Psychometric properties of the Slovenian adaptation of Zuckerman-Kuhlman Cross-Cultural 50 item personality questionnaire (ZKPQ-50-CC) in a sample of emerging adults

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Abstract: The aim of the present study was to validate the Slovenian version of the ZKPQ-50-CC (Aluja et al., 2006). The ZKPQ-50-CC is a shortened, cross-culturally validated version of the Zuckerman Kuhlman Personality Questionnaire (ZKPQ; Zuckerman et al., 1988), based on an alternative five-factor model of personality. Our sample included 2138 emerging adults (1534 females; M_{age} = 21.28 years; SD = 3.62) who filled in both the ZKPQ-50-CC and the Big Five Inventory (BFI; John et al., 1991). The results of a confirmatory factor analysis showed similarities to those of the original validation study across four European countries (Aluja et al., 2006). To improve upon the psychometric properties of the ZKPQ-50-CC scales, however, we removed six items with low factor loadings (below .30), resulting in the ZKPQ-44-CC. The five factors (Impulsive Sensation Seeking, Neuroticism-Anxiety, Aggression-Hostility, Activity, and Sociability) of the adjusted instrument suggested acceptable internal reliability, as well as satisfactory convergent and divergent validity against the BFI factors. We also determined relatively high levels of temporal stability (measurements two years apart) of the alternative five factors in a smaller follow-up sample (n = 168). Despite several drawbacks, we consider the ZKPQ-44-CC appropriate for psychological research in Slovenia.

Keywords: Zuckerman's Alternative Five-Factor Personality Model, the ZKPQ-50-CC, Slovenian validation, validity, internal reliability, temporal stability

Psihometrične lastnosti Slovenske priredbe Zuckerman-Kuhlmanovega medkulturnega vprašalnika osebnosti (ZKPQ-50-CC) pri vzorcu mladih na prehodu v odraslost

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Povzetek: Namen raziskave je bil validacija slovenske priredbe vprašalnika ZKPQ-50-CC (Aluja idr., 2006). ZKPQ-50-CC je skrajšana in medkulturno validirana različica Zuckerman-Kuhlmanovega vprašalnika osebnosti (ZKPQ; Zuckerman idr., 1988), ki temelji na alternativnem pet faktorskem modelu osebnosti. Naš vzorec je vključeval 2138 mladih na prehodu v odraslost (1534 žensk; $M_{starost}$ = 21,28 let; SD = 3,62), ki so izpolnili ZKPQ-50-CC in Inventar pet velikih faktorjev BFI (BFI; John idr., 1991). Rezultati konfirmatorne faktorske analize so pokazali podobnosti z izvirno validacijsko študijo v štirih evropskih državah (Aluja idr., 2006). Da bi izboljšali psihometrične lastnosti lestvic ZKPQ-50-CC, smo odstranili šest postavk z nizkimi faktorskimi utežmi (pod ,30) in še krajši vprašalnik poimenovali ZKPQ-44-CC. Za pet faktorjev (Impulzivno iskanje čutnih spodbud, Nevroticizem-anksioznost, Agresivnost-sovražnost, Družabnost in Aktivnost) prilagojenega pripomočka smo ugotovili sprejemljivo notranjo zanesljivost ter zadovoljivo konvergentno in divergentno veljavnost s faktorji BFI. Tudi časovna stabilnost alternativnih petih faktorjev s ponovljeno meritvijo po dveh letih (n = 168) je bila razmeroma visoka. Kljub nekaterim pomanjkljivostim menimo, da je ZKPQ-44-CC primeren za psihološko raziskovanje v Sloveniji.

Ključne besede: Zuckermanov alternativni pet faktorski model osebnosti, ZKPQ-50-CC, slovenska validacija, veljavnost, notranja zanesljivost, časovna stabilnost

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The development of ZKPQ

In their pursuit to create a biologically grounded measure of human personality, Zuckerman and his colleagues developed the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ; Zuckerman et al., 1988, 1993). It was created to serve as an alternative to the measures grounded in the Five Factor Model (FFM; Costa & McRae, 1992a), and the theory on which the ZKPQ was based on, came to be known as the alternative FFM (Zuckerman, 2002). Zuckerman (1991) claimed that basic dimensions of personality need to derive from a strong biological and temperamental approach to human personality and posited four criteria to be met in a personality measure of the basic dimensions. These dimensions should (a) be identified reliably across genders, cultures, and ages, (b) be recognized in animals, (c) exhibit at least moderate heritability, and (d) associate with biological markers (behavioral, biochemical, neurological, and genetic).

The ZKPQ was developed through several studies in the 1980s (Zuckerman et al., 1988). First, the authors selected 46 scales, such as temperament scales (e.g., Buss & Plomin, 1975), Eysenck's (1983) superfactors of Extraversion, Neuroticism, and Psychoticism, and Zuckerman's Sensation Seeking Scale (Zuckerman & Link 1968) that could be condensed into biologically based higher order factors (Zuckerman et al., 1988). Factor analyses of these scales led to three-, five-, and seven-factor models, with the 5-factor model chosen as the most appropriate (Zuckerman et al., 1991). Individual items were then selected to represent each of the five factors based on their correlations with the provisional factor scores (Zuckerman et al., 1991). A consequent series of studies was then aimed at improving the psychometric properties of the questionnaire and resulted in the final 99-item version (Zuckerman, 1992, 2002).

