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Psychometric evaluation of revised Task-Related Worry Scale (TRWS-R): A Mokken model analysis

Psychometrické zhodnotenie Mokkenového modelu pre Škálu na úlohu zameraných obáv

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Abstrakt

Cieľom predkladaného výskumu je prešetriť psychometrické vlastnosti revidovanej Škály na úlohu zameraných obáv na slovenskom výbere (N=200). Osempoložková škála bola adaptovaná z pôvodnej subškály Dotazníka kognitívnej interferencie (Sarasonet al., 1986), ktorý predstavuje užitočný nástroj pre posúdenie miery výskytu obáv, ktoré sa vyskytujú pri riešení úloh. Realizované boli odhady vnútornej konzistencie, konfirmačná faktorová analýza a Mokkenová škálová analýza. Výsledky naznačujú, že škála má obzvlášť dobrú vnútornú konzistenciu, homogenitu položiek (jednodimenzionálnosť) a spĺňa kritéria ako pre monotónny model homogenity, tak aj model dvojitej monotonicity. Poskytnutá evidencia naznačuje, že TRWS-R je vhodným nástrojom, ktorý je možné využiť pre posudzovanie kognitívnej interferencie v relevantnom výskume.

Kľúčové slová: kognitívna interferencia, uzkosť, škála na úlohu zameraných obáv, psychometrická analýza, Mokenová analýza škály

Abstract

Task-related worries can be understood as an inherent component of an anxious state and stress response. Under evaluating conditions (e.g. cognitive testing), these worries, due to cognitive interference they create, may have undesirable effects on a cognitive performance at hand. Since cognitive interference has been documented to affect a broad spectrum of cognitive performance (Hembree, 1988), development of a method for its assessment is required. For this purpose we modified a part of the original Cognitive Interference Questionnaire (Sarason et al., 1986) in order to create the revised Task-Related Worry Scale (TRWS-R) and investigated its psychometric properties. Data from two hundreds of participants (72 male, 139 female; age ranging from 18 to 24) were obtained to inspect the modified scale's properties on Slovak sample. After the scale was reformulated and shortened, the resulting set of eight items was subjected for examination

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of internal consistency (Cronbach'salpha, Revelle'sbeta, Armor'stheta, and McDonald'somega coefficients), expected unidimensionality (confirmatory factor analysis), and scalability (nonparametric item response model - Mokken scale analysis). The results indicate that the scale has rather reasonable consistency. Both mean inter-item correlation and corrected mean item-score correlation were relatively high (r= .469 and r = .636 respectively). Additionally, all estimated consistency coefficients reached required thresholds (namely: α = .88,β = .79,θ = .86,Ω =.88). Robust confirmatory factor analysis and Cronbach-Mesbah curve convergently supported the hypothesized unidimensional factor solution (CFA fit indexes: $\chi^2_{(28)}$= 26.73, p = .143, CFI = .994, TLI = .992, RMSEA = .041, SRMR = .055.). Moreover, Mokken scale analysis indicated that the scale is scalable (scale's H = .496) and satisfies the criteria of both monotone homogenity model and double monotonicity model (no significant violations were present). Consistency indices, confirmatory factor analysis, and Mokken scale analysis consistently suggest that the scale assesses a unidimensional construct with reasonable reliability.They also indicated that broader scope of worries that may be present under evaluating conditions (mapped by eight items) tend to occur simultaneously, plausibly without any finer-grained structure. The nonparametric item response model suggested that the items allow ranking persons in the same order on the latent continuum and that the ordering of the items according to their difficulty is relatively uniform across ability groups. Further research is however needed for evaluating the scale's validity and for supporting its appropriateness on more general sample. Psychometric analyses of the present study provided reasonable evidence that support acceptable properties of the revised Task-Related Worry Scale (TRWS-R). We thus conclude that TRWS-R represents a suitable instrument which can be utilized for assessment of cognitive interference in related research.

Keywords: cognitive interference, anxiety, task-related worry scale, psychometric analysis, Mokken scale analysis

Introduction

From a cognitive perspective, facing a difficult or stressful situation can be understood in terms of thoughts triggered by the given state of affairs.The most adaptive response to stress is task-oriented thinking, which directs the individual's attention to the task at hand. This presupposes an inhibition of unproductive worries and preoccupations, which can't constructively contribute to the solution. However, if the difficult situation is interpreted as threat of a personally important goal or value, an anxious state may occur. Individuals in an anxious state frequently worry about the threat they confront (Eysenck, 2007) and become absorbed in the implications and consequences of failure. As proposed (Deffenbacher, 1977; Liebert, Morris, 1967), these worries refer to the cognitive component of anxiety which parallel emotionality component, defined as person's awareness of bodily arousal and tension.

