A psychometric evaluation of the Occupational Stress Indicator

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Three samples of volunteer working adult participants, drawn from two countries (United Kingdom and New Zealand), provided data using the pencil and paper version of the Occupational Stress Indicator questionnaire (OSI; Cooper, Sloan, & Williams, 1988). In an attempt to examine the degree to which the psychometric structure of the test was reflected in the published score key, the three datasets were comprehensively analysed using item analysis and exploratory factor analysis. Little similarity existed between the published 25 subscale score keys and the meaningful, 11-scale psychometric structure found from these analyses. It is concluded that the current norms for the test are of dubious validity, and if these findings are replicated the normative data should be re-scored, perhaps using the revised score keys presented in this paper. The model underlying the OSI has not been tested comprehensively to date. The present results neither support nor disprove the model, but the new scales could be used to test it.

The Occupational Stress Indicator (OSI; Cooper et al., 1988) comprises seven questionnaires with a total of 25 subscales. The sources of pressure questionnaire has six subscales and is a measure of factors thought to have a role in the aetiology of occupational stress. There are three questionnaires for assessing moderating variables: these are for type A behaviour pattern with three subscales, locus of control with three subscales, and coping strategies with five subscales. A further three questionnaires for mental ill-health, physical ill-health, and job satisfaction (with six subscales), assess strain or 'stress effects'. The OSI is based on the

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transactional model and has been used extensively as a research tool, and in the detection and management of occupational stress. It has been used for many occupational groups in the UK, including police officers (Biggam, Power, & McDonald, 1997; Kirkaldy & Cooper, 1992; Kirkaldy, Furnham, & Cooper, 1994), occupational therapists (Rees & Smith, 1991), staff from public sector organizations (Leong, Furnham, & Cooper, 1996), civil servants (Bogg & Cooper, 1995), managers (Robertson, Cooper, & Williams, 1990), social services staff (Bradley & Sutherland, 1995) and health service workers (Anderson, Cooper, & Willmott, 1996; Rees & Cooper, 1992a). It has also been used for clinical nurses in Taiwan (Lu, Shiau, & Cooper, 1997), Australian business and professional women (Langan-Fox & Poole, 1995), Portuguese professional women (Tharakan, 1992), and Brazilian white-collar workers (Moraes, Swan, & Cooper, 1993). Recently the OSI has been promoted as a tool for conducting stress audits throughout the UK National Health Service (Doherty & Tyson, 1998). It is evident that it has acquired an international reputation in the field of occupational stress.

Numerous studies have investigated the reliability and validity of the OSI scales. The following cite reliability figures: Davis (1996); Kirkaldy *et al.* (1994); Lu *et al.* (1995); Swan, Cooper, and Moraes (1993); Williams (1996); and Williams (1997). The locus-of-control scale fails to reach acceptable levels in any of these studies, and the type A scale is weak. The reliability of the coping scale falls around or below 0.70 in two studies, but is above this in the Chinese study (Lu *et al.*, 1995). The sources of pressure, job satisfaction and physical ill-health scales are consistently reliable. The mental ill-health scale, although reliable in two studies, was not reliable in a third.

All of the outcome or stress effects measures—job satisfaction, mental ill-health and physical ill-health—have good construct validity, but the construct validity of the locus-of-control and type A scales is questionable (Cooper & Williams, 1991; Cunha, Cooper, Moura, Reiss, & Fernandes, 1992; Khan & Cooper, 1991; Robertson *et al.*, 1990). There is evidence of criterion-oriented validity on all outcome measures against self-reported absenteeism (Cooper & Bramwell, 1992; Lu *et al.*, 1997; Rees & Smith, 1991).

The OSI is more than a collection of scales, based as it is on a structural model of occupational stress (Fig. 1). In this model, which is outlined schematically by Robertson *et al.* (1990), six sources of pressure interact with three moderating variables in producing stress effects or 'the major consequences of occupational stress'. The three moderating variables also have direct effects on stress effects.

There are problems with using the OSI to operationalize this model, some of which result from the exclusive use of self-report questionnaires. The first is one of definition: labelling the mental ill-health, physical ill-health, and job satisfaction measures as stress effects, raises the question of just what occupational stress is and whether the OSI attempts to operationalize it. Occupational stress might be considered to be operationalized by the sources of pressure questionnaire, or alternatively by the combination of sources of pressure and the moderating variables specified in the model. A third possibility is that occupational stress is simply a label to summarize the notion of work-related pressures affecting health (Lazarus & Folkman, 1984). None of this is clear from the model, and indeed there





is debate about this in the stress literature as a whole (Knapp, 1988), leading some authors to question the scientific utility of the term stress (Briner & Reynolds, 1993; Pollock, 1988). Furthermore, labelling the ill-health and job satisfaction questionnaires as stress effects is potentially misleading, because these variables are determined by many factors other than occupational stress, including demographics, health behaviours, genetic predisposition, personality, personal goals, and life outside of work.

A second problem is that some of the OSI measures might be confounded. The OSI sources of pressure scale is the main indicator of aspects of the working environment that might lead to stress effects. All stress models are an attempt to relate causes of stress to outcome measures. Schafer and Fals-Stewart (1991) point out that self-report measures of stressors and outcomes are frequently confounded and overlapping and, consequently, that a significant proportion of the research in this field is of questionable value. This problem can be suspected for the OSI job satisfaction and sources of pressure questionnaires, despite the fact that their response keys differ (one emphasizing satisfaction and the other degree of pressure) because both have items to do with workload, salary, relationships at work, career prospects, style of management, and communication. Item similarities in the home/work subscales between the sources of pressure and coping questionnaires raises the possibility that these subscales may also be confounded.

Thirdly, the model specified by Robertson, Cooper, and Williams (1990) is ambiguous; for example, it is not clear whether the moderating variables act independently of each other, whether the stress effects measures are independent of each other, and whether the six sources of pressure scales should be summed or considered to have differential effects on specific stress effects measures.

