ORIGINAL ARTICLE

Assessing personality traits by questionnaire: psychometric properties of the Greek version of the Zuckerman-Kuhlman personality questionnaire and correlations with psychopathology and hostility.

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Abstract

Background: The Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) was developed in an attempt to define the basic factors of personality or temperament. We aimed to assess the factor structure and the psychometric properties of its Greek version and to explore its relation to psychopathological symptoms and hostility features.

Methods: ZKPQ was translated into Greek using back-translation and was administered to 1,462 participants (475 healthy participants, 619 medical patients, 177 psychiatric patients and 191 opiate addicts). Confirmatory and exploratory factor analyses were performed. Symptoms Distress Check-List (SCL-90R) and Hostility and Direction of Hostility Questionnaire (HDHQ) were administered to test criterion validity.

Results: Five factors were identified, largely corresponding to the original version's respective factors. Retest reliabilities were acceptable (r_{1i}'s: 0.79-0.89) and internal consistency was adequate for Neuroticism-Anxiety (0.87), Impulsive Sensation Seeking (0.80), Aggression-Hostility (0.77) and Activity (0.72), and lower for Sociability (0.64). Most components were able to discriminate psychiatric patients and opiate addicts from healthy participants. Opiate addicts exhibited higher rates on Impulsive Sensation Seeking compared to healthy participants. Neuroticism-Anxiety ($p<0.001$) and Impulsive Sensation Seeking ($p<0.001$) were significantly associated with psychological distress and Aggression-Hostility was the most powerful correlate of Total Hostility ($p<0.001$), and Neuroticism-Anxiety was the stronger correlate of introverted hostility ($p<0.001$), further supporting the instrument's concurrent validity.

Conclusions: Present findings support the applicability of the Greek version of ZKPQ within the Greek population. Future studies could improve its psychometric properties by finding new items, especially for the Sociability scale.
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Keywords: Zuckerman-Kuhlman Personality Questionnaire, ZKPQ, alternative Five-Factor personality model, psychological distress, SCL-90, hostility, sensation seeking

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Introduction

The Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) is a psychometric instrument aiming to assess basic factors of personality and has been developed to provide a framework for a top-down approach from personality traits through levels of intermediate biological levels to the genetic bases of personality, based on factors derived from a biological and temperamental approach to human personality[1-3]. The guiding assumption for its development was that basic personality traits are those with a strong biological-evolutionary basis. Therefore, scales used in psychobiological research were regarded as candidates to be included in ZKPQ[2], including Eysenk's "Big Three"[4], measures of temperament[5,6], as well as Zuckerman's Sensation Seeking scale[7]. In total, several scale markers for each of nine hypothesized factors, i.e. sociability, neuroticism, anxiety, hostility, socialization, sensation seeking, impulsivity, activity, and social desirability, were included[2]. In successive factor analyses replicated in two large American samples, it was concluded that a five-factor structure was the best and most robust solution[8]. These factors were labeled Neuroticism-Anxiety (N-Anx), Sociability (Sy), Aggression-Hostility (Agg-Hos), Impulsive Sensation Seeking (ImpSS), and Activity (Act). A full description of

the questionnaire may be found in Zuckerman (2002)[2] and Joireman and Kuhlman (2004)[9].

The five factors of the ZKPQ have been replicated in Chinese[10], German[11], Swiss-French[12], Italian[13] and Spanish samples[14,15], and certain ZKPQ scales have been found to be associated with a number of different areas of personality, including risky behaviors such as smoking, drinking, drug abuse, or gambling[3,7,16], functional styles of personality disorders[17], personality disorders[18], or traits delineating personality pathology[19]. The ZKPQ N-Anx and Sy were correlated with generalized anxiety disorder and treatment-resistant depression[20], and N-Anx and *Act* had a direct effect on the affective factor of subjective well-being[21]. Agg-Host has been also found to predict direction of defensive responses to human threat scenarios[22].

We recently used the ZKPQ in 185 patients with inflammatory bowel disease and found that ImpSS was associated with current smoking and nicotine dependence and its relationship with nicotine dependence was greater in smokers with Crohn's disease (which is closely associated with smoking), than in those with ulcerative colitis (which is largely a disease of nonsmokers)[23]. In that study, our initial examination of the factorial structure of the Greek version showed that ZKPQ was represented as a five-factor model with most items loading accordingly to the original design of the measure[23]. Prompted by this fact, we proceeded here to assess the main psychometric properties of the Greek version of the ZKPQ in four different populations, namely healthy participants, medical patients, psychiatric patients and opiate addicts.

The aims of the present study were: 1) to assess the factorial structure of the Greek version of the ZKPQ, 2) to evaluate its internal consistency and test-retest reliability, 3) to test whether the ZKPQ scales could differentiate healthy participants from psychiatric patients and opiate addicts in a theoretically meaningful and empirically documented mode and to assess the independent associations of the ZKPQ scales with a wide range of psychopathological symptoms, as measured by the Symptom Distress Checklist-90-R (SCL-90R)[24], and 4) to assess the independent associations of the ZKPQ scales with hostility features as measured by the Hostility and Direction of Hostility Questionnaire (HDHQ)[25].

