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Exploration of the Activity-Specific Model of Temperament in Four Languages

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Abstract

The Structure of Temperament Questionnaire (STQ) proposed by Rusalov (1989) measures four dynamical properties of activity -Ergonicity (energetic aspect), Plasticity, Tempo of Activity, and Emotionality- in three different areas: physical, social, and intellectual. The paper presents an investigation of the relationships between temperament scales in English, Chinese, Urdu and Polish versions of the STQ. The multi-group confirmatory factor analysis showed a better fit for *activity-specific models of temperament* than the General Arousal model and suggested a four-factor structure of temperament in each STQ version: factors of Motor Activity (Motor Ergonicity, Motor Plasticity and Motor Tempo scales), Social Activity (Social Ergonicity, Social Plasticity and Social Tempo scales), Intellectual Activity (Intellectual Ergonicity, Intellectual Plasticity and Intellectual Tempo scales) and Emotionality (Motor, Social and Intellectual Emotionality scales).
Key words: activity-specific structure of temperament, STQ.

Resumen

El Cuestionario sobre la Estructura del Temperamento (STQ) mide cuatro propiedades dinámicas de actividad -Ergonocidad (aspecto enérgico), Plasticidad, Ritmo de Actividad, y Emotividad-, en tres áreas diferentes: física, social, e intelectual. Este estudio presenta una investigación de las relaciones entre balances de temperamento en inglés, chino, urdu y versiones polacas del STQ. El análisis factorial confirmatorio multigrupal mostró una medida mas adecuada para modelos diferenciales de actividad del temperamento que el modelo de Excitatión General, y sugiere una estructura de cuatro factores del temperamento en cada versión STQ: factores de Actividad Física (Escalas de Ergonicidad Física, Plasticidad Física y Ritmo Físico), Actividad Social (Escalas de Ergonicidad Social, Plasticidad Social y Ritmos Sociales), Actividad Intelectual (Escalas de Ergonicidad Intelectual, Plasticidad Intelectual y Ritmo Intelectual) e Emotividad (escalas Físicas, Sociales e Intelectuales).
Palabras clave: estructura diferencial de actividad del temperamento, STQ.

The application of psychological tests developed in one culture to other cultures brings with it the benefits of cross-cultural comparisons on a variety of topics, but the effect of cultural diversity on the perception of test material creates a fundamental

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problem for such comparisons. One approach to this problem is to attempt to select the most basic dynamical aspects of human performance, which are universal across cultures and which do not depend much upon the content or context of the activity. The present study considers the formal dynamical characteristics of activity, energetic level, plasticity, tempo and emotionality as aspects of temperament that could serve as universal factors.

Many researchers consider temperament as consisting of the content free, formal dimensions of behaviour, whereas personality is to be considered a socio-psychological construct comprising the content characteristics of human behaviour (Eysenck, 1990; Gray, 1970; Nebylitsyn, 1972; Rusalov, 1989; Strelau, 1994; Strelau & Angleitner, 1991). As Strelau and Angleigtner (1991, p.6) pointed out in their overview, "most temperament researchers agree that temperament, whatever the traits and structure to which this concept refers, has a strong biological determination... This assumption has its roots in the fact that temperament characteristics can be observed from the first weeks of life and individual differences in temperament traits have a strong genetic determination (Buss, Eysenck, Zuckerman, Netter, Fahrenberg)". The European tradition in the analysis of temperament developed by Kant, Wundt, Heymans, Adler, Kretchmer, Gray, Pavlov, Eysenck is centered around two basic components of temperament: Activity characteristics and Emotionality characteristics.

The two-component model of temperament was developed further in the studies of the types and properties of nervous systems carried by the Russian schools of psychology. Since the original animal work carried out by Pavlov at the beginning of the 20th century, extensive experimental work with human subjects was conducted in the laboratories of Teplov (1963), Nebylitsyn (1972), and then Rusalov (1979). These experiments showed that the strength of excitation or inhibition in the Central Nervous System (CNS) determined how long an individual could sustain activation or inhibition of activation. The mobility of CNS processes determined the plasticity of behaviour, i.e how easily an individual could start or stop activity, and how flexible and adaptive the individual could be to new circumstances or instructions. The balance between excitation and inhibition was thought to be the basis of emotionality, impulsivity, and detachment behaviour. The British psychologist Jeffrey Gray conducted most of the work on the translation and analysis of Pavlov's "types of CNS" and found a strong parallel between the concept of arousal, Eysenck's concept of Extraversion and the Pavlovian concept of the strength of a nervous system (Gray, 1970, 1991).

Vladimir Rusalov who, after Nebylitsyn, inherited the Laboratory of Differential Psychology and Differential Psychophysiology in the Institute of Psychology under the Russian Academy of Sciences, developed the first version of the Structure of Temperament Questionnaire (STQ) in the late 1970's to early 1980's based on his studies of the psycho-physiological correlates of consistent individual differences in physiological measures (Rusalov, 1979). He discovered consistent between-subject differences in the amplitudes and frequencies of delta- and theta-rhythms in frontal and occipital areas in cross spectral presentations, differences in the frequency and amplitude of beta-2 rhythms of frontal and occipital areas, and differences in the spatio-temporal coherence of the EEG as measured by the synchronization and coherence of alpha, beta-1, delta

and theta rhythms. In addition to EEG studies, Rusalov measured evoked potentials, absolute thresholds in visual, auditory, and tactile modalities, strength of excitation in auditory and visual modalities, mobility in auditory and visual modalities, problem solving in deterministic and probabilistic conditions, and the speed of problem solving using a variety of intellectual tests. He also measured ergonicity using the time spent attempting to solve unsolvable problems and the number of times that a subject gave up while attempting to solve a task. These experiments showed that subjects, individually, had consistent patterns of EEG activity related to their speed, plasticity and effectiveness of performance under two conditions: deterministic, requiring only well-defined actions, and probabilistic, requiring a choice and working with several alternatives. Rusalov suggested that temperamental traits should be assessed using four scales: (1) ergonicity (endurance, the ability to sustain intensive work), (2) plasticity (the ability to effectively switch between tasks or to change the manner of performance), (3) tempo of activity, and (4) emotionality.

