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Internal and external validation of the Bortner Type A behaviour scale

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Numerous promising relations with the pathogenesis of coronary heart disease (CHD) have been made the by Bortner scale, one of the most widespread measures of Type A behaviour pattern (TABP). However, some psychometric studies, particularly those examining its reliability, dimensionality and validity, expressed relatively low promises about its applicability. First, we tried to determine the external validity of the Bortner scale as an unidimensional measure of TABP. The relationship was assessed between some possible causes of CHD and the unidimensional underlying construct of TABP measured by the Bortner scale. The prediction of CHD was shown to be poor. Then, the internal validity of the Bortner scale was analysed. The psychometric properties of the unidimensional scale were unexpectedly low. Instead, a more relevant two-factor solution was confirmed, with the first factor identified as *Speed* and the second as *Competitiveness*. In the last step, the initial model was scrutinized with the Bortner scale as a two-dimensional measure of TABP showing considerable improvement. It was shown that the questionnaire should not be used as a measure of TABP in its present form. The use of the questionnaire is justifiable only as a two-dimensional scale and with the precaution that it should be used only as a measure of some specific components of TABP. Therefore, the Bortner scale should be applied in TABP assessment only in combination with one or more other measures that might explain also other TABP dimensions not covered by the Bortner scale.

There is considerable evidence from correlation studies supporting an important relationship between the pathogenesis, various risk factors, and development of coronary heart disease (CHD), coronary artery disease or stroke, and diverse psycho-social constructs, such as the Type A behaviour pattern (TABP). TABP is an epidemiological construct characterizing cardiac patients. It has been described as an action-emotion complex that can be observed in any person who is aggressively involved in a chronic, incessant struggle to achieve 'more and more in less and less time ...' (Friedman & Rosenman, 1959, 1974). The main manifestations of this internal complex are 'explosive, accelerated speech, a heightened pace of living, impatience with slowness, concentrating in more than one activity at a time, self-preoccupation, dissatisfaction with life, a tendency to challenge and compete with others even in non-competitive situations ...' (Matthews, 1982, p. 293). This kind of behaviour usually expresses enhanced anger or aggressiveness, easily aroused hostility, hard driving competitiveness, a sense of time urgency, acquisition of material goods, achievement striving, etc. (Friedman & Rosenman,1974). As Matthews (1982) says, 'TABP is not considered to be a trait. Rather it is a set of overt behaviours that is elicited from susceptible individuals by an appropriately challenging environment. The Type A pattern is also not considered to be a discrete typology. Rather, it is thought to be a continuum of behaviours ranging from extreme Type A to extreme non-Type A or Type B' (p. 293).

The role of TABP in the development of certain psychophysiological, physiological, and physical symptoms concerning cardiovascular system has been a subject of numerous studies in the past ten years (e.g. Bass & Akhras, 1987; Friedman & Booth-Kewley, 1987, 1988; Hinton, Rotheiler, Gemmell & Shewan, 1991; Sausen, Lovallo & Wilson, 1991). Still, the nature of the causal relations between TABP and CHD remains unclear to some extent. Most recently some studies confirmed a direct causal impact of type A behaviour (in connection with job stress) on (poor) physical health (Cooper, Kircaldy & Brown, 1994; Russo & Zuckerman, 1992), but some meta-analyses (i.e., Friedman & Booth-Kewley, 1987; Matthews, 1988) found that prospective studies of TABP support a link with CHD only for certain measures (particularly the structured interview), and more recent studies suggest that anger and hostility are probably responsible for the link between TABP and CHD. Therefore although prospective studies provide strong evidence for causality, this evidence is not unambi-

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guous, because respondents cannot be randomly assigned to experimental conditions in TABP research.

Although the results of various studies are not always consistent, it was shown that TABP is correlated with the prevalence, incidence and some indices of CHD, such as hypertension (Julius & Cottier, 1983; Rosenman, 1987; Russo & Zuckerman, 1992; Waldstein, Manuck, Ryan & Muldoon, 1991), angina pectoris (French-Belgian Collaborative Group, 1982), arteriosclerosis (Cottier, Adler, Vorkauf, Gerber, Hefer & Hurny, 1983), myocardial infarction (French-Belgian Collaborative Group, 1982), and some other cardiovascular reflections (Abbott, Sutherland & Watt, 1987; Booth-Kewley & Friedman, 1987; Edguer & Janisse, 1994; Ghulam, Gupta, Bandyopadhyaya & Mishra, 1990; Sausen et al., 1991; Svebak, Knardahl, Nordby & Aakvaag, 1992). TABP as a psychological construct was also shown to be correlated with various other physiological and psychophysiological responses (Hinton et al., 1991; Lundberg, Rasch & Westermark, 1990; Morell, 1989; Salmon, Pearce, Smith, Manyande, Heys, Peters & Rashid, 1989; Suls & Wan, 1989; Van Egeren, Fabrega & Thornton, 1983; Walsh, Eysenck, Wilding & Valentine, 1994; Wrzesniewski, Wonicki & Turlejski, 1988).

A number of TABP measures have been developed in the last thirty years: The Jenkins Activity Survey (Jenkins, Zyzanski & Rosenman, 1978), the Framingham scale (Haynes, Feinlieb & Kannel, 1980), the Eysenck Type A questionnaire (Eysenck & Fulker, 1983), the Bortner scale (Bortner, 1969) and many others. Almost all of them are of the 'self-report' type, with only one exception - the Structured Interview (Rosenman, 1987). In spite of a broad application of these instruments, the confusion about their reliability and different faces of internal (i.e. content and construct) and external (concurrent and predictive) validity remains. The main unsolved question is whether (*i*) different instruments measure the same unidimensional underlying factor, TABP, or (*ii*) the TABP has a multidimensional structure, so that certain instruments assess only some particular facets of this construct. Further more, some studies (Edwards, Baglioni & Cooper, 1990b; Eysenck & Fulker, 1983; Friedman & Rosenman, 1974; Matthews, 1982) argue against unidimensional nature of TABP.