The 99-item ZKPQ comprises a set of true/false statements to assess the basic dimensions of the alternative FFM. Activity (Act; 17 items) reflects a preference for challenging and difficult tasks, as well as being active and on the go. Aggression-Hostility (Agg-Host; 17 items) indicates a tendency towards rudeness, vengefulness, "hot-headedness", and being confrontational. Impulsive Sensation Seeking (ImpSS; 19 items) displays one's need for change and novelty, a tendency towards acting on impulse, as well as preference for risky and uncertain environments and social relationships. Neuroticism-Anxiety (N-Anx; 19 items) is defined by a lack of self-confidence, proneness towards sensitivity, and pervasive experiences of negative emotion. Lastly, Sociability (Sy; 17 items) captures one's preference for social interaction, having many friends, and an aversion to social isolation. In addition to these 89 items, a 10-item validity scale serves to detect careless responding and extreme social desirability (Zuckerman, 2002).

Since its construction, the ZKPQ has been translated into several languages, such as German (Ostendorf & Angleitner, 1994), Catalan (Gomà-i-Freixanet et al., 2004), Spanish (Aluja et al., 2002), and Mandarin (Wu et al., 2000), and validated in those cultural settings. Alternative versions have also been introduced for different purposes, and to our knowledge, three short forms of the questionnaire have been developed: a 35-item short form (ZKPQ-S) consisting of 7 items per scale (Zuckerman, 2002), a 69-item short form with items selected using exploratory and confirmatory factor analysis (Aluja et al., 2003), and the ZKPQ-50-CC (Aluja et al., 2006), which showed cross-language stability and good factor loadings.

Characteristics and utility of the ZKPQ-50-CC

The ZKPQ-CC consists of 50 items with ten items per each of the five dimensions. In the original validation study (Aluja et al., 2006), the instrument was simultaneously tested using a multi-group confirmatory factor analysis with samples from four language communities (English, French, German, and Spanish). The results supported satisfactory construct validity for the 5-factor model across the samples. Correlations between the full ZKPQ and the ZKPQ-50-CC scales were around 0.90, and the differences in mean scores (effect sizes) between the national samples were modest. Overall, the authors concluded that the ZKPQ-50-CC is a useful instrument to assess traits of the alternative FFM, with good psychometric and cross-cultural properties. Moreover, Aluja and Blanch (2011) reported satisfactory convergent validity of the ZKPQ-50-CC dimensional scores with the NEO-FFI-R (Costa & McCrae, 1992b) and the Temperament and Character Inventory (TCI-R, Cloninger et al., 1993). Specifically, they found moderate to high correlations amongst the dimensional scores of the three questionnaires measuring similar personality constructs. With regard to the NEO-FFI-R, Sy and ImpSS were positively associated with Extraversion, N-Anx with Neuroticism, Act with both Extraversion and Conscientiousness, and ImpSS with Openness, whereas Agg-Host was negatively related to Agreeableness. Likewise, the authors observed moderate to high positive correlations between ImpSS and TCI-R Novelty Seeking, N-Anx and TCI-R Harm Avoidance, Sy and TCI-R Reward Dependance, and high negative correlations between N-Anx and TCI-R Self-Directedness as well as between Agg-Host and TCI-R Cooperativeness (Aluja & Blanch, 2011).

The ZKPQ-50-CC has been used to study a wide variety of psychological topics in diverse samples, accumulating support for its criterion validity. For example, the scores of Agg-Host and N-Anx were found to be elevated among individuals with type D personality (the type capturing tendencies towards experiencing negative emotions and inhibition of self-expression in social interactions), and those with cardiovascular issues (Aluja, Malas, et al., 2019). Salavera et al. (2020) further found the ZKPQ Act and N-Anx strongly predicting eudaimonic well-being. Specifically, lower levels of N-Anx predicted a sense of meaning and purpose, personal growth and self-acceptance, personal expressiveness, and feelings of belonging, while Act showed positive associations across the dimensions of eudaimonic well-being. A study using a large dataset and machine learning algorithms (Ortigosa et al., 2014) suggested that the five ZKPQ-50-CC traits (classified into low, medium and high trait level categories) could be correctly inferred based on individuals' behavior on Facebook using machine learning prediction models with high accuracy, with probability rates ranging from 60 to 80% (e.g., ImpSS and Sy could be inferred

based on one's number of friends; Act could be inferred based on the number of friends since the user has started using Facebook and the number of "active friends" with whom the user frequently interacts). A study on driving styles revealed their differential relationships with the Agg-Host, ImpSS, and N-Anx dimensions (Poó et al., 2013). Specifically, ImpSS was positively associated with a risky and angry driving style, and negatively connected to a careful driving style; N-Anx was associated with an anxious and dissociative driving style; Agg-Host was related to a risky driving style and negatively related to a careful driving style.

In general, the ZKPQ dimensions have indicated links with various risk-taking behaviors and psychopathology. For example, high scores on ImpSS predicted self-reported drug use, risky sexual behavior, smoking, and alcohol consumption in a sample of both male and female college undergraduates (Zuckerman & Kuhlman, 2000), while ImpSS, N-Anx and Agg-Host were associated with addiction severity among both male and female cocaine users (Ball, 1995). Furthermore, a comparison of the predictive power of the FFM versus the alternative FFM showed a similar effectiveness of the ZKPQ-50-CC compared to the NEO-FFI-R in predicting abnormal personality, suggesting a potential usefulness of the ZKPQ-50-CC in clinical research (Aluja et al., 2015). High levels of the ImpSS and N-Anx scores were, for example, related to Bipolar I and Bipolar II diagnosis status (Xu et al., 2015), and the alternative FFM predicted different functioning styles in individuals with a personality disorder, suggesting the most powerful predictions for antisocial, dependent, borderline, and avoidant styles (Huang et al., 2011).