Brannick (1995) has observed that in model testing it is important to compare the hypothesized model with rival, psychologically meaningful models. It would be possible to construct a very large number of such models for the OSI; for example, it could be proposed that mental ill-health is predictive of scores on some or all of the other OSI measures (the reverse causation hypothesis), or that job satisfaction interacts with sources of pressure to mitigate ill-health. The complexity involved in comparing plausible models could be very high if all 25 subscales are involved. An alternative would be to use a simplified scoring option proposed by the test authors, using single scale short-forms for the type A, locus-of-control and job satisfaction questionnaires, which would reduce the number of subscales to 17. This would not affect the model at the level of major constructs, but would simplify it, although the number of rival models would remain high.

A fourth problem is that the OSI relies entirely on self-report questionnaires and therefore apparent cause and effect relationships may be inflated by common method variance, or shared variance with a third variable such as negative affect (Watson, Pennebaker, & Folger, 1987). In addition there may be a particular problem with using the OSI (or any similar questionnaire) to assess the interaction between coping and sources of pressure. The OSI model would predict that effective coping strategies would moderate the effects of sources of pressure on stress effects. However, it might also be predicted that effective copers and poor copers perceive identical sources of pressure quite differently, with the former giving lower ratings for sources of pressure simply because their coping skills render those events less troublesome. Consequently, the moderating effect of coping would be underestimated. These problems do not invalidate the use of self-report measures, but it is important to include objective measures to guard against them (Frese, 1985; Frese & Zapf, 1988). Melamed, Ben-Avi, Luz, and Green (1995) have shown that objective working conditions may have direct effects on strains as well as effects mediated by subjective appraisal, underlining the importance of combining self-report and objective measures of sources of pressure.

Finally, a more fundamental question must be addressed as to whether the factor structure of the OSI, represented by the subscale score key, is replicable. Surprisingly, there is little research that attempts to address this question. The OSI was published with few supporting statistics: norms were given without sample descriptions and subsequently changed; factor analyses were inadequately reported; 'factors' with only three items were scored as subscales; and the initial samples were less than 200, a number that is insufficient for factor analysis of a 167-item questionnaire, and inadequate for deriving normative data. For the sources of pressure scale, with 61 items, there was no factor analysis; subscales were derived from a priori assumptions (Cooper & Marshall 1976; Williams, 1996). Since publication, extensive normative information has been collected, but the other problems have not been addressed convincingly.

There are only two psychometric reviews of the factor structure of the OSI (Lu et al., 1995; Williams, 1996). The results reported in Williams' unpublished PhD thesis, using both exploratory and confirmatory methods of factor analysis, did not support the OSI model. Further exploratory and confirmatory analyses were undertaken that enabled the author to create a second version of the test. Unfortunately, some of these latter analyses were flawed to such an extent that the wisdom of proceeding with the second score key is questionable. Lu et al. (1995) examined the factor structure of a Chinese translation of the OSI; their results did not confirm the published structure, but these analyses were also flawed. For example, the authors used orthogonal rotation of correlated factors, and six out of 15 reported factors had four or less salient items.

There has been no report of a comprehensive test of the interactive OSI model. However, given the shortcomings in the development of the instrument, such a test would be premature until the psychometric status of the components of the model, represented by the OSI questionnaires, subscales and short-form scales, has been confirmed. If a replicable and parsimonious factor structure could be identified, it might then be useful to conduct an evaluation of the OSI model and begin to consider how to deal with some of the problems raised above.

The need to examine the psychometric basis of the OSI is not just of theoretical importance. The burgeoning applied literature on the OSI is dependent on the use of the published score keys and population norms. The questionnaire is used in organizations and with individuals in sensitive situations, and therefore it is crucial to have confidence in the psychometric status of the instrument, but the literature on the OSI does not give such confidence with respect to the test's underlying factor structure or score keys. Consequently, since the OSI factor structure remains ambiguous, with little empirical evidence of clear factorial structure, it was decided that a comprehensive exploratory psychometric evaluation of the questionnaire and subscales was required. Analysis of the OSI short-form scales was not attempted. Exploratory methods of analysis were chosen as the preferred analysis framework, due to the empirical fact that there is no established structural model for many of the OSI scales.

Method

Participants

Data from three samples of volunteer participants were used.

National Health Service (NHS) sample. There were 225 participants from a survey of 1021 employees in an NHS hospital, giving a response rate of 22%, including administrative and clerical staff, nurses, doctors, managers, ancillary workers, clinical professionals, and porters. The sample comprised 81% women and 19% men, and 33% worked part-time. Age data were collected in bands: < 21 = 0%, 21-30 = 16%, 31-40 = 33%, 41-50 = 32%, 51-60 = 17%, > 60 = 2%. Length of service was: < 2 years 20%, 2–5 years 31%, 6–10 years 18%, > 10 years 31%.

Sales staff. In a survey of 632 people employed by the sales function of a UK telecommunications organization, from five sales management grades, there were 319 returns (50.5%), of which, 45.7% were accounts managers, 27% account executives, and 27.3% sales managers; with 27.3% women, and 72.7% men. Mean age was 35.8 years (SD = 8.1, range 20–56). Junior managers represented 59.2% of the sample, while senior grades made up 8.1%. Mean lifetime sales experience was 10 years.

New Zealand occupational sample. The sample comprised 153 mixed gender, shop-sales and customer administration employees from a New Zealand utility corporation. All were volunteers who responded to a poster advertisement from within their respective sales and regional administration centres. Each respondent contacted the research team, and was sent the OSI for completion. There were 100% returns of these requested questionnaires, but the proportion of employees that volunteered is not known. Age and status of respondents were not known (as a condition of obtaining the sample), although all employees were at least 19 years old.

Materials

The pencil and paper version of the OSI was used for each sample. It comprises six questionnaires, with 6-point Likert response keys for all items. Brief, clear rationales and instructions precede each questionnaire.

How you feel about your job, assesses job satisfaction with 22 items and a response key ranging from very much satisfaction to very much dissatisfaction. There are five subscales for satisfaction with achievement and growth, the job itself, organizational design and structure, organizational processes, and personal relationships. A short-form measure comprises one item from each of the subscales.