Methods

Participants

This study enrolled 1,462 participants: 475 healthy participants, 619 medical patients, 177 psychiatric patients and 191 opiate addicts attending Methadone Maintenance Programs. Healthy participants were between 21 and 65 years old: 181 males (mean age 33.2, SD: 8.4) and 294 females (mean age 32.3, SD: 8.3). They were randomly recruited from Ioannina General Teaching Hospital staff (47%), inpatients' relatives (21%), and medical students (32%), living in the greater area of Ioannina, Greece, and in adjoining small communities comprising a mixed middle-class urban and rural population.

The medical patient sample comprised patients with rheumatoid arthritis (N=168), systemic lupus erythematosus (N=56), systemic sclerosis (N=56), primary Sjögren's syndrome (N=40), inflammatory bowel disease (N=202), multiple sclerosis (N=35), and chronic pelvic pain (N=62) attending the respective clinics of the Ioannina General Teaching Hospital. Medical patients were between 16 and 87 years of age: 193 males (mean age 50.1, SD: 15.6) and 426 females (mean age 46.9, SD: 15.1).

The psychiatric patient sample comprised inpatients and outpatients of the departments of Psychiatry of the Universities of Ioannina, Thessaloniki and Patras, Greece. Psychiatric patients were between 17 and 72 years of age: 92 males (mean age 39.4, SD: 11.9) and 85 females (mean age 39.1, SD: 12.0). Principal diagnoses according to ICD-10 criteria were: Schizophrenia, schizotypal and delusional disorders [F20-F29], 48 (27.1%); mood [affective] disorders [F30-F39], 42 (23.7%); neurotic, stress-related and somatoform disorders [F40-F48], 46 (26.0%); and disorders of adult personality and behavior [F60-F69], 41 (23.1%).

The opiate addict sample comprised outpatients attending two Methadone Maintenance Clinics of the State's Organization Against Drugs (OKANA), Athens, Greece. The substance of abuse at the time of admission was heroin or other opiates, although other substances had also been used in addition to opiates (cocaine, sedatives/ tranquilizers, marijuana or alcohol). Diagnosis was confirmed by urine sample testing and assessed by the semi-structured interview *Addiction Severity Index*[26]. In these programs, patients receive medical treatment, counseling and provision of social services and the treatment plan is harm reduction rather than complete abstinence. Opiate addicts were between 21 and 60 years of age: 156 males (mean age 40.3, SD: 7.1) and 35 females (mean age 38.3, SD: 6.4).

Signed informed consent was obtained from all participants. All procedures followed the ethical standards of the Helsinki Declaration and were approved by the Ioannina General Teaching Hospital's ethical committee (No 20/14.01.2004).

Instruments

The *ZKPQ*[2,9] is a 99-item true-false self-report questionnaire that measures the following five basic dimensions of personality: *Impulsive Sensation Seeking (ImpSS)* assesses *impulsivity*, i.e., a lack of planning and tendency to act impulsively without thinking, and *sensation seeking*, i.e., a general need for thrills and excitement, a preference for unpredictable situations and friends and the need for change and novelty. *Neuroticism-Anxiety (N-Anx)* items describe, tension, worry, fearfulness, obsessive indecision, and lack of self-confidence. *Aggression-Hostility (Agg-Host)* items describe a readiness to express verbal aggression, rude, a quick temper, and impatience with others. *Activity (Act)* assesses a need for general activity and impatience and restlessness when there is nothing to do (general activity), and a preference for challenging and hard work and a lot of energy for work and other tasks (work effort). Finally, *Sociability (Sy)* includes items indicating a liking of big parties and interacting at parties and having many friends (*Parties and Friends*), and items indicating intolerance for social

isolation in extraverts and a liking for solitary activities in introverts (*Isolation Intolerance*). Ten additional items comprise an infrequency scale (Infrequency) to detect lying or carelessness in answering[2,9].

The ZKPQ was translated from English into Greek with unanimous consensus by a bilingual group of 3 psychiatrists and a clinical psychologist, using the back-translation method[27,28]. Appendices I and II present the loadings of the Greek version's items in each factor (Appendix I) as well as the items that represent the 5 factors (Appendix II). *Psychological distress* was measured using the Greek standardized version of the Symptom Distress Checklist (SCL-90-R)[24,29], a 90-item 5-point Likert-type self-report symptom inventory designed to measure a wide range of psychopathological symptoms in psychiatric and medical patients as well as in primary care[30].

Hostility features were assessed with the Hostility and Direction of Hostility Questionnaire (HDHQ)[25], a 51-true-false items self-report questionnaire designed to sample a wide range of possible manifestations of aggression, hostility or punitiveness which shows the participant's reaction to frustrating occurrences. It includes three measures of *extrapunitive* manifestations of hostility, namely *Acting Out, Criticism of Others* and *Delusional Hostility*, and two *intropunitive* tests, namely *Self Criticism* and *Delusional Guilt*. HDHQ has been extensively used in the general Greek population as well as in medical patients[31].