The present study

Based on the briefly presented research, we believe the ZKPQ-50-CC is a useful instrument to measure the basic personality dimensions with a sound theoretical grounding, and good psychometric properties across different countries. As it is also considerably shorter than the full ZKPQ, it can be used in a variety of research contexts and designs (e.g., longitudinal, cross-cultural), but was, until now, not validated

Table 1
Sample demographics in the initial and follow-up data collection

Demographic characteristics	Initial sample (*n* = 2138)	Follow-up[a] (*n* = 168)
Gender (%)		
Female	1534 (71.7)	154 (91.7)
Male	604 (28.3)	19 (8.3)
Employment status (%)		
Student	1444 (67.5)	161 (95.8)
Student and employed[b]	107 (5.0)	7 (4.2)
Employed	385 (18.0)	0 (0.0)
Unemployed	202 (9.4)	0 (0.0)
In relationship (%)	1191 (55.7)	98 (58.3)

Notes. [a]Followed-up two years after the initial measurement.
[b]Students who were also engaged in student work.

for use in the Slovenian socio-cultural environment. We thus decided to validate the Slovenian translation/adaptation (Avsec & Kavčič, 2011) of the questionnaire in a sample of emerging adults. Specifically, we aimed to examine (a) the dimensional structure of the ZKPQ-50-CC, (b) internal consistency and two-year temporal stability of its scale scores, and (c) convergent and discriminative validity of the ZKPQ-50-CC scale scores against the FFM scale scores. Considering the conceptualization of the alternative FFM which does not primarily capture another realm of personality than the FFM (Angleitner et al., 2004), as well as the empirical findings of Aluja and Blanch (2011), we expected positive correlations between Sy and Extraversion, N-Anx and Neuroticism, ImpSS and both Extraversion and Openness, Act and both Conscientiousness and Extraversion, as well as negative correlations between Agg-Host and Agreeableness.

Method

Participants and procedure

The participants of the present study took part in a large study on psychosocial development over emerging adulthood, conducted within the research program [blinded]. First, social sciences students from the three Slovenian state universities were invited to participate in their classes. They were also asked to invite their peers (18- to 29-year-olds) who were currently not enrolled in education or were enrolled in natural and technical sciences university programs (or other tertiary education programs) to participate. A total of 2532 individuals initially agreed to take part in the online survey. However, we performed the analyses with a sample of 2138 individuals (72% females; M_{age} = 21.38; SD = 3.62) who filled in both personality questionnaires and had adequate item response times (at least two seconds per item).

A small part of the student sample was followed-up, and participated again two years later. Among these, 168 out of 186 provided valid data. Demographic characteristics of both samples (the initial and the follow-up) are shown in Table 1. Group comparisons were analyzed using χ^2 (WLSM estimator). A significantly higher percentage of females (χ^2 = 106.90, df = 1, p < .01) and those involved in a romantic relationship (χ^2 = 55.37, df = 1, p < .01) partook in the follow-up. Similar mean ages in the initial sample (M = 21.4, SD = 3.6) compared to the follow-up group (M = 21.3, SD = 2.0) suggest that younger participants from the initial data collection were more likely to participate again two years later.

Upon entering the online survey, potential participants were first asked to agree with the Privacy policy, which contained information about the purpose of the study, the respondents' rights concerning anonymity, data storage, and use of the data. The survey included demographic questions about gender, age, employment, and romantic relationship status (all in a multiple-choice format). Next, a series of questionnaires followed, including the ZKPQ-50-CC and the BFI in that order. After responding to the survey, participants were offered the possibility of being afforded automatically generated feedback on their personality characteristics. The study was conducted under the code of the Declaration of Helsinki and its later amendments.

Measures

The Zuckerman-Kuhlman Personality Questionnaire-50-CC (ZKPQ-50-CC)

The ZKPQ-50-CC (Aluja et al., 2006) is a short version of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ; Zuckerman et al., 1993). Participants respond to the items within a *true/false* self-report format. The items form five scales: Impulsive Sensation Seeking (ImpSS; e.g., *I'll try anything once*), Neuroticism-Anxiety (N-Anx; e.g., *I am easily frightened.*), Aggressiveness-Hostility (Agg-Host; e.g., *If people annoy me I do not hesitate to tell them so.*), Activity (Act; e.g., *I do not like to waste time just sitting around and relaxing.*), and Sociability (Sy; e.g., *I am a very sociable person.*). The questionnaire was validated across four countries in samples of young people under 35 years (Aluja et al., 2006); the proposed 5-factor model had sufficient fit to the data (SMSR = .01, CFI = .78, GFI = .90, RMSEA = .04) and internal reliability coefficients (Cronbach αs) across the countries ranged from .60 to .83. The items used in the present study have previously been translated/adapted to Slovenian language, but the ZKPQ-50-CC has not been validated yet (Avsec & Kavčič, 2011).