How you assess your current state of health is in two parts: part A is an 18-item measure of mental ill-health, and part B is a 12-item measure of physical ill-health, which lists somatic symptoms commonly associated with anxiety or depression. The response keys to part A are individually written for each item, and follow the theme of very true to very untrue for each statement. For part B, the responses range from never to very frequently experience the particular symptom.

The way you behave generally is a type A behaviour pattern questionnaire with 14 items, and responses ranging from very strongly agree to very strongly disagree. There are three subscales for attitude to living, style of behaviour and ambition. The first six items provide a short-form 'broad view' of type A measure.

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How you interpret events around you is a measure of workplace locus of control with 12 items, and a response key ranging from very strongly agree to very strongly disagree. Three subscales assess locus of control in relation to organizational forces, management processes, and individual influence. Five items taken from the three subscales give a short-form measure of control.

Sources of pressure in your job has 61 items with responses ranging from very definitely is to very definitely is not . . . a source. Six subscales assess sources of pressure from factors intrinsic to the job, the managerial role, relationships with other people, career and achievement, organizational structure and climate, and home/work interface.

Finally, How you cope with the stress you experience has 28 coping items, with responses ranging from never to very extensively. Six subscales assess the following coping strategies: social support, task strategies, use of logic, home and work relationships, time management and involvement.

This gives a total of 25 subscale scores, including the single scale mental and physical ill-health questionnaires, with three additional short-form scales for type A, locus of control and job satisfaction.

Procedure

For each sample the pencil and paper version of the OSI was distributed with a covering letter: confidentiality was guaranteed. The instrument was self-administered and returned for scoring and analysis. For the NHS sample a biographical data sheet was included and distribution was with pay slips. The 160 participants who provided a name were sent a personal stress profile and offered the opportunity for individual feedback. The sales staff sample also received a biographical questionnaire. Arrangements were made with the central communication and distribution office for each sales region for distribution of the questionnaires, which when completed were returned by mail. The New Zealand sample completed the questionnaire anonymously and returned it to the researchers at the University of Canterbury in Christchurch for scoring and analysis.

Psychometric analyses

Since there is no published information on how the OSI subscales were derived, an attempt was made to replicate the OSI score keys through factor analysis. It will be shown that there is almost no correspondence between factor and subscale structures, and therefore further analysis was undertaken in which the published OSI score keys were ignored.

Each of the OSI scales was analysed using principal components analysis for tests of factor extraction (Kline, 1994). These analyses were conducted on the 319 participant UK sales staff data. Four-factor extraction tests were used: the Velicer MAP test (Velicer, 1976); Armor's theta (Armor, 1974); the scree test (Cattell, 1966); and the Kaiser–Guttman eigenvalues ≥ 1 criterion (Kaiser, 1960). The Velicer test determines the number of common factors in a correlation matrix, and identifies the point at which further extraction of factors will produce specifics accounting for unique variance only. Armor's theta indicates the internal consistency (or reliability) of a factor: only a small proportion of the variance in questionnaire items can be explained by a factor if theta falls below .50. The scree test is subjective, and can lead to overestimation of factors (Zwick & Velicer, 1986): it was only used for the sources of pressure questionnaire, because the results indicated by the Velicer test and Armor's theta were difficult to interpret. The Kaiser–Guttman criterion is generally regarded as unsuitable, since it leads to over-extraction of factors, and was only used to ensure that factors with eigenvalues < 1.0 were not accepted. There is no perfect test of factor extraction: the combination of methods gave a range of options that had to be tested by inspection for psychological meaning, in comparison with the scales indicated by the OSI score key.

For the second stage of the analysis, each scale was subject to MINRES (minimum residual) factor analysis for the predicted numbers of factors, again using the UK sales staff. Up to four solutions were calculated for some of the scales. MINRES (Harman & Jones, 1996) is a method of factor analysis that does not rely on iterative item communality estimation procedures, and has the feature (like maximum likelihood analysis) of extracting common factors that minimize the residual correlations between all items, having extracted *m* common factors. In each case the number of factors predicted by the OSI subscale structure was included in the solutions to be examined. Solutions were rotated using hyperplane maximized direct oblimin rotation, with hyperplane bandwidth set at \pm .1, and the δ parameter swept from -10.5 to +0.5 in steps of +0.5. Oblique rotation was chosen, because it was assumed that subscales derived from questionnaires that were designed to measure general constructs would be correlated. Each rotated solution was examined and uninterpretable solutions were rejected. This reduced the number of possible solutions to one or two options for each scale. Substantive factor loadings were interpreted as those with values $\geq \pm$.30. Pairwise data deletion was used for all factor analyses.

To test whether the proposed solutions were replicable they were computed separately (using MINRES factor analyses) for each of the three datasets, and subsequently compared. The factor comparison methodology used within the analyses below is based upon the Kaiser, Hunka, and Bianchini (KHB; 1971) congruential fit procedure, modified by Barrett, Petrides, Eysenck, and Eysenck (1998) to conform to an orthogonal procrustes target-fit procedure. This technique rotates a 'sample' matrix to a pre-specified (or actual) target factor matrix by first 'undoing' any rotational transformations for each of the matrices, then rotating the now orthogonalized sample matrix against the orthogonalized target marix by least-squares, minimizing the discrepancy between corresponding factor vectors across both matrices. The KHB factor similarity coefficients are then computed as conventional congruence coefficients between each pair of sample-target factor vectors using the formula:

$$\mathbf{r_c} = \frac{\sum_{i=1}^{k} a_{ii} a_{ic}}{\sqrt{\left(\sum_{i=1}^{k} a_{ii}^2\right) \left(\sum_{i=1}^{k} a_{ic}^2\right)}}$$

where a_{it} is the loading of variable *i* on a particular factor in the target matrix *t*, where a_{it} is the loading of variable *i* on a particular factor in the comparison matrix *c*.

Further, the technique provides for a *mean solution congruence* parameter, which is the average of the sum of each individual item vector congruence coefficient (computed for each item using item factor loadings in the sample and target matrices). Congruence coefficients vary between 0 and 1, with 0 indicating no similarity at all, and 1 indicating identity. The FAKSIM program that implements these procedures is available for download (Barrett, 1998a).

