Type II error is more possible - there could be an effect, but the study lacks statistical power to detect the effect. For a study to detect the effect with power of at least 80%, alpha .05 and effect of .2, there should be at least 191 participants. This study had 80% power to detect the effect of .3.

Why Realistic and Investigative interests were not directly related to job performance might be explained by the scoring procedure of the LQVI. In contrast to the rating system of other vocational interest instruments, in this study the raw

score from each interest subscale was correlated with the job performance measure. Other scoring strategies would be to use interest congruence indices (Camp & Chartrand, 1992) or points given if the interest item is endorsed per se, rather than endorsed on a dimensional scale (e.g., if an item of the Realistic interests subscale is endorsed as 'agree' or 'almost agree', 1 points could be given for endorsement and 0 for no endorsement, not on a scale from 1 to 5 as used in this study). If a nominal scale would have been used, then there would be no difference if the person reports 4 or 5 on the scale, as the dominant interest still could be detected by item endorsement score overall. The result that Enterprising interests were negatively related to job performance is in line with the theory of Holland's hexagon model (Holland, 1972) whereby interests from opposite dimensions, in this case, opposite of Investigative interests is Enterprising interests, could be a misfit. The idea that misfit matters was explored in a study where job satisfaction, not performance, was measured (Wiegand et al., 2020), and the misfit between interests in this case would be related to job performance.

Those study participants that reported themselves as grittier also had higher job performance ratings, as rated by their supervisor or themselves. Grit has been related to job performance previously (Berga & Austers, 2021b; Ion et al., 2017), so thereby this research confirms and adds results from a different occupational group, showing that grit is related to job performance measures. As grit is correlated to Conscientiousness (Crede et al., 2016), it is worth noting that in this sample grit was a stronger predictor of job performance than Conscientiousness. Overall, those that persevere and have passion towards long-term goals are those employees whose job performance was rated higher by their supervisor or themselves. These results add to justification of the usefulness of measuring grit to predict job performance in an employee sample.

The psychological attribute Resistance to change negatively predicted job performance, meaning, that for professionals working in ICT the more they are resistant to change, the lower their job performance rating. That is in line with the ever-changing world of internet technology, and if one cannot or does not want to follow changes, the job performance may be impacted. To date, there are no studies available that have researched resistance to change in the ICT personnel, so this study adds to the research of ICT personnel and the psychological attributes that predict job performance besides personality profile. Resistance to change as dispositional attribute may be added to the predictors of job performance in the ICT occupations. Different psychological attributes have been researched in relation to career satisfaction (Lounsbury et al., 2009) for IT professionals, e. g., openness was related to the career satisfaction for IT specialists. As openness and resistance to change may be negatively correlated, the conclusion of this research that resistance to change negatively predicts job performance seems in line with

different research results and adds to the existing scientific literature the psychological attributes important for ICT specialists.

Some limitations of the study should be noted – the sample size was too small to detect effects smaller than .3, so for the relations of other psychological attributes and job performance no conclusion can be drawn – there might exist relations if the sample size would be larger, so that smaller effects could be detected. The sample was also non-representative of ICT specialists – although mostly engineers and programmers were included in the sample, only those that were willing did answer the call for participation in the study, so the generalization of results to all ICT specialists is impacted. Finally, the causality cannot be claimed in cross-sectional studies. Future studies should explore more types of job performance, as overall job performance rating is mostly some kind of composite of different job performance dimensions, such as in-role performance or task performance and extra-role performance.

Implications for Practice

There are three important predictors of job performance for ICT specialists – vocational interests, specifically, Enterprising interest as misfit; grit and resistance to change. These are non-cognitive predictors that could be incorporated in the selection or placement of employees in the ICT occupations. Although this study did not research the settings of personnel placement or selection, the next studies could incorporate whether additionally to intellectual abilities and specific knowledge or experience, grit, resistance to change and vocational interests predict job performance in real selection scenarios. This study adds the question for future studies in real selection scenarios whether additionally to other psychological assessments vocational interests, especially, measuring misfit, could add the incremental validity for job performance predictions.

Based on the results of this study, the recommendation is adding grit, resistance to change and vocational interests in the personnel management processes such as personnel selection, upskilling or reskilling of employees or personnel placement as potentially aspects that may predict job performance and the fit of employees to the ICT occupations.

Conclusion

The predictors of job performance have been researched in psychology to understand the attributes that may differ individuals who are most suited or perform better in specific roles. This research explored non-cognitive predictors

specifically in the sample of ICT specialists, where mostly personality in the form of MBTI has been studied (Cruz et al., 2015). Therefore, to understand, what attributes are best fitted to the occupational group and whether there are ones, the study of job performance predictors was carried out.

Vocational interests have been neglected variable in the literature of personnel selection, so this study emphasizes not only that vocational interest matter, but also that misfit may matter. Grit has not been studied in the work context so much as in educational context, so this study puts grit on the map as one of the psychological attributes that are related to job performance for ICT specialists. Resistance to change has not been researched as psychological attribute related to job performance for ICT specialists, and the result of this study shows that when measuring resistance to change, predictions of job performance can be made. Most interestingly, these variables are important when personality is added alongside in the prediction model. So, not only personality may matter in the context of non-cognitive predictors of job performance (Barrick & Mount, 2005), but also other attributes matter for job performance, specifically, in ICT specialists' sample.

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