Rusalov also concluded that these four temperamental traits are activity-specific: the energetic level or tempo of performance might be different for the same individual in physical, social or intellectual activities, therefore the different aspects of the performance of these activities should be assessed and analyzed separately. He suggested analyzing these four traits separately in the areas of verbal activity (communication area) and the physical manipulation of objects (objects-related area), and he proposed the Russian and the English versions of the Structure of Temperament Questionnaire (STQ) (Rusalov, 1989). Later he developed the 150 item Extended version of the STQ model which involves 12 (4x3) components, analyzed according to four temperamental traits (ergonicity, plasticity, tempo and emotionality) in three areas of activity: social, physical and intellectual (1997, 2004).

The internal reliability for these items has been found to range from 0.70 to 0.81. Previous models of temperament and personality differ from the STQ's activity-specific approach in that they do not distinguish between areas of activity, considering, for example, arousal in motor and social activity (Extraversion or Strength of nervous system) as a non-specific general activation of the nervous system (Costa & McCrae, 1992; Eysenck, 1968; Gray, 1970; Strelau, 1999; Teplov & Nebylitsyn, 1963).

Experimental validation of the STQ was carried out in a series of studies during the 1980's and 1990's in which the performance of subjects on the following measures was compared with the STQ scales: speed of writing, reading and speed of generation of words, maximal and optimal tempo of performance in sensory-motor tasks and intellectual (including unsolvable) tasks, performance on non-verbal tasks with which subjects were unfamiliar, rigidity of perception in tactile and visual modalities, duration of the switch between one way of solving a task and another, mobility in attention as measured by Shulte (red-and-black) table, variability in line drawing (Rusalov, 1979, 1989; Rusalov & Bodunov, 1977; Rusalov & Kalashnikov, 1988; Rusalov & Trofimova, 2007). In studies of concurrent validity, the STQ was compared to Eysenck's EPQ (Brebner & Stough, 1993; Rusalov, 1989; Zinko, 2006), NEO-FFI (Bodunov *et al*., 1996; Dumenci, 1995; Trofimova & Rusalov, 2007), Strelau's PTS (Bodunov *et al*., 1996; Ruch *et al*., 1991; Strelau, 1999; Trofimova, 2009), the Torrance's Nonverbal Tests of Creative Thinking

(Rusalov & Poltavtzeva,1997), Rotter's Locus of Control scale (Byzova, 1997), meaning attribution to neutral objects (Trofimova, 1999), the choice of profession (Rusalov *et al*., 2000), Rogers Adaptivity scale (Drozdov, 1998), the Motivation for Achievement scale (Vorobieva, 2004), adaptivity strategies in the Dembo-Hoppe Level of Aspiration experiment (Zin'ko, 2006), with 20 behavioral and experimental measures of plasticity (Rusalov & Kalashnikov, 1988), with 25 measures of Mobility (Rathee & Singh, 2001), STAI (Popov, 2006), MAS (Popov, 2006; Zin'ko, 2006), use of alcohol (Bodunov *et al*., 1996), Dissociative Experiences Scale (Beere & Pica, 1995; Eputaev *et al*., 2003), Rosenzveig test (Zin'ko, 2006), scores on Cattell's 16-factors personality inventory (Vasyura, 2008), Wechsler, Shepard and Gotshield Figure tests (Rusalov & Dudin, 1995; Rusalov & Naumova, 1999) and with the school grades of high-school students (Gritzenko, 1996). The details of the results of these studies can be found in Rusalov and Trofimova, 2007.

The administration of the English version of the STQ to American and Australian samples demonstrated that it had a factor structure similar to the Russian language version, and it possessed good reliability and internal consistency (Bishop *et al*., 1993; Bishop & Hertenstein, 2004; Dumenci, 1995, 1996; Rusalov, 1997, 2004; Rusalov & Trofimova, 2007; Stough *et al*., 1991). The author of this article participated in the development of the final edition of the Extended English version of the STQ, and also supervised the forward-and-backward translation of the STQ to Chinese, Urdu and Polish languages using independent interpreters.

The purposes of the present study were: (1) to analyze the fitness of the Arousal model and of the activity-specific STQ model to the factor structure obtained in each of four samples; (2) to compare the models of the best fit across four samples; and (3) to evaluate the means in cultural and gender groups using the English, Chinese, Urdu and Polish versions of the STQ.

Method

Participants

The study used following participants:

Study 1, Canadian sample: 847 Canadian subjects, volunteers and psychology students of McMaster University (Hamilton, Ontario, Canada) and Brock University (St. Catherine's, Ontario, Canada) took part in this study during 1999-2006. The data of 26 subjects was excluded from this sample for validity reasons (social desirability bias as measured by the validity scale of the STQ), and the final sample consisted of 821 subjects, 201 males, 620 females, aged 17-59, M= 22.26, SD= 8.0. University students received a practicum credit for their participation. All subjects were fluent in English.

Study 2, Chinese sample: Initially 166 Chinese adult subjects who spoke only Chinese participated in the study, and the data of five subjects was excluded from this sample for validity reasons (random response, social desirability bias as measured by the Validity scale of STQ). 120 subjects were tested in China, Guangzhou city, Guangdong province, and 41 subjects were tested in Canada. Subjects in China were Chinese vo-

lunteers who were then working in Guangzhou Pearl River Piano Group Co., Ltd., and students from the last grade of Guang Ya High School. Chinese Canadian subjects were students and volunteers who had recently arrived in Canada. The final sample consisted of 161 subjects (80 males, 81 females, aged 17-58, *M*= 28.57, *SD*= 10.17).