Because the preferred solution to the OSI questionnaires was highly replicable, a third phase of analysis was undertaken, in which the three datasets were combined giving a sample of over 680 cases. Factor extraction tests for this sample confirmed the solution that had been found for the sales staff. The factor analyses were repeated using this large dataset, and factor analysis results were used to form a new score key for the OSI. Items were chosen using the .30 criterion, but with modification to exclude complex items, where the highest salient loading was close to the highest non-salient loading (i.e. for items which loaded just above .30, where the highest secondary loading was just below .30). The Kaiser index of factorial simplicity was used for this purpose (Kaiser, 1974): items with a value of < .40 for this statistic were excluded.

Signal-to-noise and conventional item analysis was used to assess the quality of the new scales. The computational formulae and details of the signal-to-noise analyses have been reported elsewhere (Barrett, 1998b; Barrett, Kline, Paltiel, & Eysenck, 1996). Essentially, the analyses identified internal consistency of scales using coefficient alpha, item complexity (i.e. the number of items that correlate above a specified level with more than one scale), and the signal-to-noise ratio between different scales (i.e. the extent to which any specific item correlates with its own scale, in comparison to its correlations with other scales, to which it is presumed not to belong). These parameters were combined in a formula to calculate an index of the measurement quality of a scale: the Scale QUALity index. Finally, summary quality indices were calculated for the new OSI score key as a whole. For comparison purposes the scale quality index for the sources of pressure questionnaire was calculated,

Questionnaire	MAP	Theta \geq 0.5	Scree	Eigen values ≥ 1	Options
lob satisfaction (5)	2	1	_	5	1, 2, 5
Mental ill-health (1)	1	1	_	4	1
Physical ill-health (1)	1	1	_	2	1
Type A (3)	1	1	_	5	1, 3
Locus of control (3)	1	1	_	5	1, 3
Sources of pressure (6)	6	5	3, 4	16	3, 4, 5, 6
Coping (6)	2	3		9	2, 3, 6

Table 1. Summary of factor extraction tests (based on principal component analyses) for the OSI questionnaires, showing the number of OSI subscales and the number of factors suggested by different factor extraction tests

Note. In the left-hand column the number of OSI subscales is given in parentheses. *Key.* MAP = Velicer's MAP test.

using the published OSI scoring key. SQUAL values vary between 0 and 1, with 1 indicating perfect scale quality of measurement.

Results

Factor extraction tests

The results of the principal components factor extraction tests on the sales staff data set are shown in Table 1. The final column shows the options for factor extraction, based on factor extraction tests and the OSI scoring key. Because the sources of pressure scale gave unsatisfactory results for five and six-factor solutions (see below), the scree test was used to examine alternatives.

Factor analyses of questionnaires

The sales force questionnaire data were factor analysed using MINRES factor analysis and, for solutions with more than one factor, were rotated to simple structure using oblique rotation. All of the possible solutions in Table 1 were examined.

Job satisfaction. Five factors were extracted for 308 cases, in an attempted replication of the five OSI job satisfaction subscales. The numbers of items with salient loadings on the five factors were 4, 3, 3, 4 and 1: five items loaded on more than one factor and two items failed to load. Table 2 shows the published distribution of items across the five OSI job satisfaction subscales (in the left-hand 'item' column of each pair of columns), and the factors on which those items loaded (in the right-hand 'factor' column of each pair) for the five-factor solution. The correspondence between the OSI score keys and factor loadings was poor, and therefore, given that the factor extraction tests did not support five factors, this was not considered to be a good solution.

ACE anc	uievement 1 growth	The jo	b itself	Organi de	izational sign	Organi proc	zational cesses	Relatio	sqihsno
Item	Factor	ltem	Factor	Item	Factor	Item	Factor	Item	Factor
ŝ	2	4	4	1	ω	Ś	D	5	0
9	D	~	D	10	\mathcal{C}	6	2	8	4
12	1	11	4	13	ω	15	1	18	ŝ
14	1	21	D	20	D	17	0		
16	1			22	1				
19	Ś								

Key. O = Did not load; D = loaded on more than one factor.

Table 2. Five OSI job satisfaction subscales, showing the factors on which subscale items loaded when five factors were extracted in a MINRES factor analysis

Twenty-one items loaded on the one-factor solution (JS19¹ level of salary failed to load). The two-factor solution had 12 extrinsic job satisfaction items on the first factor and the second factor had seven intrinsic job satisfaction items.

Since the MAP and scree tests indicated two factors, and the division between intrinsic and extrinsic job satisfaction is consistent with other literature on job satisfaction (Lyne de Ver, 1998; Warr, Cook, & Wall, 1979; Williams, 1996), this solution was considered to be optimal. A single-factor solution might also be valid, depending on the purposes for which assessment of job satisfaction is required (Lyne de Ver, 1998; Parsons & Hulin, 1982).

Health scales. Factor extraction tests for the mental ill-health and physical ill-health scales gave single-factor solutions, in agreement with the OSI score key.

MINRES factor analysis confirmed that 17 of the 18 mental ill-health items loaded on a single factor for 310 cases. The exception was MIH3: When you consider your level and quality of job performance recently, do you think that your contribution has been significantly useful? The marker variable was MIH14: As time goes by, do you find yourself experiencing fairly long periods in which you feel rather miserable or melancholy for reasons that you simply cannot 'put your finger on'? Given that MIH3 almost met the .30 criterion for a factor loading, the 18-item mental ill-health scale was accepted. The items for this scale have complex and clumsy wording and could be improved.

All 12 physical ill-health items loaded on a single factor for 313 cases, with the highest loading for PIH4: Feeling unaccountably tired or exhausted.

Type A scales. An attempt was made to replicate the three OSI type A subscales with 309 cases. For the three-factor solution, two items failed to load; there were six unique loadings on factor 1, which attracted items from each of the three type A subscales; factor 2 had four loadings all from the five-item type A style of behaviour subscale; and factor 3 had only two unique loadings both from the six-item attitude to living subscale. Therefore, the correspondence between this solution and the OSI subscale structure is poor.