Statistical analysis

As a preliminary step, a Confirmatory Factor Analysis (CFA) was performed in each separate group (healthy participants, medical and psychiatric patients and opiate addicts), as well as in the entire sample, to assess the goodness of fit of the five dimensional model originally proposed by Zuckerman and colleagues[2]. Since the indicators were dichotomous variables, we used polychoric correlations and the default MPlus estimator, which is a robust weighted least square estimator[32]. Both a first-order and second-order five factors solution failed to converge either in each separate sample or in the entire sample, with the diagnostics denoting serious problems of fit, suggesting that an amelioration of the model was appropriate. Therefore, we adopted an exploratory rather than confirmatory perspective in the subsequent analysis of the dimensional structure of the questionnaire using also the MPlus with Crawford-Ferguson Varimax rotation and default value for kappa (1/p, where p is the number of variables)[32].

All the subsequent statistical analyses were performed using the Statistical Package for the Social Sciences 15.0 (SPSS Inc., Chicago, IL, USA) for Windows. Normality was tested with the Kolmogorov-Smirnov test[33]. Cohen's *ds* were estimated as measures of the effect size in all comparisons performed[34]. Internal consistency (Cronbach's alphas) was calculated for the factors derived from the preceding factor analysis for each sample separately as well as for the entire sample.

To test the stability of the questionnaire over time, ZKPQ was administered twice in a sample of 132 medical students, with an interval of two months. Pearson product moment correlation coefficients were calculated to assess the retest reliability coefficients (r_{1i}) for each ZKPQ scale between the two time intervals[35].

The criterion and concurrent validity was tested with the following hypotheses in mind: (a) since *Impulsivity* and *Sensation Seeking* are highly prevalent in substance-dependent individuals[36,37], we expected that opiate addicts would present higher rates on *ImpSS* compared to healthy participants. For this, one-way ANCOVAs with Bonferroni post-hoc tests were performed adjusted for age, sex and educational level, taking into consideration that the distribution of age, sex and educational level varied across the four samples and ZKPQ subscales have been also reported to be associated with these background variables[2]. Evidence also suggests that psychiatric patients present higher rates on ZKPQ *N-Anx* and lower rates on *Sy* compared to healthy volunteers[17,19]; we therefore expected higher rates of *N-Anx* and lower rates on *Sy* in the psychiatric patient sample, compared to the healthy participant sample. To test this hypothesis, ANCOVAs with Bonferroni post-hoc tests were also performed; (b) ZKPQ scales should be associated with psychopathological symptoms, with specific scales being most closely associated with discrete psychopathological symptoms. For example, ZKPQ *Agg-Host* was expected to be most closely associated with SCL-90R *hostility* symptoms. For testing this hypothesis, a series of eight independently produced multiple regression analyses was performed with dependent variables the eight SCL-90-R subscales. Independent variables were the major demographic variables and the ZKPQ scales. Collinearity was tested based on variance inflation factors (VIF) and tolerances for individual variables[38]; (c) We also expected a remarkably powerful association between ZKPQ *Agg-Host* and HDHQ *Total Hostility*. To test this, Pearson bivariate correlations were used.

Results

Factor structure

A first-order five-factor solution confirmatory factor analysis (CFA) where all factors were intercorrelated failed to converge either for each group separately or for the entire sample, as did also a second-order solution where all ZKPQ components loaded as separate factors to the hypothesized construct "personality", with the diagnostics denoting serious problems of fit, both with regards to individual items as well as some intercorrelations.

A number of studies have found that personality models with robust structures obtained by Exploratory Factor Analysis (EFA) procedures generally obtained an unacceptable fit when performing CFA analyses[39-41]. It has been reported that among the reasons for this poor goodness-of-fit indices obtained in personality models by CFA analyses, are the inherent complexity of personality, issues related to its measurement, and issues related to the application and interpretation of CFA models[41]. Also, acceptable models in terms of CFA standards must account for a higher proportion of variance than is usually accounted for by EFA models[40-42]. Another reason that could explain this unacceptable fit is the presence of salient sec-

ondary loadings[40], which was the case also in the present study. These secondary loadings could be on detriment to obtaining acceptable fit to data when performing CFA over simple structure models[43]. However, some measures perform well from an exploratory factor analytic perspective[41]. Thus, exploratory factor analyses for dichotomous data were next performed for each group separately.