Hitherto, the psychometric properties of the Bortner scale as a TABP measure are not sufficiently, satisfactorily and clearly stated. This particularly concerns its factorial structure (internal validity), or dimensionality, and its external validity, regarding some possible indicators and causes - or rather predictors - of CHD. There are at least three reasons for studying the Bortner scale in more detail. First, it has been used frequently in practice in the last few years (Abbott et al., 1987; Adams-Campbell, Washburn & Haile, 1990; Dishman, Graham, Holly & Tieman, 1991; Gallacher, Beswick, Jones & Turkington, 1988; Ghulam et al., 1990; Lundberg et al., 1990; Missoum, Boudard & Rouchon, 1986; Oyefeso & Odeyale, 1991; Pfiffner, Lanfranconi, Nill & Buzzi, 1989; Rotheiler, Hinton, Richter & Bell, 1993; Suls & Wan, 1989; Walsh et al., 1994; White & Nias, 1994). Second, not many studies evaluating the psychometric properties of this and similar scales have been conducted (Bass, 1984; Bennett & Carroll, 1989; Edwards & Baglioni, 1991; Edwards, Baglioni & Cooper, 1990a, 1990b; Gallacher & Smith, 1989; Mayes, Sime & Ganster, 1984; Raju, Krishnaswamy & Verghese, 1987). Third, the results of different studies are not very consistent. On one side, the Bortner scale has been shown to have both, retrospective (French-Belgian Collaborative group, 1982) and prospective validity (Koskenvuo, Kaprio, Langinvainio, Romo & Sarna, 1981). A comparison of self-report and peer ratings on the scale provided evidence supporting its validity (White & Nias, 1994). It was claimed that 'Bortner scale ... is a good tool to assess the coronary-prone behaviour pattern in epidemiological surveys' (French-Belgian Collaborative group, 1982, p. 31) and that it provided a robust measure which was little affected by response rate, age, sex or adaptations of the scale (Gallacher & Smith, 1989). Moreover, it was shown that test-retest reliability, interrater reliability, and concurrent validity were satisfactory. So, it appeared to be useful for discriminating patients with CHD from normals (Raju et al., 1987). In general, as Furnham, Hillard, and Brewin (1985) said, 'It appears to be a fairly well-used, reliable (r_{tt}=0.68), and valid instrument' (p. 43). On the other side, unfortunately, some other studies expressed just the opposite findings. Bass (1984), Byrne, Rosenman, Schiller & Chesney (1985), Flanery & Bowen (1986), and O'Looney & Harding (1985) stated that diverse TABP questionnaires do not measure the same phenomenon and that the unitary nature of TABP must be questioned. Bass and Akhras (1987) have found that the Bortner scale is psychometrically impure and has doubtful validity. Bennett and Carroll (1989) have also shown that problems linked with the use of different measures of TABP (among which was the Bortner scale) include differing conceptualisations of TABP and equivocal criteria of assessment. Our own studies of some psychometric properties of the scale (Brenk, Bucik & Moravec-Berger, 1993; Bucik, Brenk & Vodopivec, 1993, 1994) threw doubt upon applicability of the scale in its present form.

The most precise and comprehensive psychometric analysis of the Bortner scale was made by Edwards and his colleagues, using data from 1320 working adults divided into three random samples (Edwards et al., 1990a - see also Edwards et al., 1990b; Edwards & Baglioni, 1991). Some information on the 'case history' of the scale (including its development, reliability, dimensionality, and validity) is also presented in their introduction. Then, they examined its reliability, dimensionality and validity, using both exploratory and confirmatory factor analyses. Through inter-

nal and external validation (regarding four criteria, *viz.* anxiety, depression, somatic symptoms, and job satisfaction) they found that the reliability of the Bortner scale as a unidimensional scale falls far below typical standards for self-report measures and that it contains two distinct, independent dimensions, one representing *speed* and the other representing *competitiveness*. They expressed concern about using the Bortner scale in its present form as a measure of the multidimensional TABP; for it was shown to be only a measure of specific TABP components. This study covered no '... hard measures of cardiovascular functioning, which constitute the most relevant criteria regarding the concurrent and predictive validity of TABP measures' (Edwards et al., 1990a, p. 328). The Edwards and Baglioni (1991) study, which examined the original and two-factor Bortner Scale, included measures of CHD risk factors (serum cholesterol, blood pressure, heart rate) and self-report measures of anxiety, depression, somatic symptoms and angina, but not the clinical manifestations of CHD. We tried to cover some white spots in the external validity of the Bortner scale by including some additional external criteria - possible predictors and indicators of CHD to check some other aspects of its validity. We tried to follow the methodology used by Edwards and his colleagues as much as possible in order to reach a fair possibility to compare and complement the results.

The aim of the present study was to reanalyse some psychometric properties of the Bortner Type A Behaviour Pattern scale, especially its internal structure and the strength and directions of its relations to some external criteria such as various predictors and indicators of CHD, which were not used in previous studies.

METHOD

Participants

The sample consisted of 743 adults (58 percent female) aged from 19 to 89 years ($M = 49.57$, $SD = 17.82$). Data were collected during regular systematic medical examinations in 1991 and 1992 at the general practitioners office. The sample embodied presumable helthy ordinary people. The participants were not selected according to any criteria on suffering from some kind of acute or cronic disease.

Measures

The Slovenian version (Brenk, Bucik & Moravec-Berger, 1993) of the 14-item Bortner scale (Bortner, 1969) was administered to all respondents immediately after the medical examination. Respondents were asked to cross one of the 24 squares between bipolar traits, according to their personal opinion about themselves[1]. The final score reflecting TABP represents the sum of responses on all 14 items. Therefore, the maximum score - which means the extreme Type A behaviour pattern - was 336, and the lowest score possible - meaning the extreme Type B behaviour pattern - was 14. The TABP, representing side of the bipolar traits is referred to in the scale with the following attributes: 1. Never late (-)[2]; 2. Competitive; 3. Anticipate (-); 4. Rushed (-); 5. Impatient; 6. Goes all out (-); 7. Does lots at once; 8. Forceful (-); 9. Wants job recognized (-); 10. Fast (-); 11. Hard-driving; 12. Expresses feelings; 13. No outside interests; 14. Ambitious.