For the one-factor solution one item failed to load: this was TA8: I am usually quite concerned to learn about other people's opinions of me particularly recognition others give me. The highest loading was for TA6: I would describe the manner of my behaviour as being quite challenging and vigorous.

Locus of control. The OSI gives three locus of control subscales for organizational forces, management processes and individual influence. For the three-factor MINRES solution, factor 1 had four unique loadings, from two of the OSI locus-of-control subscales; factor 2 had four unique loadings, from all three OSI subscales; and factor 3 had no loadings. Again there was poor correspondence between the factor structure and the OSI subscale structure.

The MAP and Armor's theta tests suggest one factor. Four items failed to load in the one-factor MINRES solution; these were LOC 3, 5, 7 and 9.

¹OSI items are referred to by the acronym for the specific questionnaire followed by the item number. JS19 is the 19th item in the job satisfaction questionnaire. The other questionnaires are SP = Sources of pressure, TA = Type A, LOC = Locus of control, MIH and PIH = Mental and Physical ill-health, COP = Coping.



Figure 2. Scree test for OSI sources of pressure.

Sources of pressure. This is the longest OSI questionnaire with 61 items that are presumed to represent six subscales. The MAP test indicated six factors, and Armor's theta indicated five, with a sixth factor having a theta of .46.

The six-factor solution, for 304 cases, was compared with the OSI score key (Table 3). These results demonstrate beyond doubt that the score key is not consistent with the factor analysis results.

Examination of the six-factor solution suggested that the first factor, with seven salient loadings, was indicative of 'pressure' from lack of growth opportunities; the second was a six-item measure of workload; the third, with five items, was indicative of poor support (or unhappiness) from home; the fourth, with six items, represented pressure from being out of touch with developments, isolation, and risk of redundancy; the sixth had eight items reflecting sources of pressure from the managerial role (but not the same as those from the OSI managerial role subscale); and the fifth factor comprised six items that were difficult to interpret as a factor. The five-factor solution was similar, with subscales for poor support from home, lack of growth opportunities, isolation/out of touch, workload, and a fifth factor that was difficult to interpret.

These solutions were unsatisfactory because the fifth factor was uninterpretable, and so the scree test was inspected (Fig. 2) to determine whether other solutions could be considered. The curve had a marked break point at three factors, and less marked at four factors. The three-factor solution gave factors for workload, pressures in the role of employee (with items about lack of opportunities, lack of recognition from superiors, morale etc.) and pressures of the managerial role (with items about taking difficult decisions, being seen as the 'boss', and lack of support from home). The four-factor solution gave the three factors from the three-factor solution, but items to do with lack of support from home formed a separate factor.

The purpose of factor rotation is to maximize simple structure, and this can be assessed by using the mean Kaiser index of factorial simplicity for the whole Table 3. Six OSI sources of pressure subscales, showing the factors on which subscale items loaded when six factors were extracted in a MINRES factor analysis

	-			- -	-	C		C	-	11	-
	dol	Mai	nager	Kelath	onships	Ca	ureer	Urg.	climate	Home	/ work
Item	Factor	Item	Factor	Item	Factor	Item	Factor	Item	Factor	Item	Factor
-	,	,	-	u		,	,	=	6		
Г	7	7	-		0	C	4	11	n	4	n
8	-	6	0	9	0	10	2	12	D	7	2
14	4	15	4	17	D	25	4	16	4	13	2
20	2	21	D	18	9	30	D	22	1	19	\mathcal{C}
33	0	24	0	26	9	32	9	23	D	29	D
36	9	31	Ś	27	9	39		28	2	41	\mathcal{C}
40	2	38	9	34	0	52	1	35	D	43	D
47	Ś	44	D	37	0	54	Ś	42	0	46	\mathcal{C}
55	D	45	Ś	50	4	58	1	48	Ś	49	ω
		51	9	56	4			53	D	59	\mathcal{C}
		57	D					61	Ś	60	D

Key. O = Did not load; D = loaded on more than one factor.

questionnaire (Kaiser, 1974). Using this criterion none of the rotated solutions to the sources of pressure questionnaire were particularly good, with mean simplicity indices of < .70. This is because of the many complex items that double loaded or failed to load, and suggests that the questionnaire is at an early stage of psychometric development. The fourth factor can be considered to be hypothetical: it is interesting that OSI home/work items form two sub-sets, one indicative of workload, and the other of an unhappy or unsupportive home environment. However, this four-factor structure needs further development.

Coping. This is the final OSI questionnaire with six subscales and so a six-factor solution was attempted. Nine items double loaded, or failed to load and factors had 8, 2, 3, 2, 2, and 2 items with no correspondence between the factor structure and the OSI subscales.

In the three-factor MINRES solution, the first factor, with eight items, was task-oriented coping with the highest loading for COP21: Set priorities and deal with problems accordingly. The second factor consisted of seven items, mainly emphasizing social support, with the highest loading for COP28: Seek as much social support as possible. Factor 3 had only two emotional control items.

Because of the weakness of factor 3 a two-factor solution was attempted. This solution was similar to the first two factors of the three-factor solution. Factor 1 was identical in both solutions, and factor 2 had 10 items, including two items that had double loaded in the three-factor solution. Factor 2 could be described as lifestyle coping, with items about seeking social support, and having interests outside of work.

Factor comparison across samples

The factor analyses reported so far have been based on one sample of approximately 300 persons. Before general conclusions can be drawn it is necessary to demonstrate that the results are consistent across other samples. The mean solution congruences from the factor comparison analyses between the three sets of OSI data, using MINRES factor analyses, are shown in Table 4. Note that a congruence coefficient of 1.0 equals identity between compared solutions. For most scales the results are highly consistent between datasets, demonstrating that the solutions are replicable. The only exception is the sources of pressure questionnaire, where replicability is acceptable (around .80 for most of the 12 comparisons), but lower than would be desired. This may be due in part to the high proportion of complex items in the sources of pressure questionnaire. It may also be due to the inclusion of items that are only relevant to managers and supervisors, even though the OSI is commonly used for non-managerial samples. In each comparison the three-factor solution is the most consistent across samples.