Scree plots showed a similar pattern among the four groups; therefore, we performed another exploratory factor analysis for the entire sample. Although a number of factors presented eigenvalues >1, inspection of the scree plot revealed a large first component and a number of "elbows" resulting in remarkable smaller eigenvalues after five components (Figure 1), indicating that a five-factor

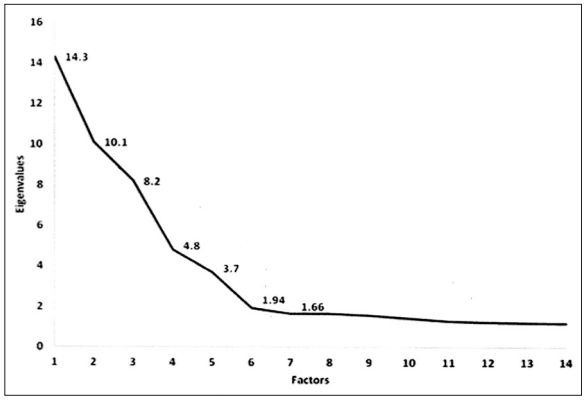

Figure 1: Scree plot of the eigenvalues of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) scores.

solution might be sufficient. However, in order to better clarify how primary factors merged to form the superordinate factors going from the seven- to three-factor levels, we also analyzed the results at the three-, four-, six- and seven-factor solutions, as this method has been also adopted for the original version of the questionnaire[2].

All component extractions were rotated with Crawfer-Ferguson Varimax rotation, and the five-factor level indicated the best goodness of fit to the data at hand, suggesting the presence of a coherent multi-dimensional structure accounting for 40.9% of the total variance. Chi-square for 3481 degrees of freedom equals 15947.511 ($p<0.001$). The chi-square statistic is known to return statistically significant values with large ($N>1000$) samples and an examination of the fit statistics is necessary. The Comparative Fit Index (CFI) was 0.904, the Tucker-Lewis Index (TLI) was 0.891, the standardized root-mean square residual (SRMR) was 0.058 and the root mean square error of approximation (RMSEA) was 0.049. These values denote adequate fit. Factor determinancies (a statistic ranging from zero to one and describes how well the factor is measured with one being the best value) were high, (0.967, 0.973, 0.977, 0.960, 0.963 for each factor, respectively). Given our sample size (>1000), a loading greater of 0.162 could be considered statistically significant[44]; we focused however on factor loadings with an absolute value greater than 0.30, since it explains a considerable amount of the variance in each variable[44].

The first factor, explaining 14.3% of the variance, was loaded saliently by 16 of 19 items from the *ImpSS* scale of the original version. Items 6 and 29, originally belonging to *ImpSS*, loaded on the second factor (*Sy*). Also, a number of items originally belonging to *Sy* showed significant secondary loadings here, while item 14 ("I often do things on impulse"), originally an *ImpSS* item, had a secondary loading on the fifth factor (*Agg-Host*). Internal consistency coefficients were high, ranging from 0.78 to 0.81 across the four samples, with a Cronbach's alpha of 0.80 for the entire sample. This factor was clearly a measure of "*Impulsive Sensation Seeking*".

Factor 2, explaining 10.1% of the variance, was loaded saliently by 12 out of 17 items from the *Sy* scale of the original version. However, several scattered loadings from other scales were also loaded on this factor, belonging originally to *ImpSS* (items 29 & 95), *Act* (items 49 & 88) or *Agg-Host* (items 3 & 16). These flows made this factor the weakest with regard to its factor content. Nevertheless, its psychometric properties when measuring the items with content originally belonging to the *Sy* scale were acceptable (Cronbach's alphas=0.60-0.66, 0.64 for the entire sample); it was therefore concluded that this factor describes a liking of big parties and interacting with many people as well as intolerance for social isolation, largely corresponding to the original *"Sociability"* scale.

All the 19 items originally belonging to the *N-Anx* scale were loaded saliently on factor 3, explaining 8.2% of the variance. Item 2 loaded also in factor 2 (*Sy*) and item 85 in factor 1 (*ImpSS*). Two items originally belonging to *Act* scale (54 & 99) loaded also in this factor. Internal consistency coefficients were the highest of all factors, ranging from 0.85 to 0.90 across the four samples, with a Cronbach's alpha of 0.87 for the entire sample. This factor clearly included items of tension, worry, fearfulness, and lack of self-confidence, and it was concluded that assesses the trait "*Neuroticism-Anxiety*".

Fourteen out of the 17 items of the original *Act* scale loaded saliently on the fourth factor, explaining 4.8% of the variance. Items 49 and 88 presented significant loadings also on factor 2 (*Sy*). The factor's structure was coherent with respect to its factor content and with adequate internal consistency (0.72), clearly including items indicating a need for general activity and restlessness when there is nothing to do, and a preference for hard work, largely corresponding to the original "*Activity*" scale.

Finally, factor 5 was loaded silently by 14 of the 17 items from the original *Agg-Host* scale, explaining 3.5% of the variance. Items 3 and 16, originally belonging to *Agg-Host*, had silent loadings on factor 2 (*Sy*). Internal consistency coefficients were high ranging from 0.70 to 0.80 across the four samples, with a Cronbach's alpha of 0.77 for the entire sample. This factor contains items describing a readiness to express verbal aggression, rude, and a quick temper, and it was concluded that assesses the trait "*Aggression-Hostility*".