The Big Five Inventory (BFI)

The BFI (John et al., 1991) self-report questionnaire consists of 44 items. The five scales are Extraversion (8 items), Agreeableness (9 items), Conscientiousness (9 items), Neuroticism (8 items), and Openness (10 items). All items are worded as short phrases (e.g., *I see myself as someone who... is depressed; tends to be lazy; is talkative.*) that are based on prototypical trait adjectives related to each of the five constructs (John & Srivastava, 1999). The items are rated on a 5-point scale (1 – *strongly disagree*, 5 – *strongly agree*). John and Srivastava (1999) reported internal reliabilities (α) between .75 and .80 for the scales and 3-month test-retest reliabilities between .80 and .90. Coefficients of concurrent validity with the NEO-FFI (Costa & McCrae, 1992b) and the Trait Descriptive Adjectives (TDA, Goldberg, 1992) that were corrected for attenuation averaged .91 for Extraversion, Agreeableness, and Conscientiousness, .88 for Neuroticism, and .83 for Openness (John & Srivastava, 1999).

Using exploratory factor analysis, good model fit was established for the Slovenian version of the BFI, with internal consistency coefficients ranging between .73 and .83 (Avsec & Sočan, 2007). The Slovenian study (Zupančič & Kavčič, 2017) of emerging adults assessing a one-year temporal stability of BFI scale scores suggested the rank-order stability

coefficients (*r*s) of .82, .63, .73, .72, and .78 for Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness, respectively. Likewise, a slightly lower stability over the two-year time interval exceeded .63 across the five scales (Kavčič & Zupančič, 2018).

Statistical analyses

The confirmatory factor analysis (CFA) was done in R version 4.1.2 (R Core Team, 2021), using *psych* (Revelle, 2021), *lavaan* (Rosseel, 2012), *semPlot* (Epskamp, 2015), and *lavaanPlot* (Lishinski, 2018) packages. We used the DWLS (Diagonally weighted least squares) method due the dichotomous nature (true/false) of the ZKPQ-50CC items. When dealing with ordinal data, DWLS estimation method has been recommended over MLR (robust maximum likelihood) (Li, 2016), used in the validation of the original scale (Aluja et al., 2006). To assess the goodness of fit of our models, we used the CFI (Bentler, 1990), TLI (Tucker & Lewis, 1973), GFI (Schermelleh-Engel et al., 2003), RMSEA (Steiger & Lind, 1980), and the standardized root mean square residual SRMR (Hu & Bentler, 1999). Due to model complexity, the following cut-off values were considered as indicating adequate fit: CFI and TLI ≥ .95, RMSEA ≤ .06, and SRMR ≤ .08 (Hu & Bentler, 1999). Further analyses were conducted in SPSS 27.

Results

Construct validity of the ZKPQ-50-CC

We tested the fit of the original 5-factor model of the ZKPQ-50-CC (Aluja et al., 2006) to the Slovenian data. While the proposed model consisting of 50 items (Table 3) did show satisfactory RMSEA, SRMR and GFI indexes, both CFI and TLI were below the cut-off points recommended by Hu and Bentler (1999). Similarly, Aluja et al. (2006) reported a CFI below the recommended cut-off point, while the RMSEA, SRMR, and GFI were all satisfactory.

In line with recent proposals to create shorter and more easily useable measures of personality (e.g., Rammstedt & Beierlein, 2014), we omitted a few items from the ZKPQ-50-CC by setting a cut-off point of .30 on item factor loading scores. Standardized factor loadings for the retained items are shown in Figure 1 and are similar to those reported by Aluja et al. (2006), mostly ranging between .40 to .70 (albeit nine of them between .32 and .39). The item reduction process resulted in the elimination of six items: two items from the aggression-hostility domain (item 14: *If someone offends me, I just try not to think about it* (λ = .24) and item 15: *If people*

Table 2
Fit indices for the 50- and 44-item ZKPQ-CC five-factor model

Model	χ^2	*df*	GFI	CFI	TLI	RMSEA [90% *CI*]		SRMR
50 items	23718.98	1225	.99	.71	.69	.051	[.050, .052]	.060
44 items	21172.52	946	.99	.80	.79	.046	[.045, .047]	.053

Note. Both χ^2 were significant at *p* < .001.

annoy me I do not hesitate to tell them so (λ = .21)), one item from the sensation seeking domain (item 21: *I often do things on impulse* (λ = .19)), and three items from the sociability domain (item 41: *I do not mind going out alone and usually prefer it to being out in a large group* (λ = .29); item 43: *I do not need a large number of casual friends* (λ = .22); item 46: *I would not mind being socially isolated in some place for some period of time* (λ = .27)). Simultaneously, the item reduction led to an improvement in CFI and TLI values (Table 2). It is also of note that the GFI had a high value of 0.99 in our sample. While the CFI and TLI still did not reach the recommended cut-off point, the results are superimposable with those of the original ZKPQ-50-CC cross-cultural validation study (Aluja et al., 2006). We conducted further analyses based on the 44-item version (henceforth ZKPQ-44-CC). Because the 44 and 50 item ZKPQ models in our study are not nested, we acknowledge that a direct comparison between the two models is not possible. Means and standard deviations of the five ZKPQ-44-CC scales and ZKPQ-50-CC for the total sample and across gender are displayed in Table S1 and S2 of the Supplement.