These task-irrelevant preoccupying thoughts do not only induce an unpleasant experience, but they also have undesirable effects on a cognitive performance due to distraction. In a review Deffenbacher (1980) showed that, despite the correlation between

worry and emotionality, only worry component is related to cognitive performance under evaluation stressors. Later meta-analysis of 562 studies (Hembree, 1988) investigating the association between evaluation (test) anxiety and cognitive performance revealed reliable and robust overall effect size of r = -.31. Following the distinction of Deffenbacher, we may however suspect this effect to be attenuated by less related emotional component and that pure effect of worry might exceed this estimation.

Because it has been documented that anxious participants under test-like conditions report being preoccupied with thoughts of their performance, performance of others, and impression they make on others (Sarason, 1978), researcher suggested that these task-irrelevant thoughts may be the key factor causing cognitive performance impairment under stress or anxiety (Sarason. 1984). Hence, Cognitive Interference Theory (CIT; Sarason, Pierce, 1990, 1995) has been used to explain the link between anxiety and diminished cognitive performance.

Following Sarason's work, Eysenck (1992) suggested that negative off-task self-dialogue associated with anxiety would influence the working memory system, which subsequently impair the cognitive performance. More specifically, task-irrelevant thoughts were viewed as being able to deplete some processing and storage resources of the working memory system. This thought was later elaborated into Attentional Control Theory (Eysenck, 2007) which assumes that anxiety impairs efficient functioning of goal-directed attentional system and increases the extent to which processing is influenced by the stimulus-driven attentional system, leading into decreased attentional control.

Since cognitive interference affects a broad spectrum of cognitive performance, development of a method for its assessment was required. For this purpose, The Cognitive Interference Questionnaire (CIQ) was created (Sarason et al., 1986). CIQ is a 22-item questionnaire designed to assess the degree to which people experienced various types of thoughts while working on a task. According to its constructors (Sarason et al., 1986), the CIQ measures two types of thoughts, task-related worries (10 items) and off-task thoughts (11 items). First ten of the CIQ's items were written to provide post-performance estimatesof the frequency of occurrence of intrusive thoughts that pertain to the task just completed. Other items consist of thoughts whose contents do not refer to the task (they were not considered in this study). Each type of thought is rated on a scale of 1 to 5: Never (1), Once (2), A few times (3), Often (4), and Very often (5). The original study (Sarason et al., 1986) provides only brief psychometric evaluation. Authors computed principal component analysis with varimax rotation to extract two significant factors accounting for 33.1% of the total variance. Factor A (item 11 to 21 of the original scale, labeled as Task-Irrelevant Interference) accounted for 55.6% of the items' covariance while factor B (item 1 to 10, labeled as Task-Related Interference) accounted for 44.4% of the covariance. No other psychometric attributes were explicitly investigated.

The task-related worry subscale of original CIQ has broad applicability for cognitive and stress research and its use can enhance confound control and result interpretability. For this reason, the aim of the present study was to modify and reformulate the original subset of task-related worry items for a Slovak version of the scale and provide a more elaborated investigation of its psychometric characteristics (see Data Analysis in section Methods).

Moreover, we tested the applicability of Mokken nonparametric (ordinal) item response theory model for the scale.

Methods

Participants

The data were obtained from participants of four independent studies that used revised Task-Related Worry Scale after a cognitive performance. The total pool of participants consisted of 211 university students in age between 18 and 24 years (72 male, 139 female). Eleven participants were excluded due to missing values (2 cases) or extreme multivariate non-normality (9 cases). Final sample thus consisted 200 cases.

Scale modification

In a pre-research stage, three independent reviewers (two of them licensed in English Language) inspected the original scale (Sarason et al., 1986) for translation and possible modifications (reformulation or item removal). Additionally 34 university subjects were asked to complete the original (translated) scale in order to obtain coarse information about particular items. Following the objective to shorten the scale and keep only most suitable items (after both qualitative and quantitative evaluation), we reformulated four and skipped two items of the original scale (see appendix for the resulting 8-item scale). The original 5-level Likert scale was expanded by one scale point to form 6-level Likert scale: Never (0), Once (1),A few times (2),Several times (3), Often (4), and Very often (5). The possible values of the scale therefore range between extremes of 0 and 40 points.