Study 3, Urdu-Canadian sample: 202 initial adult subjects (129 tested in 2003 and 73 subjects tested in 2006) participated in the study, and the final data came from the sample of 187 subjects (71 males, 116 females, aged 17-58, *M*= 25.5, *SD*= 10.8) whose first language was Urdu and who lived in Canada. The subjects were volunteers within Urdu communities in the Mississauga and Hamilton area, and McMaster University undergraduate psychology students (South Ontario).

Study 4, Polish-Canadian sample: 51 Polish-speaking subjects (13 males, 38 females, aged 17-48, *M*= 23.06, *SD*= 5.84) who lived in Canada were tested with the STQ-P. The subjects were undergraduate students in McMaster University and volunteers from Polish communities in the Toronto and Hamilton areas.

Procedure, materials and data analysis

Each subject completed the extended version (150 items) of Rusalov's Structure of Temperament Questionnaire (STQ-E for English subjects, STQ-C for Chinese subjects, STQ-U for Urdu subjects and STQ-P for Polish subjects).

This article uses the following labels: Motor Ergonicity (ERM), Motor Plasticity (PLM), Motor Tempo (TMM), Motor Emotionality (EMM), Social Ergonicity (ERS), Social Plasticity (PLS), Social Tempo (TMS), Social Emotionality (EMS), Intellectual Ergonicity (ERI), Intellectual Plasticity (PLI), Intellectual Tempo (TMI), Intellectual Emotionality (EMI), Validity scale (V).

The following statistical methods were applied using Statistica 6.0 package: (1) Scale statistics were collected in order to compare means, confidence intervals and standard deviations in different samples. ANOVA was performed to estimate the statistical significance of differences between eight cultural and gender groups. Post Hoc comparison for the different nation and gender groups was performed using the Scheffe test and Unequal samples HSD test, chosen as being the most conservative tests and as tests appropriate for unequal samples; (2) Internal consistency was calculated for all versions of the STQ using Cronbach's alpha reliability coefficient for each scale as well as item-total correlations (*CI*= 95%). Alpha coefficients were compared between the Russian sample (1937 Russian subjects, 611 males, 1326 females, aged 17-59, *M*= 23.06, *SD*= 8.83 reported by Rusalov, 2004) and the four samples under study; (3) The factorial structure of each version of the STQ was first analyzed with an unrotated principal components method for each sample. Then Varimax normalized rotation was applied in order to find a solution which would reproduce the maximum variance and number of factors. Only solutions with eigenvalues of factors greater than 1, with screen plot analysis and with maximum variance reproduced before rotation were considered and compared across cultures; and, (4) Three parallel models were examined with a confirmatory multi-group factor analysis using covariance matrices: the "Arousal" model (in which the scales were grouped by the aspect of activity), the activity-specific model

without correlated residuals (STQ) and STQ model with 6 correlations between residuals (STQ-r). Generalized Least Squares Maximum Likelihood method of estimation were used for the calculation of the fit coefficients.

Results

In all four samples each scale had a normal distribution of scale scores, which varied from 12 to 48. The means of the men's and women's scores in the four samples are presented in Table 1, and a summary of the significant differences (p <0.01) is given in Figure 1. Chinese females had statistically significant lower means than the other 7 sub-samples on the three scales of intellectual activity, lower means than Canadians (both males and females) and Urdu-speaking males on the three scales of physical activity and lower means than Polish (both male and female) subjects on the scales of Motor Ergonicity and Tempo. Chinese men had lower means than Canadian men on the three scales of physical activity and Intellectual Tempo. Urdu females also had lower means than both gender groups in the Canadian sample on the scale of Motor Ergonicity. Canadian females had statistically significant higher means on Social Ergonicity and Tempo than both Chinese groups.

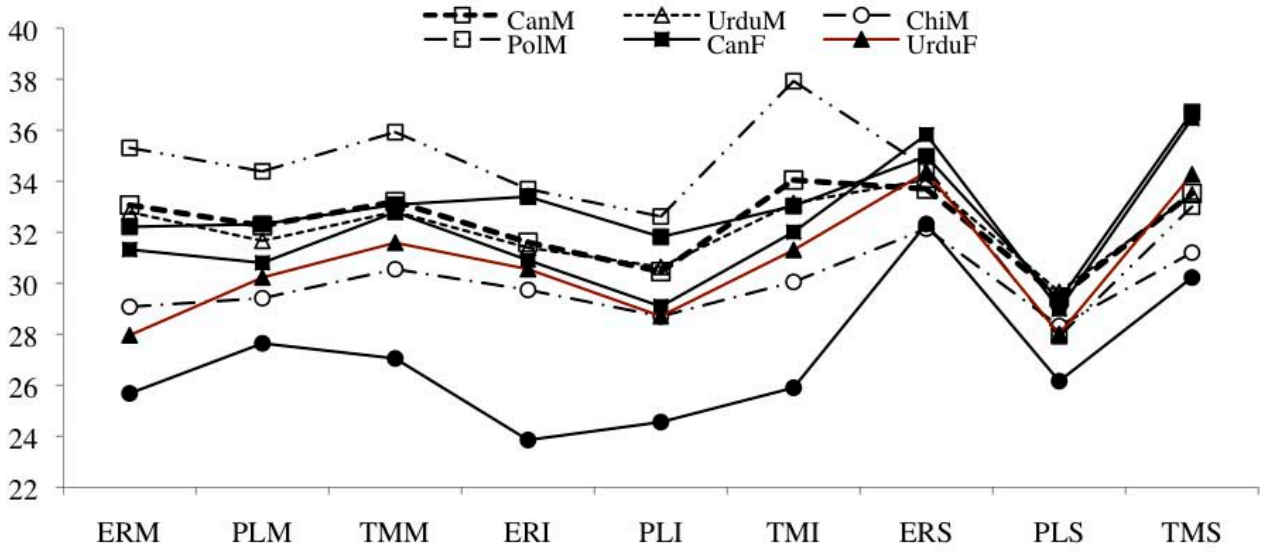
In terms of gender differences within the cultural groups, males in the Canadian sample had significantly (p <0.01) higher means than females on Intellectual Tempo, but females had higher means on Social Ergonicity and Social Tempo. Urdu males had higher means on Motor Ergonicity than Urdu females, and Chinese males had higher means than females on three scales measuring aspects of intellectual activity.