During the medical examination the estimates of possible indicators and predictors of CHD were measured or registered in a laboratory, and some anamnestic information were gathered by a short questionnaire (e.g. age, family anamnesis, 'bad habits', medicament consumption, salt consumption, state of health etc.). The description, labels, and values of these variables are briefly represented in table 1.

Procedures

Scrutinizing the validity and the dimensional structure of the Bortner scale was performed in the following steps:

(i) External validity of the Bortner scale as an *unidimensional congeneric measure* of TABP (each item measures the same dimension), under the supposition of τ-equivalence (each item contributes the same amount of information to the final score on that particular dimension), and without τ-equivalence. The Bortner factor model was tested for τ-equivalence because the scale is being used in practice just as a τ–equivalent measure, that is each item is supposed to contribute to TABP in a similar extent.

(ii) Exploratory and confirmatory analysis - exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) - of the *dimensionality* of the Bortner scale itself (CFA of unidimensional scale with and without τ-equivalence; EFA of the structure of the scale; CFA of the two-dimensional scale - congeneric model; CFA of the two-dimensional final - noncongeneric model).

[1] In this respect our version differs slightly from that in Edwards et al. (1990b) study, in which they used a numerical response format centered at zero ascending to five in both directions.

[2] The items marked with (-) signs are actually reversed in the scale (i.e. 'Always late' for item 1).

(iii) Validity of the Bortner scale as a *two-dimensional noncongeneric measure* of TABP.

RESULTS

Basic Statistics

Table 2 displays the basic descriptive statistics of the individual items in the Bortner scale and Table 3 presents the summary statistics for the TABP scale.

Table 4 displays the descriptive statistics for the selected possible indicators and causes of coronary heart disease.

The dispersion of individual data in some items in the Bortner scale and in a more extensive way in other measured variables do not fit the normal distribution very well. Therefore, it was not easy to decide which method of parameter estimation for confirmatory validation of different models should be used in our analysis: one from the group of methods based on the presumption of a normal distribution of the data, such as Maximum Likelihood (ML) estimation, or some other method which does not need to meet this requirement. The second alternative was used, namely

Table 1

The description of possible indicators and causes of CHD, used in the study

possible indicators of CHD		
	name	description
#[a]	PULS	pulse rate in rest
#	SYSTOL	systolic blood pressure in rest
#	DIASTOL	diastolic blood pressure in rest
#	SEDIMEN	laboratory findings (urine) - sedimentation
#	ALBUMIN	laboratory findings (urine) - albumins
*[b]	PRESSUR	family anamnesis - higher blood pressure (0 - *not present*, 1 - *present*)
*	C_ATERO	family anamnesis - cerebral arteriosclerosis (0 - *not present*, 1 - *present*)
*	APOPLEX	family anamnesis - apoplexy of the brain (0 - *not present*, 1 - *present*)
possible predictors of CHD		
	name	description
#	AGE	age in years
*	DETECT	combined measure of the detection of appearance of one or more following diseases: arterial hypertension, diabetes, angina pectoris, myocardial infarction, peripheral angiopathy, cerebral atherosclerosis
*	HEART	presence of the symptoms of heart diseases (0 - *not present*, 1- *present*)
*	VEINAGE	presence of the symptoms of peripheral veinage disease (0 - *not present*, 1 - *present*)
#	WEIGHT	anthropometry - body weight
#	HEIGHT	anthropometry - body height
#	PERIUPP	anthropometry - upper arm perimeter
#	PERIWRI	anthropometry - wrist perimeter
#	GLUCOSE	laboratory findings (blood) - glucose
#	TRIGLIC	laboratory findings (blood) - triglicerides
#	CHOLEST	laboratory findings (blood) - cholesterol
*	SALT	salt consumption (1 - *few*, 2 - *medium*, 3 - *a lot*)
*	FEELING	subjective state of health (1 - *very bad*, 2 - *bad*, 3 - *good*, 4 - *very good*)
*	SMOKING	'bad habits' - smoking (1 - *never*, 2- *stopped*, 3 - *1-5 per day*, 4 - *6-20 per day*, 5 - *more than 20 per day*)
*	ALCOHOL	'bad habits' - alcohol consumption (1 - *no*, 2 - *rare*, 3 - *occasional*, 4 - *often inebriated*, 5 - *often intensively inebriated*)
*	ANALGET	medicament consumption - analgetics (0 - *no*, 1 - *yes*)
*	PSYCFAR	medicament consumption - psychopharmacs (0 - *no*, 1 - *yes*)

[a] Continuous variable
[b] Categorical variable

Table 2

Descriptive statistics for items - attributes included in the Bortner scale

Items	*M*	*SD*	Kurtosis	Skewness
01 (-)	19.02	5.41	1.40	-1.40
02	10.45	6.59	-0.88	0.26
03 (-)	9.72	6.44	-0.73	0.51
04 (-)	15.50	6.18	-0.38	-0.57
05	8.31	6.26	-0.34	0.77
06 (-)	18.57	4.47	1.63	-1.06
07	10.85	7.40	-1.32	0.23
08 (-)	11.14	6.78	-1.11	0.21
09 (-)	14.83	6.99	-0.97	-0.46
10 (-)	17.21	5.83	0.21	-0.92
11	12.11	6.86	-1.13	0.01
12	11.92	7.00	-1.18	0.16
13	8.18	6.46	-0.12	0.94
14	7.22	5.76	0.03	0.92

Note: The values of items marked with (-) are already converted so that higher values always represent TABP. The smallest possible value on each item was 0 and the largest was 24. See the text for the explanation of items.

the Weighted Least Square estimate (WLS), which is asymptotically distribution free and which uses the input matrix of polychoric or polyserial correlations of ordinal or censored variables and the asymptotic covariance matrix as a weight matrix. Both can be computed with PRELIS2 and prepared as a LISREL8 input (Jöreskog & Sörbom, 1993b; see also Jöreskog & Sörbom, 1993a).