Data Analysis

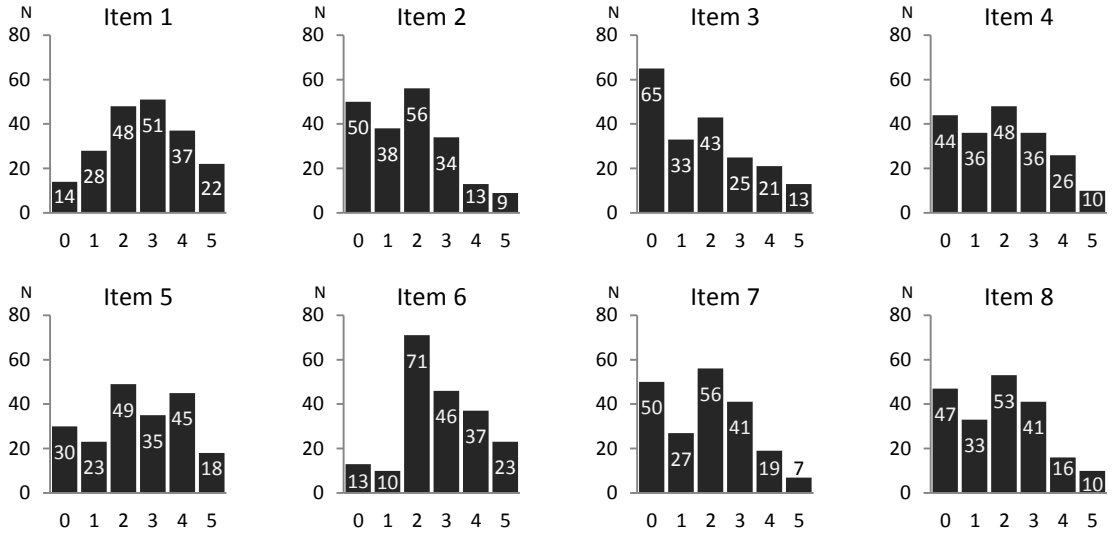
Due to rather incomprehensive psychometric documentation, we inspected correlation matrices, various consistency coefficients and factor structure of the new 8-item scale. On basis of authors' original exploratory factor analysis (Sarasonet al., 1986), we hypothesized that one-factor solution of confirmatory factor analysis would yield appropriate fit. Additionally, Mokken scale analysis (Mokken, Sijtsma, 1986) was also provided to inspect item scalability parameters, monotonicity curves, and invariant item ordering. Expanding the unrealistic deterministic Guttman scaling model (Guttman, 1950) with a probabilistic framework, Mokken scaling techniques are useful tools for construction of summative unidimensional scales. All analyses were computed in RSudio (RStudio Team, 2015) using R language (R Core Team, 2013) and package *mokken*, *MSA* and *ltm.*

Results

Inter-item and item-score correlations

Frequency plots for all items are provided in Fig.1. Median of the summed raw scores was 16 with interquartile range of 13 (Mean = 17.1,SD = 8.5, Mode = 12). The distribution of total scores was positively skewed (.438, SE = .172). The average polychoric correlation coefficient among all items was r = .507, SD = .092. The average corrected polychoric correlation between the composite (summation) score and items was r_{poly} = .642, min = .590, max = .727.