Convergent and discriminative validity, and internal reliability

To examine the convergent validity of the ZKPQ-44-CC, we computed correlations of its five scale scores with the corresponding BFI scale scores by means of Pearson's correlational coefficients. Despite ZKPQ-CC responses being measured on a dichotomous true/false rating scale, the total value/sum of affirmative responses for each of the scales represents its dimensional score. Accordingly, the Pearson's r can be used (e.g., Aluja & Blanch, 2011). A vast majority of the correlations between ZKPQ-44-CC and BFI dimensions in the present study (Table 3) were statistically significant, with those suggesting convergence highlighted in bold. As expected, higher levels of Agg-Host moderately correlated with lower levels of Agreeableness ($r = -.52$, $p < .01$); higher levels of ImpSS associated (albeit lower) with higher levels of both Extraversion ($r = .31$, $p < .01$) and Openness ($r = .27$, $p < .01$); higher levels of N-Anx were strongly related to higher levels of Neuroticism ($r = .69$, $p < .01$); Act moderately correlated with Conscientiousness ($r = .43$, $p < .01$), but weaker with Extraversion ($r = .27$, $p < .01$); finally, higher levels of Sy were associated with higher levels of Extraversion ($r = .55$, $p < .01$) These associations are similar to the pattern of correlations between the ZKPQ-50-CC dimensions and the FFM dimensions reported in the validation of the original questionnaire (Aluja & Blanch, 2011), and suggest convergent validity of the ZKPQ-44-CC. Likewise, our results show discriminative validity, as the ZKPQ constructs are theorized to be relatively independent from one another. Low intercorrelations between the ZKPQ-44-CC dimensional scores (Table 3) are congruent with Zuckerman's orthogonal model (Zuckerman et al., 1993). Similarly, the theoretically unrelated ZKPQ and BFI dimensions did not show convergence as indicated by low or non-significant correlations between the respective scale scores of our study. The item reduction of the three scales (i.e., Agg-Host, ImpSS and Sy) in addition suggested negligible change or no change of the intercorrelations between the ZKPQ-44-CC scales, as well as of their associations with the BFI scales (compare Table 3 and Table S3 in the Supplementary material).

From the multitrait-multimethod matrix (MTMM; Table 3) it is also discernable that Cronbach's αs range from .68 to .82, suggesting satisfactory to good internal reliability of the ZKPQ-44-CC scales (George & Mallary, 2003). As evident from Table S3 of the Supplement, the respective coefficients of the three reduced scales appear strongly similar to those of the full 50-item version.

Figure 1
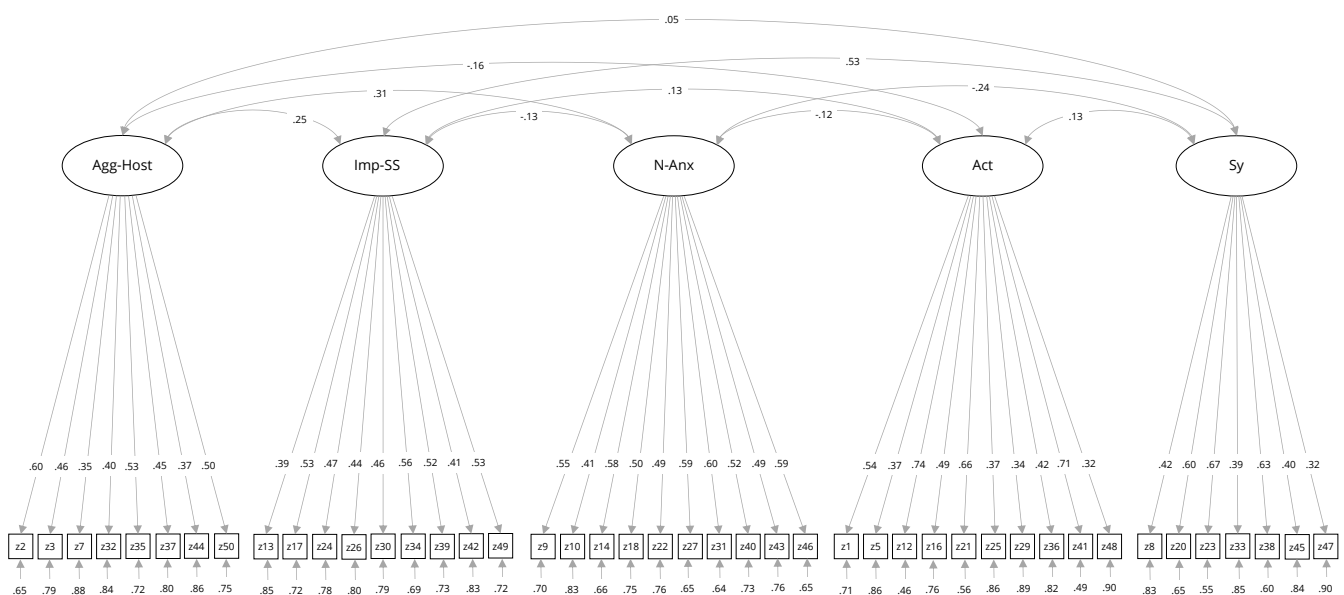*The ZKPQ-44-CC model with standardized factor loadings*

Table 3
MTMM matrix displaying convergent validity and internal consistency (diagonal)