External Validation - Unidimensional Scale

The external validation of the Bortner scale in its present form was established by using the LISREL 8 methodology of testing the degree of fitting of the proposed theoretical model to the data. The Bortner scale was considered (i) a unidimensional congeneric measure of TABP and (ii)

Table 3

Summary statistics for the Bortner scale

Statistics	*M*	*SD*	No. of variables
scale	175.24	29.19	14
	Mean	**Max.**	**Variance**
Item Mean	12.52	19.04	15.20
Item Variance	40.27	54.69	84.80
Inter-item correlation	0.04	0.38	0.01

Table 4

Descriptive statistics for possible detectors and causes of coronary heart disease

Variables	*M*	*SD*	Kurtosis	Skewness	Min	Max
PULS	75.04	10.53	1.05	0.68	48	120
SYSTOL	140.85	20.66	0.50	0.73	95	215
DIASTOL	80.13	9.69	0.41	0.22	50	120
SEDIMEN	0.05	0.24	50.02	6.33	0	3
ALBUMIN	0.02	0.20	112.86	10.14	0	3
PRESSUR	1.95	0.88	-1.71	0.10	1	3
C_ATERO	1.38	0.73	0.76	1.59	1	3
APOPLEX	1.49	0.82	-0.44	1.20	1	3
AGE	49.55	17.77	-1.03	0.20	19	93
DETECT	0.39	0.69	5.15	2.07	0	5
HEART	0.15	0.36	1.72	1.93	0	1
VEINAGE	0.09	0.29	6.08	2.84	0	1
WEIGHT	75.32	12.87	0.29	0.39	46	138
HEIGHT	168.02	9.15	-0.20	0.01	140	195
PERIUPP	29.15	3.15	0.59	0.15	19	44
PERIWRI	17.49	1.41	0.11	0.23	14	23
GLUCOSE	3.22	2.58	0.59	0.23	0	16.3
TRIGLIC	1.14	1.63	16.74	3.24	0	15.6
CHOLEST	4.04	2.76	-0.92	-0.33	0	11.8
SALT	1.60	0.56	-0.87	0.22	1	3
FEELING	2.87	0.55	1.33	-0.52	1	4
SMOKING	1.70	1.18	0.45	1.40	1	5
ALCOHOL	1.32	1.22	-1.10	0.39	0	4
ANALGET	0.28	0.45	-1.07	0.97	0	1
PSYCFAR	0.11	0.31	4.68	2.58	0	1

Note: PULS = pulse rate in rest; SYSTOL = systolic blood pressure in rest, DIASTOL = diastolic blood pressure in rest; SEDIMEN = sedimentation; ALBUMIN = albumins; PRESSUR = higher blood pressure; C_ATERO = cerebral arteriosclerosis; APOPLEX = apoplexy of the brain; AGE = age in years; DETECT = combined measure of the detection of appearance of one or more diseases; HEART = symptoms of heart diseases; VEINAGE = symptoms of peripheral veinage disease; WEIGHT = body weight; HEIGHT = body height; PERIUPP = upper arm perimeter; PERIWRI = wrist perimeter; GLUCOSE = glucose; TRIGLIC = triglicerides; CHOLEST = cholesterol; SALT = salt consumption; FEELING = subjective state of health; SMOKING = smoking; ALCOHOL = alcohol consumption; ANALGET = analgetics; PSYCFAR = psychopharmacs (see Table 1 for the details).

τ-equivalent measure of TABP. That means, first, that each item measures the same latent construct and second, that each item was constrained to contribute the same amount of information to the final score on that particular construct, that is all items are loaded equally on the latent construct (Jöreskog, 1971; Jöreskog & Sörbom, 1993a). The model failed to fit even after many iterations (150), so it was not possible to obtain a solution. Figure 1 shows the model without τ-equivalence supposition - all fourteen items were free to vary.

In the presented model the CHD construct was conceived as an endogenous latent variable, possibly affected by TABP and five other exogenous latent variables, some general possible causes of CHD (CAUSES), anthropometric measures (ANTHR), laboratory blood findings (BLOOD), most common 'bad habits' (HABITS), and possible medicament consumption (DRUGS). The model doesn't fit the data at all. The so-called χ^2/df ratio is far above 1 (3.39). The results of some previous studies relating the psychometric properties of the Bortner scale (Bennett & Carroll, 1989; Edwards et al., 1990a, 1990b; Edwards & Baglioni, 1991) led us to the conclusion that one of the most likely causes for such a bad fit could lie in the poor construct validity of the Bortner scale as a unidimensional measure. Therefore, we decided to try to improve the model fit by dropping the assumptions of the unidimensionality of the Bortner scale.

Reliability and Dimensionality of the Botrner Scale

The theoretical model of the Bortner TABP scale as a congeneric unidimensional measure based on the assumption of τ-equivalence (called the Model 1) was examined first, using the confirmatory factor analysis (Jöreskog & Sörbom, 1993a). The overall goodness-of-fit statistics for the model are presented in Table 5. Model 0 in the Table 5 presents the null model of independence among all vari-

ables, which is always compared with a model with *k* common factors when comparing different goodness-of-fit indices between the models.