Infrequency

A percentage of 12.8% of the healthy participants, 13.6% of the medical patient sample, 17.4% of the psychi-

atric patient sample and 15.1% of the opiate addict sample had scores above 3 in the infrequently "true" social desirability type items. Higher Infrequency scores suggest either inattention to the content of the items and acquiescence or a very strong social desirability set, and scores above 3 are considered to indicate questionable validity[2].

Internal Consistency and Descriptive Statistics for the Healthy Participant Sample

Internal consistencies are presented in Table 1 for the entire sample as well as separately for the four samples. In general, internal consistency coefficients were similar in all four samples.

Descriptive statistics of the ZKPQ components in the sample of healthy participants are presented in Table 1 separately for males and females. As can be seen, females did not differ from males, although females tended to score higher on *N-Anx* scale but the difference did not reach statistical significance (p=0.09).

Intercorrelations between ZKPQ scales

Several intercorrelations were observed among the ZKPQ scales. The highest intercorrelations emerged between *ImpSS* and *Agg-Host* (r=0.35, p<0.001), as well as between *N-Anx* and *Agg-Host* (r=0.28, p<0.001). Significant intercorrelations were also observed between *Act* and *Sy* (r=0.22, p<0.001), *ImpSS* and *Sy* (r=0.23, p<0.001) as well as between *ImpSS* and *N-Anx* (r=0.20, p<0.001) while *N-Anx* was negatively correlated with *Sy* (r=-0.18, p<0.001).

Table 1: Internal consistencies in the four samples and gender differences in the healthy participant sample for the Greek version of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ).

	Cronbach's alphas					Healthy participant sample (N=475)			
	Healthy participants (N=475)	Medical Patients (N=619)	Psychiatric Patients (N=177)	Opiate addicts (N=191)	Total (N=1462)	Females (N=291) Mean ± SD	Males (N=184) Mean ± SD	*d* (1)	P-values for the t-tests
Impulsive Sensation Seeking	0.78	0.81	0.78	0.75	0.80	8.0 ± 3.9	7.7 ± 4.1	0.075	.422
Sociability	0.62	0.60	0.68	0.66	0.64	8.3 ± 2.8	8.3 ± 3.1	0.003	.971
Neuroticism-Anxiety	0.85	0.86	0.90	0.86	0.87	7.5 ± 4.5	6.7 ± 4.2	0.182	.090
Activity	0.76	0.69	0.78	0.70	0.72	7.9 ± 3.6	7.6 ± 3.6	0.083	.394
Aggression-Hostility	0.70	0.80	0.77	0.75	0.77	6.4 ± 3.1	6.2 ± 3.2	0.064	.641

SD: Standard deviation, (1) Cohen's *d* as the Effect Size.

Table 2: Comparison of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) scales' scores between the "healthy" participant (HS, *N*=475), the medical patient (MP, *N*=619), the psychiatric patient (PP, *N*=177) and the opiate addicts (OA, *N*=191) samples.

								Adjusted for age, sex & education				
ZKPQ scales		**mean**	**SD**	**Post-hoc(1)**	**F**	**P**	***d* (2)**	**Adj. mean**	**SE**	**Post-hoc(1)**	**F**	**p**
Impulsive Sensation Seeking	1.HS	7.9	3.9	2,3,4	68.8	<.0005	0.783	7.4	.21	3,4	54.9	<.0005
	2.MP	6.5	3.7	1,3,4				6.7	.17	3,4		
	3.PP	8.7	4.1	1,2,4				8.8	.33	1,2,4		
	4.OA	10.9	3.7	1,2,3				10.9	.29	1,2,3		
Sociability	1.HS	8.2	2.9	2,3,4	20.5	<.0005	0.568	8.0	.17	3,4	13.0	<.0005
	2.MP	7.3	3.1	1,4				7.4	.14	4		
	3.PP	6.7	3.0	1				6.7	.27	1		
	4.OA	6.5	3.0	1,2				6.3	.24	1,2		
Neuroticism-Anxiety	1.HS	7.1	4.4	2,3,4	44.6	<.0005	0.842	7.1	.26	2,3,4	35.7	<.0005
	2.MP	9.0	4.9	1,3,4				8.9	.22	1,3,4		
	3.PP	11.5	5.2	1,2				11.7	.42	1,2		
	4.OA	10.4	4.6	1,2				10.7	.36	1,2		
Activity	1.HS	7.8	3.6	2	4.9	.002	-0.025	7.6	.20	2	5.0	.002
	2.MP	8.6	3.5	1,4				8.5	.17	1		
	3.PP	8.5	3.8	-				8.5	.32	-		
	4.OA	7.7	3.2	2				7.7	.28	-		
Aggression-Hostility	1.HS	6.3	3.1	4	19.6	<.0005	1.016	6.2	.19	4	13.6	<.001
	2.MP	6.0	3.6	4				6.2	.16	4		
	3.PP	6.4	3.4	4				6.1	.30	4		
	4.OA	8.2	3.4	1,2,3				8.0	.26	1,2,3		

(1) Numbers indicate that each specific group differs significantly at least at a 0.01 level from the group indicated based on Bonferroni post-hoc tests.
(2) Cohen's *d*s were calculated considering the opiate addict sample as the treatment group and the healthy participant sample as the comparison group.