	Agg-Host	ImpSS	N-Anx	Act	Sy	BFI_A	BFI_O	BFI_N	BFI_C	BFI_E
Agg-Host	.68									
ImpSS	.18**	.73								
N-Anx	.22**	−.10**	.80							
Act	−.13**	.12**	-.15**	.77						
Sy	.03	.36**	-.17**	.08**	.69					
BFI_A	**−.52****	−.01	-.15**	.11**	.23**	.72				
BFI_O	−.07**	**.27****	-.11**	.21**	−.01	.08**	.78			
BFI_N	.35**	−.12**	**.69****	−.14**	−.24**	-.40**	-.12**	.82		
BFI_C	−.26**	−.20**	−.20**	**.43****	−.01	.28**	.11**	−.25**	.79	
BFI_E	.06**	**.31****	-.33**	**.27****	**.55****	.17**	.24**	−.37**	.24**	.80

Notes. The associations between theoretically congruent BFI and ZKPQ dimensions are presented in bold. Agg-Host = Aggression-Hostility, ImpSS = Impulsive Sensation Seeking, N-Anx = Neuroticism-Anxiety, Act = Activity, Sy = Sociability.
*p < .05, **p < .01

Table 4
Rank-order stability coefficients of the ZKPQ-44 dimensional scores (2-year time interval)

	Agg-Host1 (95% CI)		ImpSS1 (95% CI)		N-Anx1 (95% CI)		Act1 (95% CI)		Sy1 (95% CI)	
Agg-Host2	**.66****	**[.55, 78]**	.17*	[.01, .25]	.18*	[.02, .24]	-.03	[−.13, .09]	.25	[.10, .40]
ImpSS2	.11	[−.05, .31]	**.66****	**[.52, .73]**	−.16*	[−.27, -.01]	.05	[−.09, .17]	.34**	[.24, .59]
N-Anx2	.17*	[.03, .48]	−.17*	[.52, .73]	**.61****	**[.52, .78]**	−.11	[−.28, .04]	-.02	[−.25, .20]
Act2	.02	[−.18, 23]	.15*	[.01, .32]	.03	[-.12, .18]	**.58****	**[.43, .67]**	.09	[−.08, .33]
Sy2	.18*	[.03, .35]	.39	[.20, .43]	−.03	[-.14, .09]	−.01	[−.12, .11]	**.72****	**[.63, .86]**

Notes. The coefficients of rank-order (temporal) stability and their confidence intervals (in parenthesis) are presented in bold. Agg-Host = Aggression-Hostility, ImpSS = Impulsive Sensation Seeking, N-Anx = Neuroticism-Anxiety, Act = Activity, Sy = Sociability; 1 = First measurement, 2 = Second measurement
*p < .05, **p < .01

Temporal stability of the dimensional scores

We conducted temporal (rank-order) stability analysis of the ZKPQ-44-CC scales by means of Pearson correlation coefficients across the five-dimensional scores. The coefficients between the initial measurement and repeated measurement two years later (*n* = 168) are relatively high (Table 4) and similar to those reported for the BFI across the same time interval in an emerging adult sample (Kavčič & Zupančič, 2018).

Discussion

The purpose of this study was to validate the ZKPQ-50-CC in a Slovenian sample of emerging adults. We examined the dimensional structure of the Slovenian adaptation of the ZKPQ-50-CC, its convergent and discriminative validity, internal reliability, and temporal stability across the two-year time span. We found the structure of the 50-item instrument comparable to that of the original validation study across samples of four European countries (Aluja et al., 2006). A notable difference between the analysis in our study and the original validation is that Aluja et al. (2006) used a Maximum likelihood estimator, while we used the DWLS (Diagonally weighted least squares), which is more suitable when working with dichotomous data (Li, 2016). Despite using a different parameter estimator, our results were similar to those of Aluja et al. (2006). Upon further examination of the 50-item model, we decided to remove six items with lowest factor loadings (< .30). Doing so, the fit indexes improved slightly and the resulting ZKPQ-44-CC also improved somewhat upon the model fit (e. g., higher CFI, TFI, GFI values) of the original cross-cultural study by Aluja et al. (2006). The six removed items in our study may have had low factor loadings due to culture-specific interpretation (meaning) of the items' content, as well as culture-specific norms of behaviour. In regard to the item, *I do not need a large number of casual friends*, for example, the term "casual friends" is not common in a Slovenian cultural context. Friends are considered as partners within close/intimate relationships, not people one casually interacts with (those would likely be referred to as colleagues, for example). Likewise, assertive/dominant displays of boundary setting are perhaps more frowned upon in the Slovenian culture and the tolerance towards self-expressive and self-enhancing behaviour, particularly

disagreeable behaviour (e.g., the omitted item *If people annoy me I do not hesitate to tell them so*), may be lower than, for example, in the USA (e.g., Kohnstamm, 1989; Tilton-Weaver & Kakihara, 2007) or Western European cultures.