Questionnaire development

Given the high degree of replicability across the samples, the three datasets were combined. Principal components factor extraction tests on these combined data

Questionnaire	Number of factors	Similarity coefficient: NZ and Sales	Similarity coefficient: NHS and Sales	Similarity coefficient: NZ and NHS
Iob satisfaction	2	.97	.98	.99
Mental ill-health	1	.98	.99	.98
Physical ill-health	1	.99	.99	.99
Type A	1	.98	.93	.90
Locus of control	1	.97	.97	.97
Sources of pressure	3	.80	.82	.94
1	4	.77	.78	.82
	5	.79	.80	.78
	6	.77	.80	.77
Coping	2	.93	.93	.94

Table 4. Factor similarity tests for the OSI questionnaires, between the three survey samples, based on MINRES factor analyses

gave results that were almost identical to those shown in Table 1. The only differences were that there were slightly fewer components with eigenvalues ≥ 1.0 for some scales; and the MAP gave two factors for mental ill-health. Given that three out of four extraction tests, and the OSI score key, all agree on one factor for the mental-ill health scale, the latter result was ignored.

One and two-factor MINRES solutions were computed for job satisfaction. All of the job satisfaction items loaded in the one-factor solution, and so all of the items could be used to form a single scale. However, a two-factor solution would have greater utility, and so this was used for scale development. One-factor solutions were calculated for mental ill-health, physical ill-health, locus of control, and type A. A three-factor solution was calculated for sources of pressure. Two and three-factor solutions were examined for coping. The third factor for the coping questionnaire comprised only four items, representing avoidance coping. There is support in the literature for three-factor solutions to coping (Endler & Parker, 1990; Ingledew, Hardy, Cooper, & Jemal, 1996; Roger, Jarvis, & Najarian, 1993), but given that only four items contributed to this factor, more items would be needed to produce a reliable avoidance coping subscale. Therefore, only the two-factor solution was adopted for scale development.

Table 5 gives the eigenvalues and common variance statistics from the principal components analyses for the components that were adopted for subsequent MINRES factor analysis and scale development. The final column shows the factor correlations between the rotated MINRES factors for the cases where there was more than one factor for a questionnaire.

Based on these considerations, 11 factors were available for scale development. Complex items that just met the \pm .30 criterion were excluded by removing items with a Kaiser index of factorial simplicity < .40. The results of scale development and item analysis are shown in Table 6. The penultimate column shows the number

Questionnaire	Ν	Eigenvalues	Common variance (%)	Correlations between MINRES factors
Job satisfaction	683	F1 8.97	40.77	65
		F2 1.71	7.76	
Mental ill-health	688	6.37	35.40	
Physical ill-health	689	4.50	37.53	_
Type A	686	3.73	26.64	
Locus of control	688	2.87	28.88	
Sources of pressure	677	F1 15.80	25.91	Range: .32 to41
1		F2 3.90	6.39	0
		F3 3.35	5.49	
Coping	684	F1 5.08	18.15	.27
1 0		F2 2.66	9.51	

Table 5. Summary of principal component analyses of the OSI questionnaires

Note. The factor correlations in the right-hand column are between the rotated MINRES factors that were used to derive scales.

of non-scale items that correlated with a scale at a level higher than the mean ITC (item total correlation) for that scale, and gives an indication of item complexity. In practice there were few such items. The final column gives an indication of psychometric scale quality. A SQUAL of .50 represents 50% noise and 50% signal: only the physical ill-health scale has a SQUAL of < 50%, due to overlap with mental ill-health items.

Summary statistics were calculated to give an indication of the overall psychometric quality of the 11 OSI scales, using the revised scoring keys: the signal-tonoise ratio (SNR) was .79 (i.e. 80% signal; 20% noise); the overall test quality index (TQI) was .71; and test complexity (TC) was 18.11%. These figures are comparable to those for the Eysenck Personality Questionnaire-Revised (Eysenck & Eysenck, 1975; SNR = .89, TQI = .79, and TC = 5.00%), a six-scale normative version of Gordon's (1984) Survey of Interpersonal Values (SNR = .83, TQI = .721, TC = 16.67%), Psytech International's (Bondorowicz & Paltiel, 1994) 10-scale Occupational Personality Profiler (SNR = .80, TQI = .68, TC = 17.35%), and the new 16PF5 (Cattell, Cattell, & Cattell, 1994) 17-scale test (SNR = .71, TQI = .55, TC = 33.51%). For comparison purposes the 61-item OSI sources of pressure scale was scored using the published OSI sources of pressure scoring key. None of the OSI sources of pressure scales had adequate scale quality: the SNR for the whole questionnaire was only .24, the TQI was only .08, and test complexity was 83.61%. These results are an emphatic demonstration of the problems with the published OSI sources of pressure score key.

A correlation matrix was calculated for the 11 new scales. It will be noted from Table 7 that type A is negatively correlated with lifestyle coping, and positively correlated with occupational coping; intrinsic and extrinsic job satisfaction are strongly correlated; as are mental and physical ill-health; all three sources of

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Questionnaire	Items	M	SD	Coefficient alpha	Mean item: Total correlation	Number of non-scale items	squal
intrinsic job satisfaction	10	34.85	7.60	.87	09.	0	.59
Extrinsic job satisfaction	8	30.44	7.20	<u> 06</u>	.68	0	.74
Mental ill-health	18	55.38	13.68	89.	.53	1 (PIH)	.61
Physical ill-health	12	33.32	10.36	.85	.52	2 (MIH)	.48
Fype A	11	39.98	7.12	62.	.45	0	.90
Locus of control	8	26.31	4.44	.72	.41	0	.74
Managerial pressures	17	45.72	12.69	.86	.48	1 (EMPP)	.63
Employee pressures	15	51.36	12.30	.89	.57	0	.72
Workload	11	39.96	8.78	.85	.54	0	69.
Lifestyle coping	10	36.48	6.76	.76	.42	0	.86
Occupational coping	7	29.62	4.27	.78	.51	0	.90
Vote. The seventh column (number	r of non-scale it	ems) shows the	number of ite	ms that have high co	orrelations with a scale to whi	ch they do not belong.	