Fig.1: Absolute frequencies of item's response distribution



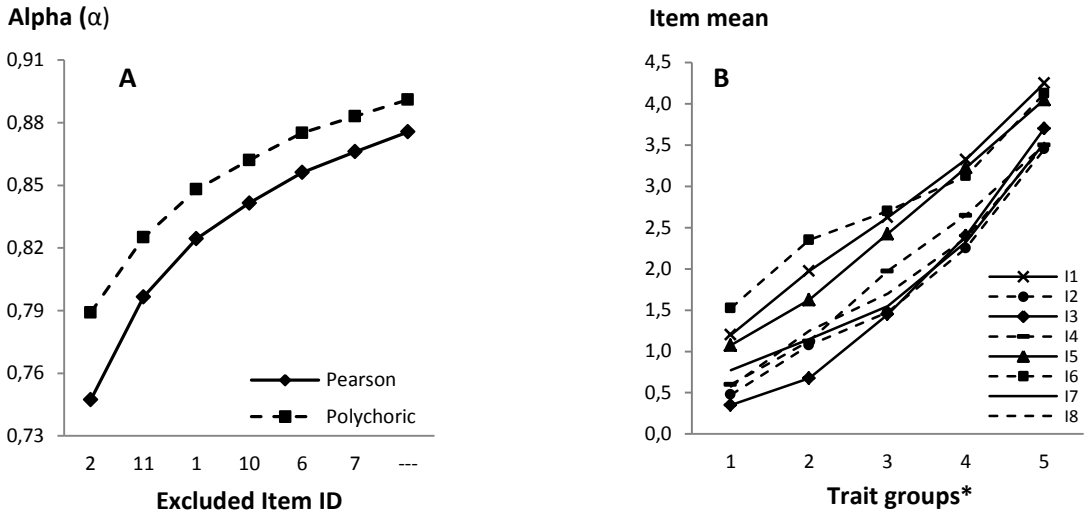
Horizontal axis represents Likert scale labels: 0 - "Never", 1 - "Once", 2-"A few times", 3 - "Several times", 4 - "Often", 5 - "Very often"

Consistency indices

Firstly we examined the common consistency coefficients for the 8-item scale. Assuming approximately Tau-equivalent measurement model, we firstly computed standard Cronbach's alpha, α = .88 (polychoric α_{poly} = .89), which indicate good internal consistency (Ercan et al., 2007). Plotting the estimated α-coefficients after step-wise item removal while maximizing alpha compose so called Cronbach-Mesbah curve (CMC; Mesbah, 2010). As for the present scale, monotone increasing CMC (Fig.2A) is interpreted as an evidence for assumed unidimensional solution. Revelle'sbeta coefficient (Revelle, Zinbarg, 2009) was estimated to be β = .79. The difference between α and β was minor, which also indicatea good homogenity and unidimensionality. Because the assumptions of Alpha are rather restrictive, we also computed McDonald's omega (McDonald, 1999), the value of Ω =.88 (polychoric Ω_{poly} =.89) suggests that α coefficient was relatively unbiased (i.e. the measurement model may approximate tau-equivalence). MS-method of estimation indicated reliability of *MS* = .87 (Molenaar & Sijtsma, 1984). Finally, we estimated Armor's theta coefficient (Armor, 1974;

Zumbo, Gaderman, 2007). Its high level of θ = .864 indicated that single component extraction accounted for large variance of the scale (approximately 51% of the variance).

Fig.2: Cronbach-Mesbah Curve (A) and items'monotonicity plot (B)



** Sample of 200 cases was divided to five equal groups (N=40) according to their (increasing) latent trait.*

Confirmatory Factor Analysis

Simple unidimensional congeneric model was evaluated by means of confirmatory factor analysis (CFA). Because of the items' ordinality and non-normality (Mindrila, 2004), we used diagonally weighted least squares estimator (DWLS) and Satorra-Bentler correction for χ^2 statistic. The results indicate a reasonably good overall fit $\chi^2_{(28)} = 26.73$, p = .143,CFI = .994, TLI = .992, RMSEA = .041 (p = .610), SRMR = .055.

Mokken Scale Analysis

Previous analysis provided supportive evidence that all 8 items can be considered to measure a single underlying construct. Consistently, Loeviner's coefficients of scalability (H) of all items exceeded recommended threshold of H = 0.3 (see Tab. 1.) indicating that the scale is homogenous. Scale's total scalability was .496 (95%CI of scale's H = .439 - .553), which suggest that the items form scale of medium to strong strength. Subsequent analysis revealed that there are no monotonicity violations (V_M) among items and all item characteristic curves (ICC) are monotonically increasing functions of latent trait (see Fig.2B). Thus, assumptions for monotone homogenity model (MHM) were supported. Additionally, we assessed the last assumption of non-intersection of ICCs. As shown (Tab.1, Fig.2B), there were two violations of the double monotonicity model. The magnitude of both violations was however neither substantial nor significant suggesting for approximately invariant item ordering. In addition to these analyses, we also compared constrained (assuming that items have equal discrimination parameter) and unconstained response grade model (Samejima, 1969). The results of ANOVA indicate, that there is not a significant difference between the models (p = .126). We therefore conclude that the items have equal discrimination parameters.