Internal consistency coefficients (alpha) for each scale were in most cases similar to those in the Russian sample (Rusalov, 2004) (Table 2). The uncorrected item-total correlations for the samples under study were analysed for effect sizes followed Cohen's (1992) guidelines assigning large effect size to r= 0.5 and higher, small effect size to r lower than 0.3, and medium effect size to r values between 0.3 and 0.5. Out of the total 150 items of the STQ, 8 items had effect sizes of item-total correlation below 0.5 in at least three out of four samples: item number 1 (Motor Ergonicity), 11, 66, 131 (Motor Plasticity), 2 (Intellectual Plasticity), 118 (Motor Tempo), 27 (Intellectual Tempo), 126 (Social Emotionality).

Factor coordinates in principle components factor analysis in the four samples are given in Figure 2. The left column shows that the three Emotionality scales form a cluster separately from the nine activity-related scales. The right column of Figure 2 shows the coordinates of the factors from the perspective of the second and the third factor. The activity-related scales had a tendency to create clusters according to the types of activity-motor, social and intellectual.

Factor analysis with Varimax rotation revealed a four-factor solution of the STQ-E, STQ-C, STQ-U and STQ-P, which was consistent across the samples and was similar to the STQ-R structure (Rusalov, 2004) (Table 3). In all samples the scales formed the factors of Emotionality, Motor Activity, Social Activity and Intellectual Activity.

Confirmatory factor analysis (CFA) was performed individually for each sample as well as multi-group CFA using parallel analysis with three models. The results of



CanM	ChM,ChF	ChM,ChF	ChM,ChF	ChF	ChF	ChF,ChM	CaF	ChF	CaF
CanF	ChF,UrF	ChF	ChM,ChF	ChF	ChF	CaM,ChF	ChM,ChF		ChM,ChF
UrduM	UrF,ChF	ChF	ChM,ChF	ChF	ChF	ChF		ChF	
UrduF	CaM		ChF	ChF	ChF	CaM,ChF			ChM,ChF
ChinM				ChF	ChF	ChF,PoM			PoF
ChinF	PoM,PoF		PoM,PoF	PoM,PoF	PoM,PoF	PoM,PoF			PoF

Figure 1. Means of 8 groups: males and females from Canadian (CaM, CaF), Urdu (UrM, UrF), Chinese (ChM, ChF) and Polish samples (PoM, PoF). Six rows under the plot indicate significant differences ($p<0.01$) between a given sample (marked in bold in the left column) and the samples marked in the row. For clear presentation the symmetric cells in this matrix are not duplicated. There were no significant differences on any of three Emotionality scales, and between the gender groups in Polish sample.

Table 1. Means, confidence intervals (MCI, 95%) and standard deviations (SD) for the samples tested with English, Chinese, Urdu, and Polish versions of STQ.

		ERM	ERI	ERS	PLM	PLI	PLS	TMM	TMI	TMS	EMM	EMI	EMS
Canadian Males	MCI	33.06 32.1-34.0	31.60 30.8-32.4	33.69 32.7-34.7	32.25 31.5-33.0	30.45 29.7-31.2	29.45 28.6-30.3	33.20 32.4-34.0	34.04 33.3-34.8	33.52 32.8-34.3	27.16 26.3-28.0	30.14 29.4-30.9	28.25 27.4 29.1
	SD	7.03	5.63	7.34	5.40	5.16	6.27	5.75	5.52	5.48	5.89	5.69	5.97
Urdu Males	MCI	32.79 31.0-34.6	31.39 30.1-32.7	34.06 32.6-35.6	31.66 30.2-33.1	30.63 29.3-31.9	29.66 28.2-31.1	32.80 31.4-34.3	33.14 31.9-34.4	33.48 32.2-34.8	26.56 25.0-28.1	27.86 26.4-29.3	28.08 26.7 29.5
	SD	7.63	5.64	6.35	6.00	5.55	6.01	6.12	5.38	5.56	6.43	6.20	5.99
Chinese Males	MCI	29.08 28.0-30.1	29.74 28.7-30.8	32.14 31.0-33.3	29.41 28.3-30.5	28.70 27.8-29.6	28.33 27.2-29.5	30.55 29.5-31.6	30.05 29.1-31.0	31.20 30.1-32.3	28.23 27.1-29.3	29.43 28.4-30.4	28.58 27.5 29.6
	SD	4.64	4.64	5.20	4.96	3.99	5.25	4.73	4.22	4.89	5.04	4.54	4.66
Polish Males	MCI	35.31 29.9-40.7	33.69 30.7-36.7	34.54 29.8-39.3	34.38 31.6-37.2	32.62 28.9-36.3	27.92 24.0-31.8	35.92 32.2-39.6	37.92 34.4-41.5	33.00 29.2-36.8	25.23 22.1-28.3	27.31 22.7-31.9	24.46 20.1 28.8
	SD	8.94	5.01	7.87	4.68	6.13	6.49	6.09	5.87	6.24	5.10	7.54	7.14
Canadian Females	MCI	31.32 30.8-31.9	30.90 30.5-31.3	35.83 35.3-36.4	30.80 30.4-31.2	29.09 28.7-29.5	28.98 28.5-29.5	32.78 32.4-33.2	32.01 31.6-32.4	36.45 36.0-36.9	25.46 25.0-25.9	30.81 30.3-31.3	29.65 29.2 30.1
	SD	6.91	5.58	6.76	5.50	5.08	6.59	5.24	5.28	5.48	5.77	5.81	5.57
Urdu Females	MCI	27.96 26.8-29.1	30.55 29.5-31.6	34.36 33.3-35.5	30.22 29.3-31.2	28.71 27.7-29.7	28.01 26.8-29.2	31.59 30.6-32.6	31.30 30.4-32.2	34.27 33.2-35.3	26.28 25.1-27.4	30.38 29.2-31.6	29.22 28.1 30.3
	SD	6.14	5.73	6.04	5.11	5.25	6.38	5.34	5.11	5.88	6.33	6.39	5.82
Chinese Females	MCI	25.68 24.5-26.9	23.85 22.6-25.1	32.32 31.1-33.5	27.64 26.6-28.7	24.56 23.5-25.6	26.16 25.0-27.3	27.05 26.0-28.1	25.90 24.8-27.0	30.22 29.1-31.3	27.98 26.8-29.2	29.84 28.7-31.0	29.14 28.0 30.3
	SD	5.39	5.84	5.39	4.62	4.80	5.32	4.90	4.84	4.85	5.37	5.35	5.16
Polish Females	MCI	32.21 29.8-34.6	33.39 31.5-35.3	34.97 32.6-37.3	32.32 30.3-34.3	31.82 30.2-33.5	29.32 27.2-31.5	33.08 31.5-34.7	33.03 31.4-34.6	36.71 35.1-38.3	24.34 22.2-26.5	30.32 28.4-32.3	28.29 26.2 30.4
	SD	7.28	5.65	7.14	6.01	5.01	6.55	4.79	4.87	4.88	6.47	5.89	6.28