It is obvious that theoretical speculations are not supported by the data. According to the χ^2 statistic and other goodness-of-fit indices - Root Mean Square Residual (RMSR), Adjusted Goodness of Fit Index (AGFI), and Non-Normed Fit Index (NNFI), out of which the latter two, as compared to the former two, should be relatively independent of the sample size and a number of constrained or free parameters (Anderson & Gerbing, 1984; Bentler & Bonett, 1980; Jöreskog & Sörbom, 1993a; Marsh, Balla & McDonald, 1988; Mulaik, James, Van Alstine, Bennett, Lind & Stillwell, 1989) - the model and, therefore, also the assumption of τ-equivalence should clearly be rejected. Cronbach's alpha (Cronbach, 1951) of the whole Bortner scale was also calculated (α=0.364). It was shown to be even lower than internal consistency coefficients calculated in other studies (ranging from 0.504 to 0.680 - Bortner, 1969; Edwards et al., 1990a, 1990b; Furnham et al., 1985; Mayes, Sime & Ganster, 1984). In addition, the squared multiple correlation coefficients for each of the 14 items in the scale, expressing the reliability of each of them, according to the particular tested model, appeared to be unexpectedly low, ranging from 0.01 to 0.37.

The second step was to test the fit of the model in which the Bortner scale was considered as a congeneric unidimensional measure of TABP without τ-equivalence constraints. Therefore, we didn't constrain the relations between the manifest variables and the latent construct (TABP) to be equal. The overall fit statistics for Model 2 are presented in Table 5. The fitting of the second model is also unsatisfactory in spite of the fact that there is considerable improvement in fitting compared to the previous

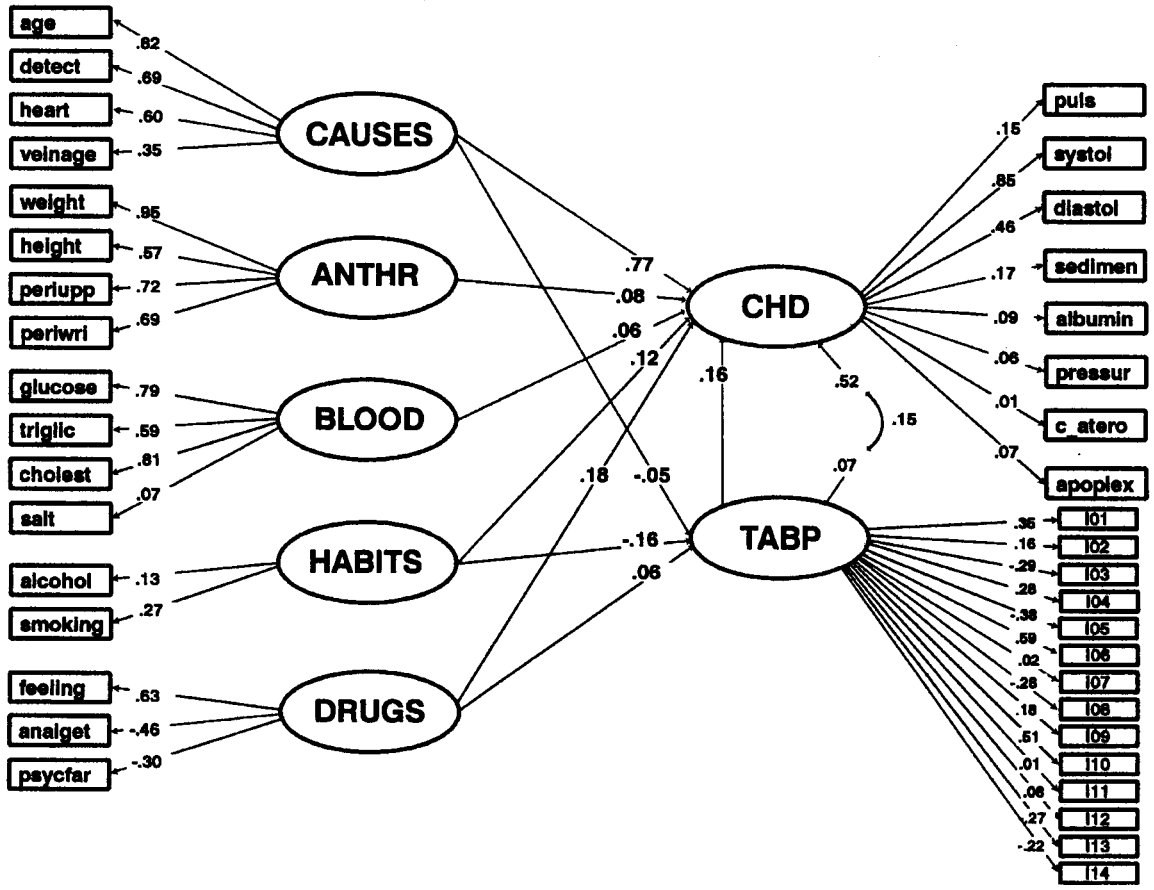

Figure 1. External validation of the Bortner scale as a unidimensional measure of Type A behaviour pattern. χ^2 (df = 683) = 2318.28, p< 0.00; RMSR = 0.101, AGFI = 0.85, NNFI = 0.79. CHD = indicators of coronary heart disease; CAUSES = possible causes or predictors of CHD; ANTHR = anthropometric measures; BLOOD = laboratory blood findings; HABITS = most common "bad habits"; DRUGS = possible medicament consumption and subjective state of health; TABP = unidimensional Bortner scale (standardized solution; see Table 1 for description of manifest variables and Table 5 for explanation of the goodness-of-fit indices; errors of measurement are omitted in the presented model).