Test-Retest Reliability

Retest reliability analysis performed in the subset of the 132 medical students with an interval of two months revealed that the test-retest reliability coefficients (r_{1i}) were quite satisfactory for all scales, namely *ImpSS* (r_{1i}=0.89, p<0.001), *Sy* (r_{1i}=0.85, p<0.001), *N-Anx* (r_{1i}=0.90, p<0.001), *Act* (r_{1i}=0.82, p<0.001), and *Agg-Host* (r_{1i}=0.79, p<0.001).

Criterion and Concurrent Validity

a) ZKPQ and Psychiatric and Opiate Addict Populations

As Table 2 shows, opiate addicts presented higher rates on *ImpSS, N-Anx* and *Agg-Host* and lower rates on *Sy* compared to healthy participants, even after adjustment for age, sex and educational level. Psychiatric patients presented higher scores on *N-Anx* and lower scores on *Sy* compared to healthy participants, and these differences hold also after adjustment for confounders.

b) Psychopathological correlates of ZKPQ components

Table 3 presents the results of eight independently produced multiple regression analyses performed with dependent variables the major psychopathological subscales of the SCL-90-R and independent variables the major demographic variables and the ZKPQ scales. The most powerful associations were those of *N-Anx* with all psychopathological scales, with the exception of *Agg-Host*, which was the stronger correlate of *hostility* symptoms as measured by the SCL-90R. *Agg-Host* was also associated with SCL-90R *paranoid ideation*. *ImpSS* showed minor but significant associations with *hostility, anxiety, depression, paranoid ideation and psychoticism* symptoms, while *Sy* had also significant but negative associations with all psychological distress symptoms. All tolerance values ranged from 0.41 to 0.95, all being >0.2, and all variance inflation factors were <2, indicating that multicollinearity was not biasing the regression models[38].

c) ZKPQ and hostility features as measured by the HDHQ

Table 3: Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) scales most closely associated with several types of psychopathology as measured by the SCL-90-R symptom subscales, after adjustment for age, sex and educational level in the entire sample (*N*=1,462).

Independent Variables	Dependent Variables							
	Somatization	Interpersonal Sensitivity	Hostility	Anxiety	Phobic Anxiety	Depression	Paranoid Ideation	Psychoticism
Age	.140***	-.070**	.038	-.027	-.017	.029	-.043	-.033
Sex	-.059*	.029	-.004	.036	.022	-.056*	.045	.074**
Education	-.096***	-.035	-.021	-.048	-.023	-.027	-.073**	-.026
Impulsive Sensation Seeking	.034	.054	.108***	.081*	.002	.146***	.149***	.152***
Sociability	-.071*	-.133***	-.067*	-.080**	-.012	-.129***	-.094**	-.083**
Neuroticism-Anxiety	.504***	.584***	.364***	.635***	.525***	.621***	.441***	.488***
Activity	.035	-.006	.012	-.005	-.019	-.037	.003	-.055*
Aggression-Hostility	.002	-.006	.406***	-.014	-.060*	-.004	.111***	.021
R^2_{adj}	0.335, p<0.0005	0.404, p<0.005	0.449, p<0.0005	0.454, p<0.0005	0.260, p<0.0005	0.480, p<0.0005	0.329, p<0.0005	0.322, p<0.0005

Eight independently produced multiple regression analyses with dependent variables the major SCL-90-R subscales and independent variables the major demographic variables and the six components of the Greek version of the ZKPQ. Values shown are standardized (beta) regression coefficients; *** p<0.001, ** p<0.01, * p<0.05.

Table 4: Bivariate correlations of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) scales with hostility features as measured by the Hostility and Direction of Hostility Questionnaire (HDHQ) in the entire sample (*N*=1,462)

Independent Variables	Total Hostility	Extraverted Hostility	Introverted Hostility	Acting out Hostility	Criticism of others	Delusional Hostility	Self-criticism	Delusional Guilt
Impulsive Sensation Seeking	0.148***	.437***	.272***	.418***	.133***	.039	.095**	.209***
Sociability	-0.076*	-.068*	-.116***	-.090**	-.038	-.027	-.045	-.195***
Neuroticism-Anxiety	0.407***	.377***	.669***	.394***	.276***	.248***	.650***	.586***
Activity	0.070*	.137***	-.172***	.074*	.102**	.150***	-.074*	-.123***
Aggression-Hostility	0.626***	.453***	.221***	.504***	.383***	.409***	.219***	.202***

Values shown are Pearson's correlation coefficients; *** p<0.001, ** p<0.01, * p<0.05.