Table 2. Comparison of Cronbach's reliability statistics (alpha) for four versions of STQ with the data from Russian sample (Rusalov, 2004 with permission).

	Alpha Canadian, N=821	Alpha Chinese, N=161	Alpha Polish-Can, N=51	Alpha Urdu-Can, N=187	Alpha Russian, N=1937
ERM	0.83	.73	.87	0.80	.87
ERI	0.73	.79	.70	0.71	.82
ERS	0.84	.71	.86	0.75	.83
PLM	0.71	.75	.72	0.70	.78
PLI	0.70	.72	.70	0.72	.75
PLS	0.78	.74	.78	0.73	.81
TMM	0.70	.75	.73	0.70	.83
TMI	0.70	.72	.71	0.68	.82
TMS	0.73	.70	.74	0.70	.80
EMM	0.73	.71	.77	0.75	.75
EMI	0.74	.70	.82	0.77	.82
EMS	0.71	.71	.80	0.71	.84

CFA showed that the STQ and STQ-r activity-specific models had a much better fit than the "Arousal model". The "Arousal" model grouped all scales measuring energetic components (ERM, ERI and ERS) into the Arousal factor, all scales measuring plasticity and tempo (PLM, PLI, PLS, TMM, TMI and TMS) in a Mobility factor, and all scales of emotionality (EMM, EMI and EMS) in the factor of Emotionality. The inclusion of correlations between the indicated factors improved the "Arousal" model, but the final fit coefficients still indicated a bad fit (Table 4). The fit coefficients were much better when the scales measuring the different aspects of activity were grouped by the type of activity, i.e. they followed the activity-specific model of the STQ. In order to reach the best fit it made sense, however, to acknowledge the fact that social activities are driven in many aspects by emotionality, that prolonged social interaction also requires prolonged mental attention, and that plasticity (re-programming) in physical activity requires some decision making, i.e. intellectual plasticity as well. Having correlations between the residuals of the three emotionality scales and Social Plasticity, and between Motor and Intellectual Plasticity, improved the fit of the STQ model in all four samples. The direct correlation between the indicated scales, or the re-grouping of the scales according to the correlations between the indicated residuals made the model much worse in all four samples. Correlated residuals between Motor Emotionality and Motor Plasticity, and between Social and Intellectual Ergonicity (STQ-r model) improved the fit of the STQ model in the Canadian, Urdu and Chinese samples, and correlated residuals between Motor Plasticity, Intellectual and Social Tempo improved the model in the Polish sample.

The Comparative Fit Index (CFI) for the STQ-r model was greater than .90 for all samples, the root mean square error approximation (RMSEA) was around or below .08 in all samples and in multi-group CFA (Table 3). The ratio of χ^2 to degrees of freedom and standardized root mean square residual (SRMR) also showed the best fit of the STQ-r model in comparison to the "Arousal" model in all samples. The χ^2 to degrees of freedom ratio in the Canadian sample was higher than 5 (affecting this ratio