Table 5

Summary of goodness-of-fit measures for confirmatory analyses of the internal structure of the Bortner scale with structural equation models

Model	Description	χ^2	*df*	*p*	χ^2/df	RMSR	AGFI	NNFI
0	Null model	946.71	91	.000	10.40	4.70	0.79	-
1	Unidimensional congeneric, τ-equivalent model	857.16	90	.000	9.52	4.41	0.83	0.09
2	Unidimensional congeneric, not τ-equivalent model	569.31	77	.000	7.39	3.75	0.85	0.40
3	Two-dimensional congeneric, τ-equivalent model	703.77	88	.000	7.99	4.12	0.82	0.23
4	Two-dimensional congeneric, not τ-equivalent model	441.49	76	.002	5.81	3.07	0.88	0.53
5	Two-dimensional final model (non-congeneric, not τ-equivalent)	234.74	70	.011	3.35	1.95	0.93	0.75

Note: χ^2/df = the ratio between χ^2 and degrees of freedom; RMSR = Root Mean Square Residual; AGFI = Adjusted Goodness of Fit Index; NNFI = Non-Normed Fit Index

model. It is clear, however, that different items do not load equally on the underlying construct called TABP. The difference between χ^2, obtained with and without τ-equivalence restriction, is 287.85, which is statistically highly significant with 13 (90-77) degrees of freedom. It means that items represent the construct, defined as TABP, to varying degrees and that failure to represent the construct is manifested in an item loadings that are low in an absolute sense. According to our analysis so far, it seems that the Bortner scale does not have a simple unidimensional structure and that we should look into the internal structure of the scale with more attention and exactness.

The exploratory factor analysis, with the Maximum likelihood extraction method and oblique rotation (Norušis, 1988), served as a first tool for testing the multidimensionality hypothesis of the scale.

The combination of two extraction criteria (Cattell's Scree test and Kaiser-Guttman criterion of extracting factors with eigenvalues higher than 1) suggested a two-factor solution, which is presented in Figure 2. It should be noted, however, that both factors explain only 28.7 percent of the total variance, which indicates a weak factor structure. Because of the resemblance of the two-factor solution with previous studies (Edwards et al., 1990a), this structure was tested via confirmatory factor analysis. In the first model (Model 4 in Table 5), the exclusiveness or the congenerity of the structure was presumed. Each manifest variable (item) was supposed to reflect only one construct, the one with which its correlation coefficient was higher according to the factor structure matrix in the two-factor solution. The substantial drop in χ^2 with losing only two degrees of freedom can be observed in fitting the Model 3 to the data (in comparison to Model 1), although the model is still far from being confirmed.

The assumption of τ-equivalence was tested in the two-factor model also. The difference between the χ^2 in fitting the model under τ-equivalence restriction (Model 3 in Table 5) and without it (Model 4 in Table 5) was 262.28, which is highly significant with 12 degrees of freedom. Therefore, as in the one-factor Bortner scale testing, the assumption of τ-equivalence utilised in the application of the Bortner scale as a two-dimensional instrument was also not supported. The two constructs can be interpreted as two dimensions (i.e. Speed and Competitiveness), which is in strong accordance with the outcomes of other studies (Edwards et al., 1990a, 1990b).

To enhance the explanatory strength of the scale, we tried to surmount the assumption of congenerity of the model. According to the height of item loadings on each of the factors in the two-factor solution, obtained in the exploratory factor analysis of the scale, and following the suggestions from modification indices coming out of the congeneric two-factor solution of TABP, the final two-dimensional non-congeneric model of the Bortner scale was proposed (Model 5 in Table 5). The solution is presented in Figure 3.

Comparing the outcomes (goodness-of-fit statistics) of this model with the outcomes of the original unidimen-

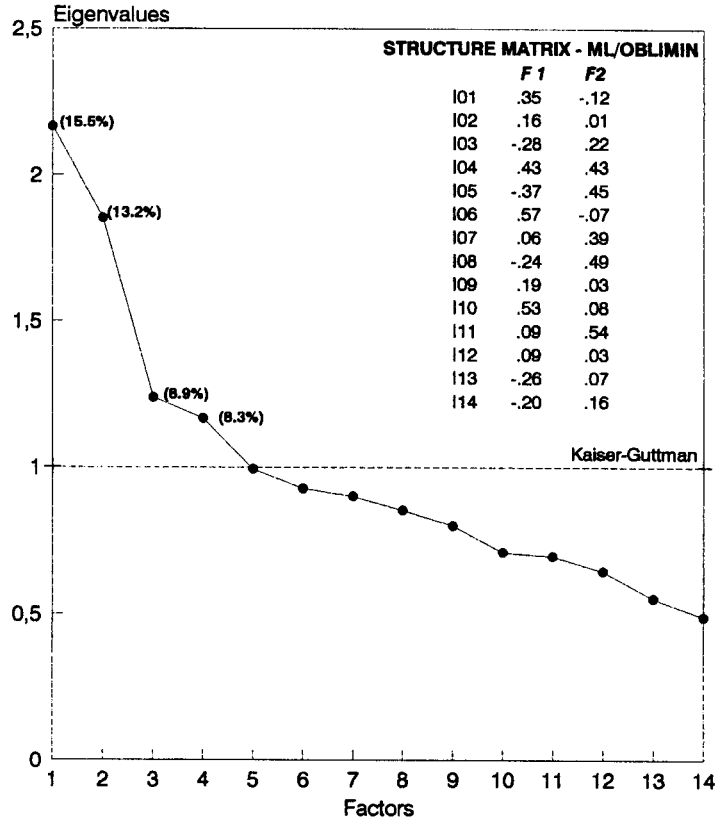

Figure 2. Exploratory factor analysis of the Bortner scale - the combination of Cattell's Scree-test and Kaiser's criterion - and the structure matrix with factor loadings on each factor. Numbers in parenthesis represent the percent of total variance explained by each factor.

sional τ-equivalent model of the Bortner scale, as presently being used as a measure of TABP, it is clear that the Bortner scale is an instrument which helps us to cover only some (namely, two) parts of the multidimensional TABP construct and not a distinct independent unidimensional construct. However, it should be noted again that the model is still not confirmed in a fully satisfying way. But in spite of that, one could describe a typical person with high score on the first dimension of the model (Speed), in terms of 14 items, as being fast, going all out, patient but always rushing and never late. A person with high score on Competitiveness tends to be hard driving, forceful, rushing, trying to do lots at once, impatient, etc. It can be concluded that the Bortner scale should be used only as a two-dimensional measure, with particular items weighting differently on each of the two constructs or dimensions. It should be noted, however, that items that load on two factors are conceptually ambiguous, because they are not determined by a single underlying factor; they will hardly achieve discriminant validity, because by construction the factors have similar manifestations. In such cases it is often advisable to delete items that appear to represent multiple factors rather than allowing them to load on the factors. But this suggestion can only be accepted when one has a large number of items, representing the construct(s), so in further analysis we remain with the Bortner scale as a two-dimensional noncongeneric and not τ-equivalent measure.