As shown in Table 4, *Agg-Host* was the most powerful correlate of *total hostility, extraverted hostility, acting out hostility, criticism of others and delusional hostility*. On the other hand, *N-Anx* was the stronger correlate of *introverted hostility, self-criticism and guilt*. *ImpSS* was associated with all HDHQ subscales and showed remarkable correlations with *extraverted hostility* and *acting out hostility*, while *Sy* was negatively associated with *acting out hostility* and *guilt.* Finally, *Act* was positively associated with *extraverted hostility* and negatively with *introverted hostility*.

Discussion

The results of the present study showed that the Greek version of the ZKPQ shares remarkable similarities with its original version regarding its five structured item content, its stability over time as well as the criterion and concurrent validity. In terms of the factors' item content, all factors presented item loadings similar to those obtained with the original version. Internal consistency coefficients were adequate for *ImpSS, N-Anx, Act* and *Agg-Host* across all four samples and a bit lower for *Sy*. The associations of its components with specific psychopathological symptoms in a theoretically meaningful mode and the ability of most components to discriminate healthy participants from psychiatric patients and/or opiate addicts suggest that the ZKPQ accurately assesses traits that have significant clinical utility. The acceptable convergent validity of certain ZKPQ components with hostility features as measured by the HDHQ is a further construct validity indicator.

Similar to the results of studies from China[10], Germany[11], France[12], Italy[13], and Spain[14,15], our findings showed that a five factor solution was best fitted to data at hand, as the original version of the instrument. Overall, our factor analysis revealed that 84.3% of the items loaded saliently on the respective scales of the original version. The percentages of the items that loaded as expected ranged from a low of 70.6% (*Sy*) to a high of 100.0% (*N-Anx*). However, *Sociability (Sy)* scale was the weaker factor in terms of factor content and showed also borderline acceptable internal consistency coefficients in all four samples (0.60-0.66), in contrast with the original version of the instrument, where the respective values were 0.77-0.79. Also, with the exception of the Chinese version that found a Cronbach's alpha of 0.63 for *Sy*[10], studies in Spanish, German and Catalan samples found also higher internal consistency coefficients for Sy, ranging from 0.73 to 0.81[11,14,15]. Whether this discrepancy is connected to methodological and/or translation issues or reflects cultural differences in the notion of "sociability" within the Greek population remains unclear. Although no measures of cultural interests or intellectual styles are included in the ZKPQ[2], cultural differences may still exist. For instance, Chinese female sample[19] showed lower and Spanish female sample[40] greater Sy values compared to our healthy participant sample (7.5 and 9.9 vs. 8.3, respectively). Compared to the original version, both Greek males and females presented lower sociability scores (9.8 vs. 8.3 and 10.2 vs. 8.3, respectively). Scores in other scales differ also among various studies. *N-Anx*, for example, was greater for females in the Chinese, Spanish and USA samples compared to our sample (9.3, 8.9 and 10.5 vs.7.5) but similar for males. Also, our male healthy participants presented lower scores in *ImpSS* compared to the Chinese, Spanish and USA samples (7.7 vs. 9.4, 10.6 and 11.0, respectively), but this was not the case for females, indicating the significance of factors such as methodological, translational, cultural and intellectual differences.

Another explanation lies on the specific meaning that a psychiatric patient or an opiate addict may attribute to item content. For example, item 43 (I tend to be uncomfortable at big parties), originally loading to *Sy* scale, may be interpreted in a different way by a psychiatric patient with generalized anxiety or panic disorder, becoming closer to a neurotic or anxiety trait. Likewise, item 99 (Other people often urge me to "take it easy"), originally belonging to the *Act* scale, may be interpreted also in terms of *Sy* in the opiate addict environment. Based on our findings, Greek clinicians assessing personality using the ZKPQ should bear in mind the above mentioned discrepancies, especially with regard to the *Sy* scale, while future studies should clarify some of the scales' contents and their meaning in the Greek population.

On the other hand, internal consistencies for the rest of the scales were satisfactory and similar to those found in other studies. For instance, *N-Anx* showed the highest reliability here (0.87), in line with the results from studies in USA, Spanish, German, Catalan, Chinese and Japanese samples, which showed that Cronbach's alphas for *N-Anx* were the highest and above 0.79[2]. In addition, the *ImpSS* scale presented here a robust factor structure both in terms of model fitting and item content. These findings are further validity indicators of ZPKQ's Greek version.

The Greek version of ZKPQ showed a remarkable stability over time given the adequate retest reliability coefficients obtained, all ranging between 0.79 and 0.89, consistent with the relevant findings of the original version that found retest reliabilities ranging from 0.76 to 0.84 for all ZKPQ scales using similar sample sizes and time interval[2]. Our results also showed several factor intercorrelations, with most significant being those between *ImpSS* and *Agg-Host*, *ImpSS* and *N-Anx*, *N-Anx* and *Agg-Host*, *Act* and *Sy*, and *ImpSS* and Sy. Interestingly, the same factor intercorrelations were found in the Spanish version of ZKPQ (*ImpSS* & *Agg-Host*, *ImpSS* & *Sy*, *N-Anx* & *Agg-Host*, *Act* & *Sy*)[40]. The lack of perfect orthogonality in personality questionnaires including ZKPQ appears to be the rule rather than the exception, since factors tend to be related to a greater or lesser extent because some items of different factors share a common meaning that is empirically reflected in the secondary loadings[45].