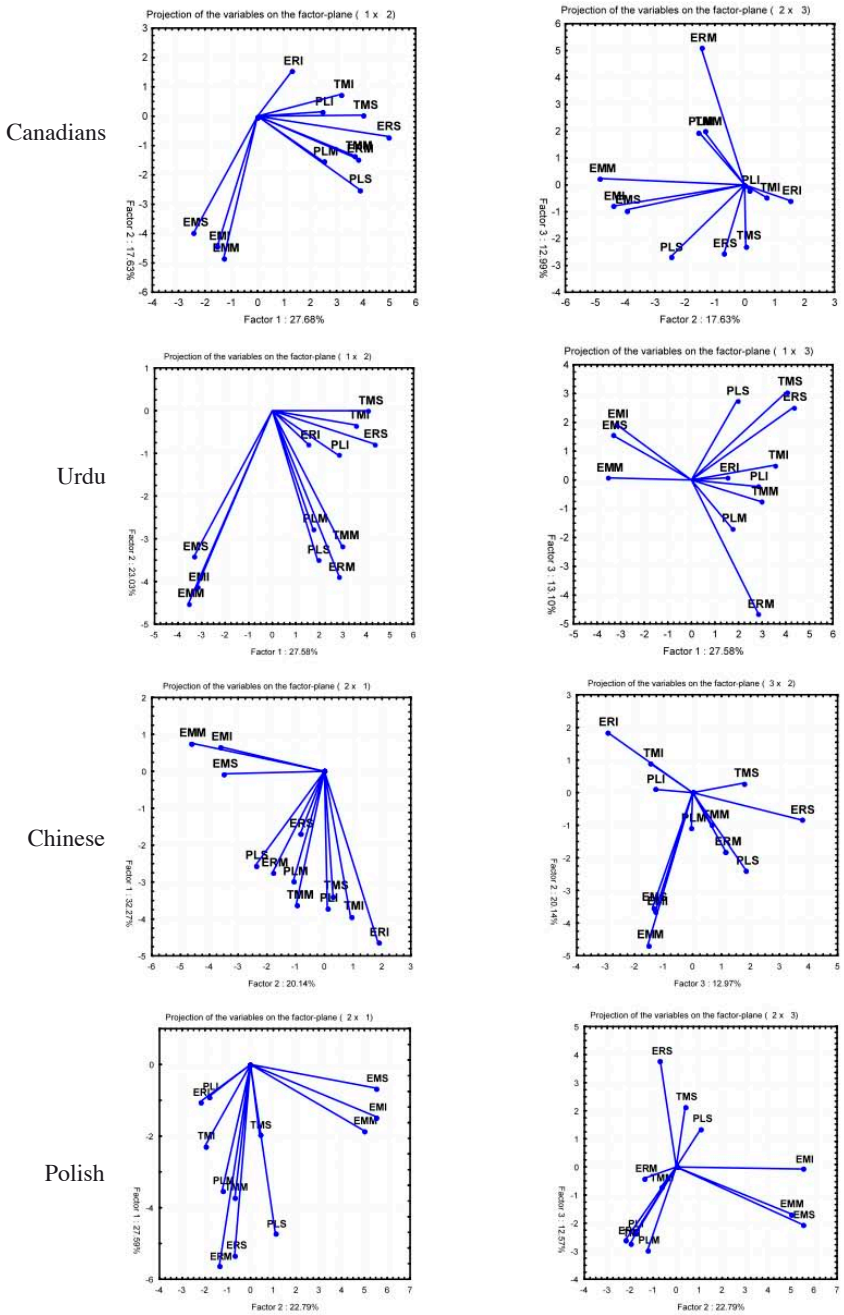


Figure 2. Factor coordinates for the first two (left column) and 2-3rd factors (right column) in principle components factor analysis in four samples.

Table 3. Factors extracted after varimax normalized rotation for four samples and compared to the reported factors from Russian sample (Rusalov, 2004). The information about the variance accounted for by the presented solutions in Russian sample is not available.

Factors	1	2	3	4	1	2	3	4
	Canadians *N*= 821				Can-Polish *N*= 51			
ERM	.11	.09	.86*	-.08	.84*	-.05	-.11	.11
PLM	-.16	.00	.68*	.36	.77*	.07	.39	-.07
TMM	.05	.33	.79*	.09	.77*	.04	.16	.30
ERI	.10	-.07	-.12	.80*	.06	-.12	.79*	.03
PLI	.03	.15	.20	.77*	-.05	-.06	.85*	.08
TMI	.15	.26	.17	.71*	.38	-.05	.68*	.04
ERS	.14	.81*	.18	-.04	.37	-.09	-.06	.79*
PLS	-.20	.76*	.12	.11	.36	.24	.06	.68*
TMS	.15	.78*	.06	.22	-.18	.05	.14	.85*
EMM	-.84*	-.08	.17	-.02	.13	.87*	-.04	.00
EMI	-.82*	.04	-.03	-.08	.01	.84*	-.27	.13
EMS	-.80*	-.05	-.17	-.15	-.11	.88*	.03	.03
Eigv	2.18	2.07	2.00	1.97	2.38	2.35	2.10	1.94
Var	.18	.17	.17	.16	.20	.20	.17	.16
	Can-Urdu *N*= 187				Russian *N*= 1937			
ERM	-.03	.87*	.02	.00	.00	.03	.89*	.02
PLM	.14	.75*	-.01	.30	-.05	.06	.78*	.16
TMM	.03	.76*	.37	.07	-.10	.30	.77	.23
ERI	.07	.03	-.07	.87*	-.13	-.1	.07	.87*
PLI	-.10	.36	.30	.53*	-.23	.27	.17	.68*
TMI	-.25	.17	.35	.72*	-.05	.26	.12	.69*
ERS	-.23	.19	.81*	.04	-.15	.87*	.20	-.1
PLS	.36	.17	.69*	.00	.00	.85*	.05	.07
TMS	-.23	-.07	.76*	.35	-.14	.71*	.20	.31
EMM	.88*	.16	-.14	-.08	.83*	.12	-.0	-.1
EMI	.86*	-.03	.02	.00	.88*	-.1	.0	-.1
EMS	.86*	-.03	-.06	-.08	.85*	-.1	-.1	-.0
Eigv	2.57	2.15	2.07	1.79				
Var	.21	.18	.17	.15				
	Chinese *N*= 161							
ERM	-.02	.16	.13	.88*				
PLM	.43	.12	.11	.61*				
TMM	.46	.04	.22	.69*				
ERI	.85*	-.08	-.02	.07				
PLI	.83*	.02	.08	.22				
TMI	.84*	-.01	.22	.14				
ERS	-.13	-.06	.84*	.05				
PLS	.25	.24	.74*	.15				
TMS	.33	-.16	.69*	.29				
EMM	-.06	.89*	-.04	.10				
EMI	-.10	.85*	-.08	.09				
EMS	.10	.83*	.14	.06				
Eigv	2.71	2.35	1.87	1.82				
Var	.23	.20	.16	.15				

* Significant structure coefficients (p <0.01).
Var: Explained variance.