Table 6. Summary of item analyses and assessments of scale quality for the eleven proposed OSI scales

Key. MIH = Mental ill-health; PIH = physical ill-health; EMPP = employee pressures; SQUAL = scale quality—a high number indicates high quality.

Psychometric evaluation of OSI

	EJS	IJS	HIM	HId	TA	LOC	MSP	251	WKL	TCO	000
EIS	1.00	.67*	.38*	36*	+60 -	42*	08*	46*	45*	*60.	.08*
IJS) •	1.00	36*	35*	02	34*	06	51*	29*	01	$.10^{*}$
МІН			1.00	.66*	.03	.34*	.29*	.29*	.44*	06	35*
PIH				1.00	.14*	.33*	.27	.36	.39	01	17*
TA					1.00	02	.05	.17*	$.14^{*}$	21*	.18*
LOC						1.00	.16*	.40*	.38*	*60.	07
MSP							1.00	.51*	.52*	*60.	03
SSP								1.00	.55*	.14*	.05
WKL									1.00	.03	.02
LCO										1.00	.25*
000											1.00

Table 7. Correlation matrix for the 11 proposed OSI scales

= manageriai Kø. EJS = Extrinsic job satisfaction; IJS = intrinsic job satisfaction; MIH = mental ill-health; PIH = physical ill-health; TA = Type A; LOC = locus of control; MSP pressures; SSP = employee pressures; WKL = workload; LCO = lifestyle coping; OCO = occupation coping. pressure scales are moderately correlated; managerial pressures are unrelated to job satisfaction, whereas employee pressures are moderately negatively correlated with job satisfaction; mental ill-health is negatively correlated with occupational coping; and external locus of control is correlated with ill-health, low job satisfaction, and managerial and employee pressures.

A subsidiary analysis was conducted in which the 22 OSI job satisfaction items were formed into a single scale and correlated with the intrinsic and extrinsic job satisfaction scales. The latter scales were each correlated .90 (p < .001; N = 658) with the single scale.

Discussion

These analyses have shown that it is possible to derive a replicable structure for the OSI across samples from different occupations in two countries, and with different proportions of men and women. Of the published subscale score keys, only those for the ill-health scales were replicated. The scale quality was not very good for these two scales, mainly because of poor discrimination between them, which may reflect the influence of a latent psychological distress, or neuroticism factor.

The OSI manual claims that for the other questionnaires, subscales were identified through factor analysis, although the analyses were inadequately reported, and the sources of pressure scale was not factor analysed. In this research there was very poor, or even no correspondence between the solutions generated and the subscale score keys.

The solution reported here gives factors for physical and mental ill-health; one factor for type A, and one for locus of control; separate intrinsic and extrinsic job satisfaction scales; a perceived workload scale; an 'employee' sources of pressure scale, and a 'managerial role' sources of pressure scale; and two coping scales, labelled 'lifestyle' and 'occupational' coping. There is evidence of a fourth source of pressure to do with the supportiveness of home life, but further development would be needed to derive a reliable factor.

The arguments for multiple dimensions in job satisfaction are well documented (Brooke, Russell, & Price, 1988; James & James, 1989; Mathieu & Farr, 1991). Some multidimensional models make a distinction between intrinsic and extrinsic job satisfaction, and others distinguish job satisfaction facets. In an analysis of over 14 000 cases, Williams (1996) proposed a hierarchical model by grouping the OSI job satisfaction subscales into an intrinsic satisfaction factor comprising the subscales for achievement, and the job itself; and an extrinsic factor comprising the organizational design, organizational processes, and personal relationships subscales. Confirmatory analysis regression weights between the five factors varied from .70 to 1.0, indicating a high degree of redundancy, but the OSI job satisfaction subscales have not been replicated in the analyses reported here. Instead, the analyses confirm the findings of Lyne de Ver (1998) and Warr et al. (1979) that job satisfaction comprises intrinsic and extrinsic job satisfaction subscales that are correlated in the order of .50/.60, and which correlate with a general job satisfaction factor at around .90. Whilst there may be a lower level in the hierarchy, it seems unlikely that this level would be replicable across different settings.

The interpretation of the distinction between extrinsic and intrinsic job satisfaction is open to debate. Farr (1977) argued that the distinction between job satisfaction and job dissatisfaction (Herzberg, Mausner, & Snyderman, 1993), could be an artefact in which respondents attribute their satisfaction to their own qualities and their dissatisfaction to aspects of the working environment. These attributions may also be the foundation for the distinction between intrinsic and extrinsic job satisfaction, with intrinsic satisfaction reflecting the individual's experience of their own job, and extrinsic satisfaction reflecting satisfaction with aspects of the working context.

The OSI sources of pressure questionnaire is problematic: replicability of various factor solutions for this questionnaire between the sales staff and the other two staff groups was less than for other scales. This may be because self-reported sources of pressure vary so markedly between different occupational contexts that it is unrealistic to try to detect general factors, although part of the problem may lie in the questionnaire itself since it was published without pilot testing (Kline, 1986). Simple structure was examined for three- to six-factor solutions and a large number of items were rejected for each solution. None of the solutions were at all similar to the OSI score key, and therefore there was no support for the *a priori* classification that underlies the published subscales. The three-factor solution that was finally adopted includes a measure of perceived workload, which, judging from the items, is similar to 'psychological demand' (Karasek, 1979; Karasek, Schwartz, & Theorell, 1982; Karasek & Theorell, 1990).

Table 7 shows that the three sources of pressure scales are moderately correlated, and that job satisfaction is moderately correlated with employee pressures and workload, but not with managerial pressures. The low correlation between managerial pressures and job satisfaction may be because the managerial factor has very little overlap with the job satisfaction scales: it comprises items about conflict between career and home life, and the managerial role, which do not feature in the job satisfaction measure. By contrast, nearly all of the items in the employee sources questionnaire are closely replicated in the job satisfaction scales. Given this degree of item overlap, it is incumbent on test users and researchers to demonstrate that any relationship found between 'sources' of pressure and job satisfaction 'effects' is not merely a confounded one. However, the fact that the correlation between employee sources and job satisfaction only explains approximately 25% of the common variance between the measures, suggests that people do discriminate between the instructions for indicating satisfaction versus perceptions of pressure.