The criterion validity was supported in three ways. First, similar to the findings of other studies[17,20,35-37], we found that opiate addicts presented higher rates on *ImpSS* and psychiatric patients presented higher scores on *N-Anx* and lower scores on *Sy* scales compared to healthy participants, confirming our initial hypothesis (a).

Second, specific ZKPQ scales were independently as-

sociated with discrete psychopathological symptoms as expected [hypothesis (b)]. To the best of our knowledge this is the first study reporting correlations of the ZKPQ scales with a wide range of psychological distress symptoms. Our results showed that *Agg-Host* was strongly associated with SCL-90R *hostility* symptoms and *N-Anx* was significantly associated with all SCL-90R psychological distress symptoms scales. *ImpSS* was also associated with hostility symptoms and with *depressive, paranoid ideation* and *psychoticism* symptoms too, indicating that a possible underlying psychopathology may characterize "high impulsive sensation seekers". Previous studies have shown that *ImpSS* loaded on the same factor with EPQ *Psychoticism* scale; also, a significant correlation of *ImpSS* with Block's *Ego Undercontrol* scale has been observed[2,46].

Third, as expected [hypothesis (c)], *Agg-Host* was the strongest independent correlate of HDHQ *total hostility*. Additionally, *Agg-Host* was significantly associated with HDHQ *extrapunitive* hostility and its subscales *acting out, delusional hostility and criticism of others*, but not with *introverted* hostility, i.e. *self-criticism and guilt*, indicating a close relationship between *Agg-Host* and extraversion. Similarly, *Act* was positively associated with *extrapunitive* and negatively with *intropunitive* hostility features, while this was also the case for the *Sy* scale. On the other hand, *ImpSS* showed significant associations with all HDHQ hostility scales. Studies with the original version of ZKPQ showed that *N-Anx* was strongly associated with the EPQ *Neuroticism* scale, while *ImpSS* had moderate loadings in the extraversion factor of the analysis performed with EPQ and ZKPQ[2]. Significant loadings on the "extraversion" factor were observed with the original version for *Sy* and *Act* as well[2].

Strengths of our study are the reasonably large sample sizes, the use of sound instruments and the fact that we followed the same with the original version of ZKPQ operational framework. This study has some limitations however. We used only self-report measures and we cannot refute the criticism that an underlying response style might have intervened with the results. Additionally, the "healthy" participant sample was recruited from hospital staff, medical students and inpatients' relatives and, although large enough, could not be considered representative of the general population. Also, more detailed studies on patients with specific psychiatric diagnoses are needed, to confirm the instrument's discriminating properties. Furthermore, the factors derived from the present study are descriptive rather than explanatory constructs. Further study is needed on the underlying forces that produce these dimensions of individual differences in personality. For example, recent evidence from neuroscience research has linked specific personality traits as measured by the five-factor NEO-PI[47] with structural as well as functional magnetic resonance imaging findings in predicted brain regions[48], supporting the biologically based, explanatory model of personality of this instrument. Although genome-wide association studies have shown that *ImpSS*, *N-Anx* and *Agg-Host* pinpointed to genes in bipolar patients[49] and linkage studies have revealed associations between *ImpSS* and polymorphisms of dopamine-related genes[50], the recent developments in the neuroscience field could provide an additional research potential to further explore the underlying background of the ZKPQ facets.

In conclusion, the results of the present study showed that the Greek version of ZKPQ shares similar psychometric characteristics as the original version. Greek clinicians should pay attention when assessing personality features using the ZKPQ in people with medical or mental disorders, since present findings showed that some scales' content might be interpreted differently by those groups, especially with regard to the *Sy* scale. Test-retest reliabilities were acceptable for all scales, and internal consistencies were adequate for *N-Anx*, *Agg-Host*, *ImpSS* and *Act* and somewhat lower for *Sy*. Opiate addicts exhibited higher rates on *ImpSS* scale and psychiatric patients presented higher rates on *N-Anx* and lower rates on *Sy* scales compared to healthy participants, while the ZKPQ scales were associated with symptoms of psychological distress and hostility features in a theoretically meaningful mode. These findings support the applicability of the Greek version of ZKPQ within the Greek population. Future studies could try to enhance the psychometric properties of some scales, especially for the *Sy* scale, by devising new suitable items, further exploring the relevance of its scales for diagnosis and research.

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Conflict of interest

The authors declare that they have no competing interests and there is there is not any conflict of interest with regard to the present study.

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In the electronic version of the paper two appendices are included, Appendix I: the ZKPQ questionnaire facets' items and factor loadings for both the original and the Greek versions, Appendix II: the components of the Greek version's ZKPQ questionnaire

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