Table 4. The fit indices from Confirmatory Factor Analysis conducted separately for each sample and in multi-group CFA.

Fit Indices	Canadian	Chinese	Urdu	Polish	Multigroup FA
"Arousal" model with uncorrelated residuals, 4 correlated factors					
χ^2	1967.03	474.26	626.15	174.78	3446.26
Df	55	55	55	55	219
χ^2/df	35.76	8.62	11.38	3.18	15.74
SRMR	.174	.175	.207	.191	1.32
CFI_{SB}	.348	.425	.285	.346	.277 (PGI)
$RMSEA_{SB}$	.22 (.21–.23)	.23 (.21–.25)	.25 (.24–.27)	.20(.17–.24)	.54 (.53–.55)
STQ model with uncorrelated residuals, correlated factors (Fig. 3)					
χ^2	480.62	112.26	169.45	60.25	1486.66
Df	49	51	51	48	207
χ^2/df	9.81	2.20	3.32	1.26	7.18
SRMR	.077	.10	.101	.091	.122
CFI_{SB}	.853	.916	.852	.840	.849 (PGI)
$RMSEA_{SB}$	.10 (.09–.11)	.08 (.06–.10)	.11 (.09–.13)	.07 (0 –.12)	.15 (.14–.16)
STQ-r model with six correlated residuals, correlated factors (Fig. 3)					
χ^2	286.33	71.68	104.49	47.89	552.92
Df	43	45	46	42	178
χ^2/df	6.66	1.59	2.27	1.14	3.11
SRMR	.059	.073	.070	.077	.079
CFI_{SB}	.917	.963	.927	.968	.955 (PGI)
$RMSEA_{SB}$	.08 (.07–.09)	.06 (.03–.08)	.08 (.06–.10)	.06 (0 –.11)	.08 (.07–.09)

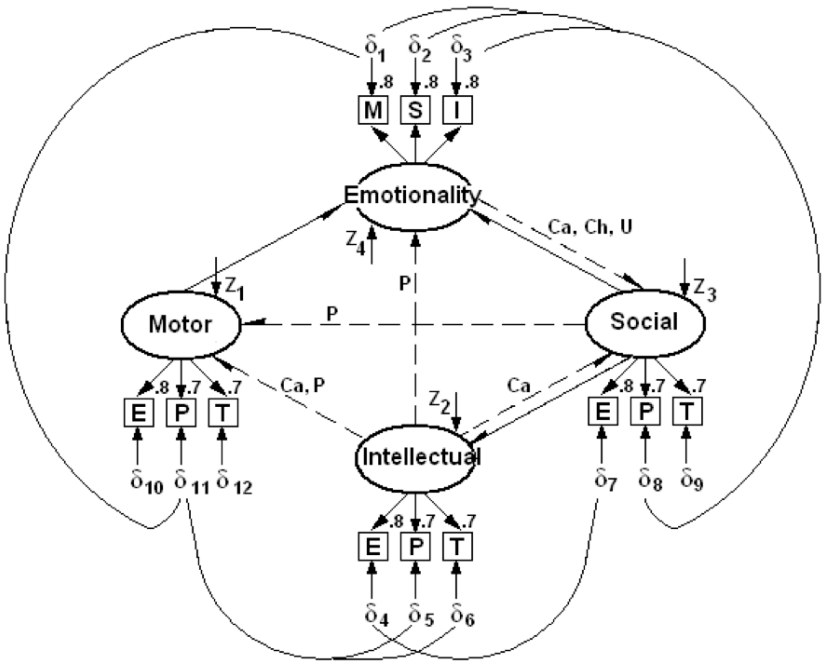
SRMR: Standardized Root Mean Square Residual; CFI: Comparative Fit Index; RMSEA: Root Mean Square Error Approximation; PGI: Population Gamma Index; df: degree of freedom.

in multi-group CFA), which can be explained by the size of the Canadian sample. As noted by Thompson and Daniel (1996), large sample sizes artificially inflate chi-square-to-degrees-of-freedom values (p. 204).

In all four samples the correlation between Emotionality and Social Activity factors, the impact of Social Activity on Intellectual Activity, and Motor Activity on Emotionality, were elements of the STQ and STQ-r models. The differences between samples were found only in the impact of the Intellectual Activity factor on Emotionality (in Polish sample only), on Motor Activity (in Canadian sample only), and the impact of Social Activity on Motor Activity (Polish sample only) (Figure 3).

Discussion

It is impossible to "wash out" the influence of culture on meaning attribution during the presentation of any test statements, as the perception of even the simplest figures or the performance of simple acts is affected by human experience. Therefore it is impossible to completely separate the dynamical and content components of human performance. If, however, the test focuses only on the dynamical and universal properties of activity, this helps to simplify the challenging task of gathering data from various



1. Emot → EMM
2. Emot → EMI
3. Emot → EMS
4. Social→ERS
5. Social→PLS
6. Social→TMS
7. Intel → ERI
8. Intel → PLI
9. Intel → TMI
10. Motor→ERM
11. Motor→PLM
12. Motor→TMM
13. δ1→EMM
14. δ2→EMI
15. δ3→EMS
16. δ4→ERI
17. δ5→PLI
18. δ6→TMI
19. δ7→ERS
20. δ8→PLS
21. δ9→TMS
22. δ10→ERM
23. δ11→PLM
24. δ12→TMM (P)
25. Social → Emot
26. Social → Intel
27. Motor → Emot
28. Intel → Motor (Ca, P)
29. Intel→Social (Ca) or Intel→Emot (P)
30. Emot → Social (C, Ch, U) or Social →Motor (P)
31. δ1--δ8
32. δ2--δ8
33. δ3--δ8
34. δ7--δ4
35. δ11--δ5 (C, Ch, U) or δ11--δ6 (P)
36. δ11--δ1 (C, Ch, U) or δ11--δ9 (P)