External Validation - Two-Dimensional Scale (Reestimation)

Considering the better fitting in checking the models of the Bortner scale as a measure of two dimensions of TABP, it seemed interesting to reestimate the initial model of the external validation of the scale, but this time with the Bortner scale as a two-dimensional noncongeneric measure of TABP, and to observe if there is any improvement in the model fitting compared to the model in Figure 1. This model is presented in Figure 4. The calculations of final scores on the Speed and Competitiveness factors in the Bortner scale were performed in accordance to the appertenance and loadings of items on both constructs as being calculated in the Model 5.

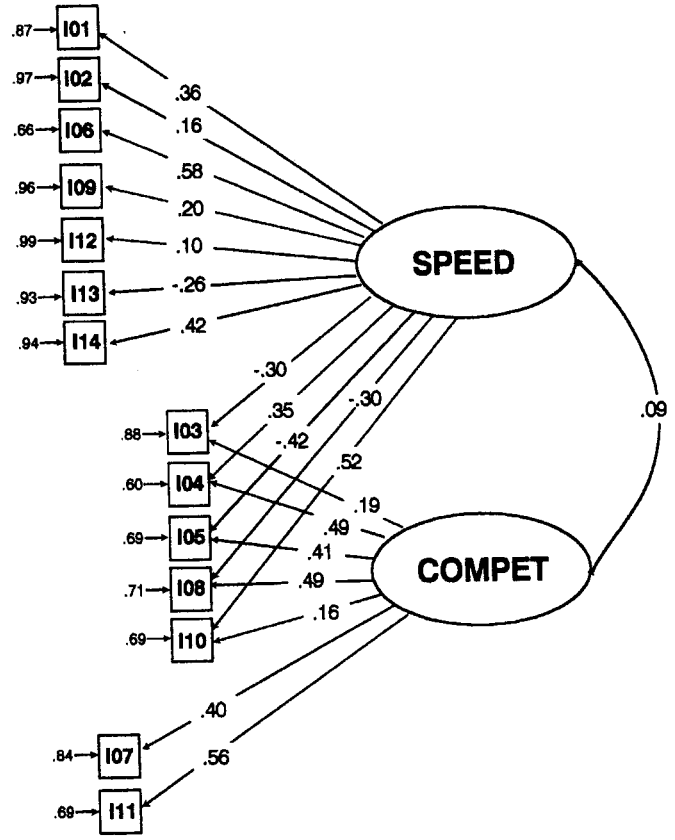

Figure 3. Two-dimensional final model (non-congeneric and without τ-equivalence presumptions) for the Bortner scale. SPEED = speed factor, COMPET = competitiveness factor (standardized solution; see Table 5 for overall goodness-of-fit measures).

In the structural model the relations between the constructs are presupposed in such a way that endogenous constructs SPEED and COMPET affect the third endogenous construct - CHD, in addition to other - exogenous constructs. SPEED and COMPET are not supposed to correlate with each other in a substantial extent or to influence one another significantly (in fact their correlation is 0.26). The model can be accepted with low possibility of error in making decision.

Strength and direction of the relations between constructs in structural model are rather interesting, particularly the height and direction of the influence of the two TABP construct on CHD in comparison to the influence of other constructs on CHD. But it is most important for the purposes of our study that the two-dimensional structure of the Bortner scale has been confirmed in an external validation procedure as well. The examination of the internal structure and the external validity of the scale pointed out the fact that one should understand the Bortner scale as an instrument, measuring only two of various dimensions of the construct called TABP.

DISCUSSION

According to Edwards et al. (1990b), Speed/Impatience, Hard-Driving/Competitiveness, Time Pressure, Job Involvement, Anger/Temper, and Job Responsibility should be among the most common '...core components of TABP...' (p. 443). The outcomes of our internal validation of the Bortner scale confirm these prior findings (Edwards et al., 1990a), that one cannot speak of the Bortner scale as being a measure of TABP, but only as being a measure of two single components of multidimensional construct - TABP. Therefore, it is suggested that the scale should not be applied in its present form, but merely as an instrument estimating two dimensions of the TABP construct: Speed (Impatience) and Competitiveness (Hard-Driving). When a complete impression about the TABP in participants is required, various complementary measures of other TABP dimensions, not included in the Bortner scale, should be