In support of the convergent validity of the ZKPQ-44-CC, we observed the proposed associations between the theoretically related FFM and the dimensions from the ZKPQ model. These results are also consistent with those by Aluja and Blanch (2011) who established a similar pattern of relations between the corresponding five dimensions of the NEO-FFI-R (McCrae & Costa, 2004) and the ZKPQ-50-CC (Aluja et al., 2006). A notable difference in our results compared to those reported by Aluja and Blanch (2011) is that we found a higher correlation between Activity and Conscientiousness ($r = .43$) than the two authors ($r = .30$), perhaps because four of the Activity items may have a connotation of one's propensity toward dutiful and responsible work in the Slovenian language (e.g., *to keep busy all the time* translates into *biti stalno zaposlen* and *zaposlen* also means being employed; *doing things all of the time* translates into *ves čas nekaj delati* and *delati* also means to work). The correlation between Aggression-Hostility and Neuroticism was also somewhat higher in our sample compared to the sample of Aluja and Blanch (2011), i.e., $r = .35$ and $r = .23$, respectively. However, using the ZKPQ-III and the NEO-PI-R (Costa & McCrae, 1992b), Aluja et al. (2002) reported a correlation of .31 between the two dimensions. These differences in the magnitude of associations could be due to various factors, such as differences in the characteristics of the languages involved, the structure of the samples, the FFM instruments employed, and also reflect the cultural differences in personality (Allik, 2012). Overall, our results suggest comparable levels of convergent and discriminant validity, and internal reliability to those reported in the previous studies.

The low or non-significant intercorrelations between the ZKPQ domains in our study (rs between .03 and .22, except for $r = .36$ between Sociability and Impulsive Sensation Seeking) are consistent with the theoretically orthogonal ZKPQ model (Zuckerman et al., 1993) and comparable to those reported in past research, which, for example, range between -.02 and .27 (Aluja et al., 2002) and between -.14 and .22 (Rossier et al., 2008). In addition, the intercorrelations between the ZKPQ-44-CC scores appear even somewhat lower than those between the BFI scores in our study (ranging between -.40 and .08). The moderate correlation between the ZKPQ-44-CC Sociability and Impulsive Sensation Seeking stands out among our intercorrelations, a result also documented by the authors using the ZKPQ questionnaires (e.g., Aluja et al., 2003; Gomà-i-Freixanet et al., 2004) who found these two dimensions among the most highly correlated.

Our results further suggest acceptable internal consistency of the five ZKPQ-44-CC scales scores (with somewhat lower reliability of .68 for the Aggression-Hostility scale), as well as their relatively high temporal (rank-order) stability over a two-year time span. The level of stability is similar to the one- and two-year stability of the BFI scores in Slovenian emerging adults (Kavčič & Zupančič, 2018; Zupančič & Kavčič, 2017),

albeit somewhat lower than the typical stability over the same time span in adulthood (e.g., Lucas & Donnellan, 2011; Wortman et al., 2012). As noted by Robins et al. (2001) who also found lower (but still relatively high) levels of stability in FFM traits over the emerging adult years, this is expected and in line with dense developmental changes in this period, characterized by both demographical and psychological instability (Arnett, 2000).

Over the past decade, several researchers have proposed the use of shorter personality measures that would enable easier and less time-consuming data collection (Rammstedt & Beierlein, 2014), particularly in larger psychological and interdisciplinary surveys, cross-cultural and follow-up studies. A trend of creating shorter measures has already been observed in Slovenian psychological research (e. g., Komidar et al., 2016; Slobodskaya & Zupančič, 2010). Thus, the reduction of ZKPQ-50-CC items to improve the psychometric properties of the questionnaire was not only justified, but also desirable. Due to its slight psychometric improvements over the 50-item instrument and the fact that the 44-item version retains its convergent and discriminative validity, as well as internal reliability compared to the full version, we suggest the ZKPQ-44-CC of the Slovenian adaptation more appropriate for research purposes than the former version.

Limitations and considerations for further research

There are several limitations to this study. Females were over-represented in our main sample (especially in the smaller follow-up sub-sample). Based on previous reviews of personality trait research (see Specht, 2017 for an overview), however, an unbalanced gender ratio should not present a major concern because the structure of personality traits and their relative developmental stability has been found strongly similar across genders. A more likely drawback may be the fact that our sample of emerging adults consisted mostly of students, which may have underestimated the stability estimates as personality ratings tend to stabilize when young people settle down on their developmental pathways (e.g., financial independence, living arrangement, career, committed love relationship).

A notable limitation of our study is that the fit index scores for the TLI and CFI were below those normally deemed acceptable ($< .90$), but nevertheless comparable (in fact even slightly higher) to those reported in the original ZKPQ-50-CC validation study (Aluja et al., 2006). Despite this weakness, the ZKPQ-50-CC has become a well-established measure in personality research (e.g., Aluja & Blanch 2011; Aluja et al., 2007; Ortigosa et al., 2014), suggesting the deviation from "good fit" in our data might not be too detrimental in practice. Another potential weakness is a dichotomous response format of the instrument (in its various forms, including the ZKPQ-44-CC). While such questionnaires have certain advantages (e.g., avoiding responses regressing to the mid-point of the scale, neutral responses), they also possess disadvantages, such as leaving respondents to choose between one of two

options, where neither captures their true feelings and can thus result in the survey bias (Altman & Royston, 2006).