Figure 3. The STQ-r Model with a list of parameters used in the Confirmatory Factor Analysis. Solid lines indicate relations common for all samples, dash lines indicate relations present only in the given sample. Deltas and zetas represent latent residual variables.

cultures and the cross-cultural adaptation of the test. The analysis of the psychometric properties of the English, Chinese, Urdu and Polish versions of the STQ tested on corresponding samples showed results similar to those obtained from Russian samples using the STQ-R, showing overall a satisfying level of internal consistency and item-total correlations. However more work can be done to improve the English, Chinese, Urdu and Polish versions. Eight out of 150 items of the STQ consistently showed medium to low item-total correlation (in at least 3 out of 4 samples), which constitute 5% of

the test, and its elimination or the development of alternatives for those items might improve the internal consistency of the STQ scales.

The samples under study had different gender ratios, therefore the comparison of sample means by gender groups was more appropriate than the comparison of means of the whole samples. In spite of the high scores of the Polish sample, the small size of the Polish sample had a negative impact on the significance of differences between the Polish sample and the three other samples, i.e. the differences were not as significant as they seem. Significant differences between cultures were found for Chinese versus Canadian and for Chinese versus Polish samples. Cultural expectations and attitudes which dictate that the subjects choose a negative or positive impression bias in responses might be the factor lowering the means on the Motor and Intellectual Activity scales of the STQ in the Chinese sample. Chinese culture promotes more reasoning, more well-thought out and well-regulated behaviour, while Canadian culture promotes socially active and tempo-oriented behaviour. In Chinese culture, modesty is a very important requirement in behaviour, possibly creating a negative response bias in testing, more so in women (who are more sensitive to social expectations) than men. In Canadian and Polish cultures this is not an issue. These differences prove the importance of having norms for each culture in which the Structure of Temperament Questionnaire is to be administered. It also opens a way for emic considerations in the development of Chinese versions of self-reporting measures.

Exploration of several models of temperament using STQ scales in four cultures showed consistency of the activity-specific model and the worst fit for the model of the general arousal. In the STQ model it was hypothesized that temperament traits are structured by the specifics of activities (i.e. traits related to physical activity are independent of traits related to social activity and to intellectual activity) rather than by general arousal, general mobility and lability factors. The best fit model for all four samples had the scales of Motor Ergonicity, Motor Plasticity and Motor Tempo unified in the factor of Motor Activity, the scales of Social Ergonicity, Social Plasticity and Social Tempo unified in the factor of Social Activity, with the factor of Intellectual Activity including the scales of Intellectual Ergonicity, Intellectual Plasticity and Intellectual Tempo. This structure was in agreement with the latent structure analysis of the Russian language version (Rusalov, 1997, 2004) and with the factor analysis of the 8-scales English version conducted on an Australian sample (Stough, Brebner, & Cooper, 1991) and three studies done with American samples (Bishop, Jacks, & Tandy, 1993; Bishop & Hertenstrein, 2004; Demenci, 1996). This structure also supports the common understanding that if a person is able to sustain intensive and/or long physical work this does not necessarily mean that the same person is capable of long and/or intense conversation -exactly this separation between the two types of performance was missing in some concepts of Extraversion.

The results also confirm the validity of the traditional distinction between emotionality (as types of reaction to events) and dynamical characteristics of activity (as types or styles of action). Three Emotionality scales did not join the factors related to the types of activity, and instead formed one stable factor of Emotionality, understood as sensitivity of the individual to failure and success. The classic distinction between

Activity and Emotionality has been supported over the years by the discovery of the role of the limbic and hormonal systems in the regulation of behaviour. Intellectual activity is also often considered as a regulatory system based on the activity of neocortical areas of the brain. Two regulatory systems, emotional-limbic-hormonal and intellectual-neocortical, organize, control and regulate the actual performance of individual motor and social acts. The Activity-Emotionality pair is common in the general arousal models of temperament presented as Extraversion-Neuroticism (Eysenck, 1968), Big Five model (Costa & McCrae, 1992), BAS-BIS systems (Gray, 1970), or as Strength of Excitation-Balance in the set of Pavlovian models (Strelau, 1999; Teplov & Nebylytzin, 1963). The further development of such two-factor models might benefit from consideration of the fact that human beings in all cultures have developed communicative, mental and physical activities to such a level that they require different regulatory systems. Thus it is reasonable to expect that human temperament traits related to the dynamical aspects of Activity should have different arousal and lability controls for performance in three functionally different areas of activity.

In CFI modeling, in all four samples, having correlations between the named factors and six correlations between residuals improved the fitness of the model. This shows that a model with a clear cut between the three types of activities would be rather extreme, and there are issues concerning the common nature of these activities which should be considered. The correlation between the Social Activity factor and Emotionality, with corresponding correlated residuals is likely a reflection of the role which emotionality plays in social life, and also the role of social events on the emotional state of a person. The interaction between the social and intellectual aspects of activity appeared in this model as an impact of the Social Activity factor on the Intellectual Activity factor, with correlated residuals between the Social and Intellectual Ergonicity scales, which were universal for all four samples. Differences between the four samples in inter-correlation between factors might indicate a stronger control of the factor of Intellectual Activity over Motor and Social Activity in Canadian and Polish cultures, and intellectual control over emotionality in Polish culture.

The small size of the Polish sample and the fact that Polish and Urdu subjects were tested in Canada, and not in the country of their origin, are the limitations of this study. To compensate for the differences in sample sizes, Scheffe test and Unequal samples HSD test were used in order to assess the cross-cultural differences. The fact that the Polish and Urdu subjects in our study had very limited English skills and were not integrated into Canadian culture suggested that the cultures of origin had a bigger impact on the responses of these subjects than did Canadian culture.

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