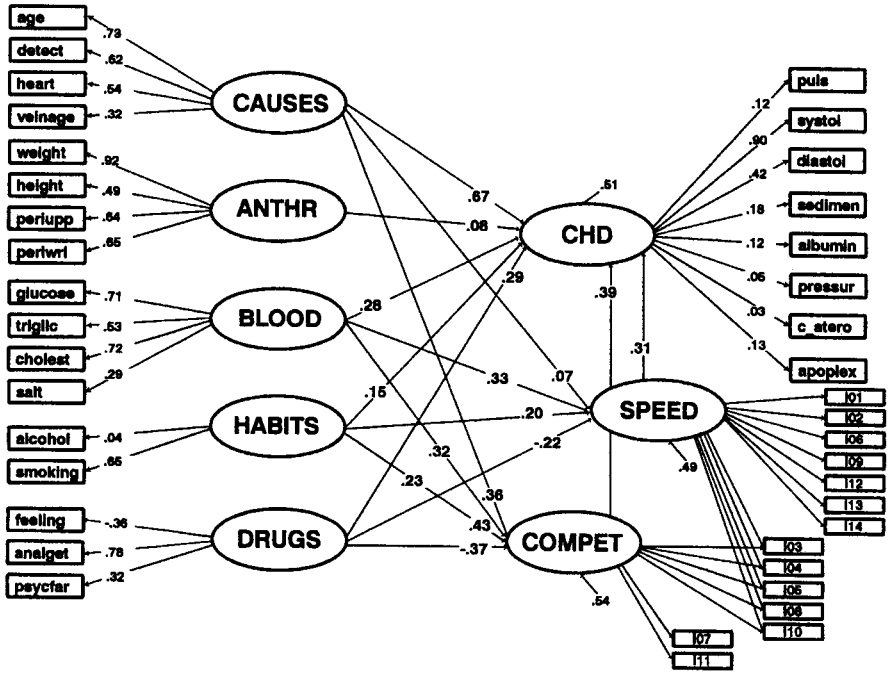

Figure 4. External validation of the Bortner scale as a two-dimensional noncongeneric measure of Type A behaviour pattern - reestimation. χ^2 (df = 672) = 1097.2877, $p< 0.01$; RMSR = 0.061, AGFI = 0.91, NNFI = 0.85. CHD = indicators of coronary heart disease; CAUSES = possible causes or predictors of CHD; ANTHR = anthropometric measures; BLOOD = laboratory blood findings; HABITS = most common "bad habits"; DRUGS = possible medicament consumption and subjective state of health; SPEED = speed factor in the Bortner scale; COMPET = competitiveness factor in the Bortner scale (standardized solution; see Table 1 for description of manifest variables and Table 5 for explanation of the goodness-of-fit indices; errors of measurement are omitted in the presented model; the values of the measurement model for SPEED and COMPET are not presented as they are almost entirely the same as in Figure 3).

administered in addition. Considering relatively poor reliability estimates and fit statistics also in a two-dimensional final confirmatory model of the scale, it is not easy to justify its use in any form.

Edwards et al. (1990a) examined the concurrent validity of the Bortner scale by analysing the relationship between the two underlying dimensions of TABP and four criteria, including job satisfaction, anxiety, somatic symptoms, and depression. 'Speed' was negatively related to job satisfaction and positively related to anxiety and somatic symptoms. 'Competitiveness' was positively related to job satisfaction. There were no criteria covering measures of cardiovascular functioning as being used in our study. In accordance with results in the study of Edwards and his colleagues, our external validation shows that, when the Bortner scale is used as a two-dimensional measure (and regarding the fact that the model of relations between TABP and some possible predictors and indicators of CHD was confirmed), there are some interesting relations in the model, which could be regarded as causal. Competitiveness factor (defined as hard driving, forceful, rushing, trying to do a lot of things at once, impatient) seems to be related to detected changes in CHD status in slightly greater extent than the Speed factor (interpreted as fast, going all out, patient but always rushing and never late), with both dimensions having positive relationship with CHD. These influences appear to be at least as strong as (or even stronger than) most influences of other measured or latent variables included in the model - e.g., age, presence of symptoms of different diseases, anthropometric and blood characteristics of participants, their health and their habits of harmful substances, and medicament consumption. CHD construct is here described mainly by variables, such as diastolic and systolic blood pressure, sedimentation and albumins laboratory findings in urine. Therefore, TABP is at least to some extent associated with CHD - as was also concluded in a meta-analytical study of Miller, Turner, Tindale, Posavac and Dugoni (1991). Furthermore, the confirmation of the proposed theoretical model suggests that the two examined characteristics of TABP are responsible for some clinical symptoms of CHD, i.e., they seem to cause them. However, considering the explicated psychometric properties of the Bortner scale and the incompleteness of the proposed model, this conclusion should be

taken with highest precaution. Further careful research should be planned and conducted regarding this question and also - in accordance with Friedman and Booth-Kewley's warnings (Friedman & Booth-Kewley, 1988) - questions relating to clear distinction between TABP and coronary-prone behaviour, when speaking of their influence on coronary heart disease.

Our results suggest that some of the dimensions of the TABP construct do act like one of the predictors of CHD. It would be of great interest for the researchers in this area to built an instrument and which would cover as many components or dimensions of the TABP construct as possible. With strong psychometric properties, Edwards, Baglioni and Cooper (1990b) have suggested the methodology for developing such new measures of TABP on the basis of existing measures - the Bortner scale, the Framingham scale, and the JAS. With such multidimensional measure and with carefully selected external criteria of various detectors of CHD it would be much easier to answer the question whether particular TABP dimensions influence the risk factors, the beginning, the development and pathogenesis of CHD. The Bortner scale itself is obviously not efficacious enough to make any strong conclusions about the relations between TABP and CHD.

The researchers should be aware of another additional problem when examining the TABP via self-report assessment measures. These instruments are, like most other personality questionnaires, sensitive to particular answering characteristics of the respondents. They are all open to a range of response biases, such as social desirability bias, faking bad, acquiescence, opposition, extremity or 'mid-point' response set, carelessness, and inconstancy (Friedman & Booth-Kewley, 1988; Furnham, 1986, 1990; Rorer, 1965; Wilde, 1977). According to some studies (Bass & Akhras, 1987; Furnham, 1986), the Bortner scale is no exception. Therefore, it would be a reasonable decision to take also some other kinds of TABP estimates into account. One of them could be Structured Interview (Rosenman, 1978, 1987). It was shown to be better predictor of CHD than some less reliable and valid self-report measures.

In our study, we tried to establish a methodological framework for analyzing the characteristics of a particular instrument regarding its internal structure and relationships to some external criteria. We believe that this methodology could as well be applied in examining the psychometric properties (i.e. reliability and some of the components of internal and external validity) of other instruments measuring some other components of the construct called Type A behaviour pattern.

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