A prospective avenue for future research regarding the ZKPQ measures in Slovenia would be a validation of the Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ; Aluja et al., 2010). The ZKA-PQ was created to overcome several of the ZKPQ's shortcomings (e.g., the restricted sampling of item content, disregarding facets) for its use in clinical populations. In addition, the ZKPQ (Aluja et al., 2006) has been able to predict personality disorders (Aluja et al., 2007) and presents a useful measure in clinical settings. This calls for investigation of diagnostic validity of the shortened Slovenian version of the instrument. Past research has established criterion validity of the different ZKPQ forms by examining it, for example, in male and female athletes (O'Sullivan et al., 1998), prostitutes (O'Sullivan et al., 1996), and cocaine abusers (Ball, 1995). Studies in this direction in Slovenia could thus serve as a way to provide evidence on criterion validity of the ZKPQ-44-CC, as well as a noteworthy possibility for further Slovenian personality research in general. Another possible area of future research involves exploring the biological underpinnings of the ZKPQ-44-CC in Slovenian samples. In fact, a study concerning heritability estimates of the five dimensions of at the time yet to be validated version of the Slovenian ZKPQ-50-CC (Rašl, 2013) paved the way for the promotion of research in that direction. Studies based on the alternative FFM model (using various forms of the ZKPQ) have found several genes associated with Anx-N (e.g., GNAS, AS and DRD4) and ImpSS (SLC6A3) (Aluja, Balada, et al., 2019), as well as genes associated with levels of serotonin (5-HTTLPR, 5-HTTVNTR), dopamine (DRD2), and testosterone (CAG, GGN). High ImpSS is, for example, associated with low serotonin, high testosterone and high dopamine; high Sy shows relations with high testosterone, high dopamine, and low MAO-A (Aluja et al., 2009; García et al., 2012, 2016; Zuckerman, 2005).

Conclusion

The alternative FFM is an important model of human personality due to its strong focus on the biological underpinnings of personality and its operationalization in a psychometrically sound measures of personality over thirty years of research (Zuckerman, 1991, 1992; Zuckerman et al., 1988). The ZKPQ measures have been widely used in many different languages/cultural contexts (Aluja et al., 2006; Mohammad Rahim et al., 2013; Wu et al., 2000), and clinical settings (e.g., Aluja et al., 2007, 2010). Looking back at the criteria Zuckerman and Kuhlman first required of a personality measure (e.g., Zuckerman et al., 1988), the extant studies demonstrate that various ZKPQ measures largely meet the criteria and thus justify the use of these measures. Our results suggest that the Slovenian adaptation of the ZKPQ-50-CC (the ZKPQ-44-CC) displays comparable construct validity to the original version (Aluja et al., 2006), as well as convergent validity, discriminative validity, internal reliability, and temporal stability. Although its criterion validity is yet to be established, we consider the ZKPQ-44-

CC acceptable for its use in the Slovenian socio-cultural environment due to the presented psychometric properties. Based on the adequate, though not especially good, indicators of validity and reliability, the questionnaire might be most appropriate in studying large samples and for the purpose of group comparisons.

Acknowledgement

Data availability statement

Data and scripts for the analyses are available at OpenScienceFramework: https://osf.io/q6hys/

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Supplementary material

An additional table containing item difficulties for the ZKPQ-44C can be found in the data repository: https://osf.io/q6hys/

Table S1

Mean scores and standard deviations for the 50-item five ZKPQ dimensions in the total sample and across gender

	Total (*SD*)	Males (*SD*)	Females (*SD*)
Aggression-Hostility	4.39 (1.76)	4.61(1.80)	4.30 (1.74)
Impulsive Sensation Seeking	5.50 (2.53)	6.00 (2.48)	5.31 (2.53)
Neuroticism-Anxiety	4.38 (2.87)	3.03 (2.50)	4.91 (2.83)
Activity	5.04 (2.75)	5.43 (2.72)	4.88 (2.74)
Sociability	5.26 (2.49)	5.21 (2.51)	5.28 (2.48)

Note. SD = standard deviation.

Table S2

Mean scores and standard deviations for the 44-item five ZKPQ dimensions in the total sample and across gender

	Total (*SD*)	Males (*SD*)	Females (*SD*)
Aggression-Hostility	2.86 (2.04)	3.32 (2.11)	2.73 (2.00)
Impulsive Sensation Seeking	5.10 (2.43)	5.58 (2.34)	4.91 (2.44)
Neuroticism-Anxiety	4.38 (2.87)	3.03 (2.50)	4.91 (2.83)
Activity	5.04 (2.75)	5.43 (2.72)	4.88 (2.74)
Sociability	3.80 (1.94)	3.84 (1.93)	3.79 (1.95)

Note. SD = standard deviation.

Table S3

MTMM matrix displaying convergent validity and internal consistency (diagonal) for the full 50 item ZKPQ-50-CC

	Agg-Host	ImpSS	N-Anx	Act	Sy	BFI_A	BFI_O	BFI_N	BFI_C	BFI_E
Agg-Host	.67									
ImpSS	.27**	.71								
N-Anx	.22**	-.04*	.80							
Act	−.10**	.11**	−.15**	.77						
Sy	.08*	.29**	−.13**	.06**	.72					
BFI_A	**−.52****	−.07	−.15**	.11**	.22**	.72				
BFI_O	−.07**	**.26****	−.11**	.21**	−.07**	.08**	.78			
BFI_N	.34**	−.05*	**.69****	−.14**	−.20**	−.40**	−.12**	.82		
BFI_C	−.24**	−.22**	−.20**	**.43****	−.01	.28**	.11**	−.25**	.79	
BFI_E	.09	**.32**	−.27**	**.27****	**.51****	.17**	.24**	−.37**	.24**	.80

Notes. The associations between theoretically congruent BFI and ZKPQ dimensions are presented in bold. Agg-Host = Aggression-Hostility, ImpSS = Impulsive Sensation Seeking, N-Anx = Neuroticism-Anxiety, Act = Activity, Sy = Sociability
* $p < .05$, ** $p < .01$