Tab.1: Summary of item characteristics

Item	H	V_M	V_I	R_{IT}	h^2
Item 1	.537	0	0	.697	.58
Item 2	.515	0	0	.669	.55
Item 3	.557	0	0	.722	.67
Item 4	.482	0	1	.621	.48
Item 5	.461	0	0	.584	.44
Item 6	.472	0	1	.587	.43
Item 7	.462	0	0	.591	.45
Item 8	.475	0	0	.613	.49

H - Loevinger'sscalability coefficient, V_M - monotonicity violations, V_I - intersection violations, R_{IT} - corrected item-total correlation, h^2 - item communality

Discussion

The present study investigated psychometric attributes of revised Task-Related Worry Scale (TRWS-R) on Slovak sample. Consistency indices, confirmatory factor analysis, and Mokken scale analysis consistently suggest that the scale assessesa unidimensional construct with reasonable consistency. Unidimensionality indicate that broader scope of worries indicated by eight items tend to occur simultaneously, plausibly without any finer-grained structure. Additionally, Mokken model analysis shown that each item in the set allow to rank persons in the same order on the latent continuum and the ordering of the items according to their difficulty is relatively uniform across ability groups. Thus, the attribute of ordinal specific objectivity (invariant item ordering) was also satisfied. Figure 2B may however suggest that the hierarchy of worries is less pronounced at higher level, than at lower levels of the latent trait. Nevertheless, from the descriptive standpoint, it seems that worries about own errors and comparing to others performance are the most common (occur most frequently). From the item-level of analysis, each item loads on the common factor with relatively similar strength (R_{IT}) and have reasonable discrimination parameter (H).

Further elaboration of these results is however needed. Firstly, even though the sample size for the 8-item length scale can be considered as satisfactory (25 cases per item), the sample should be further extended to non-university participants and perhaps clinical population. Secondly, it is indeed inevitable to evaluate scale's validity by experiments and demonstrate its relatedness to critical criteria (e.g. anxiety scales, stress experience).

Conclusions

By supporting psychometric appropriateness, we can conclude that TRWS-R is a suitable instrument which can be utilized for assessment of cognitive interference in research, which can capitalize on the "cognitive component" of anxious states and stress experience. Due to its brief length and simple administration, relatively precise estimate of cognitive interference can be obtained easily and within a short time span. These proprieties favor scale's broad applicability.

Appendix

English version of TRWS-R

Instructions: This scale concerns the kinds of thought that go through people's heads while they are working on a task. The following is a list of thoughts, some of which you might have had while doing the task(s) on which you have just worked. Please indicate approximately how often each thought occurred to you while working on it.

Item	
1*	I thought about what others would learn about me
2*	I thought about what task I was supposed to undertake next
3	I thought about how I would feel if I were told how I performed
4*	I thought about the impression I was making upon others
5	I thought how others have done on this task
6*	I thought how many errors I had made
7	I thought about how much time I had left
8	I thought about how I should work more carefully

** new or substantially reformulated items*

Slovak version of TRWS-R

Inštrukcia: Táto škála sa zaoberá rôznymi typmi myšlienok, ktoré môžu ľuďom prísť na um počas práci na nejakej úlohy. Nasledujúci zoznam predstavuje myšlienky, ktoré ste mohli mať počas práce na úlohe (úlohách), ktorú ste práve robili. Prosím označte približne ako často sa u Vás vyskytla každá z myšlienok počas riešenia úlohy.

Item	
1*	Premýšľal(a) som o tom, aké veci sa o mne dozvedia
2*	Premýšľal(a) som nad tým, aká úloha ma ešte čaká
3	Premýšľal(a) som o tom, ako by som sa cítil(a) keby mi povedali aký bol môj výkon
4*	Premýšľal(a) som o tom, ako musím na zúčastnených pôsobiť
5	Premýšľal(a) som o tom, ako sa v tejto úlohe darilo ostatným ľuďom
6*	Premýšľal(a) som o tom, koľko krát som spravil(a) chybu
7	Premýšľal(a) som o tom, koľko mám ešte času
8	Premýšľal(a) som o tom, že by som mal(a) pracovať opatrnejšie

** new or substantially reformulated items*

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