One of the interesting findings is that the OSI 'home work' items divide into two groups: one group featured in the workload measure; the other group featured in the managerial pressures scale in the three-factor solution, and in a supportive/ unsupportive home environment scale in the four-factor solution. These two aspects of the relationship between home and work could be worthy of further investigation. Whilst the three-factor solution to the sources of pressure questionnaire was the most congruent across the samples studied here, this may not be the best solution in psychological terms. With further development it is possible that four reliable factors would emerge, and that the supportive home dimension would stand on its own. The locus-of-control questionnaire is the most strongly criticized in the OSI literature (Rees & Cooper, 1992b; Robertson *et al.*, 1990; Williams, 1996). Whilst there was no evidence for locus-of-control subscales, the eight-item locus-of-control scale derived from these analyses had satisfactory psychometric properties. Interestingly, it also had moderate correlations with employee sources of pressure and workload, suggesting that externals are particularly sensitive to workload demands (or may have difficulty in controlling workload) and, as might be expected, that externals may be more dissatisfied with their working environment than internals.

By contrast the type A scale had only modest correlations with the other scales. This construct is of historical significance because of its hypothetical role in coronary heart disease (Friedman & Rosenhaum, 1974). However, in a metaanalytic review, Booth-Kewley and Friedman (1987) found that the relationship between the type A behaviour pattern and disease outcome was weak, especially when measured using questionnaire scales, giving correlations of about r = .07between the measure and disease outcome. The construct performs better when assessed using structured interviews, giving correlations of about r = .34. Furthermore, the authors discovered that depression and anxiety were better predictors of disease outcome than type A measures. Miller and Turner (1991) took issue with these authors in a more recent review, and argued that the type A behaviour pattern is prognostic of disease outcome, although they agreed that questionnaire scales perform badly compared to a structured interview approach. More recent research suggests that only certain aspects of the type A construct are relevant to disease outcome (Roger, Nash, & Najarian, 1995). The OSI scale was published at about the same time as some of the doubts about type A were voiced. The OSI type A questionnaire may now be obsolete and could be replaced, either by interview schedules, or by a second generation questionnaire that targets the aspects of the type A construct most likely to be implicated in health outcomes.

There is a growing consensus that there are three replicable coping constructs, representing rational, or task-oriented coping, emotion-focused coping, and avoidance coping (Endler & Parker, 1990; Ingledew *et al.*, 1996; Roger *et al.*, 1995). However, it has been argued that in some questionnaires emotion-focused coping is merely confounded with psychological distress (Deary *et al.*, 1996; Lyne de Ver, 1998; Stone, Greenburg, Kennedy-Moore, & Newman, 1991). The OSI coping scale produced two factors for lifestyle coping and occupational coping. Judging by the items, the latter is similar to the rational/task-oriented coping construct, whereas the lifestyle factor is unique and therefore worthy of further investigation in its own right.

These analyses suggest a structure for the OSI that is in conflict with the published score keys, but not with the OSI model itself: sources of pressure, mental and physical ill-health, job satisfaction, coping, type A, and locus of control all remain. Therefore, it would be possible to use the new score key to specify a revised version of the OSI model shown in Figure 1. This model might state that for managers and supervisors the three sources of pressure scales would interact with the four scales for type A behaviour pattern, coping (two scales) and locus of control, to produce effects on job satisfaction and physical and mental ill-health.

According to Robertson *et al.* (1990) there would also be direct effects between the moderating variables and the outcome measures. For staff without supervisory responsibilities only two of the sources of pressure scales would be relevant.

Examination of the correlations in Table 7 suggests alternative models. For example, there may be two higher order latent variables, one for mental and physical ill-health and the other for employee pressures and job satisfaction. Workload or psychological demand may be the only important source of pressure. Occupational coping may be a moderating variable for mental ill-health, whereas type A may be more relevant to physical ill-health. The OSI locus-of-control measure may be an important moderating variable for all of the outcome measures (Williams, 1997), despite its bad press in the OSI literature. These ideas are speculative and there are other possibilities, but it is clear that the new OSI scales, if replicated, might be useful to both practitioners and theoreticians.

Conclusions

This study could be criticized on the grounds that response rates were low, varying from 20–50%. Higher response rates would have been desirable, although the degree of congruence in the solutions across widely different populations is reassuring. Given the lack of rigorous work on the structure of the OSI, and the failure to publish adequate statistics with the test, there is a good case for reporting the present results, if only to stimulate others with more complete and extensive data to attempt to falsify our findings.

These analyses suggest that the OSI has a meaningful factor structure that is similar to the published structure at the level of individual questionnaires, but which diverges considerably at the level of subscales. The proposed structure is parsimonious and supported by a detailed psychometric assessment. One of the most important assets of the OSI is the immense amount of data that has been collected, providing valuable normative information. Unfortunately these norms have been published on the basis of a score key which, if the present results are replicated, should be abandoned. This does not mean that the normative data is valueless, but rather that it may need to be recalculated around a new solution (see Appendix below). Whilst this paper may not have unearthed the definitive solution (for example, we did not explore the possibility of specific item redundancy) it indicates most of the work that needs to be done, and which we believe should be done on the extensive data held by the test authors. Such a re-analysis would undoubtedly stimulate further research.

Even with an improved factor solution there remain problems with the OSI, some of which could have been dealt with from the beginning, had the test been developed using conventional psychometric standards. The most interesting of these lie in the sources of pressure scale, which incorporates a poorly developed factor to do with the supportiveness of the home environment that may be worthy of further development.

The model that was originally assumed to underpin the OSI is rarely mentioned in the literature, and no test has ever confirmed it; essentially the OSI has been treated as a collection of scales. In many cases there are better published alternatives for these scales, but few with such extensive normative information, and the OSI has potentially useful and unique features, including a lifestyle coping measure that has been revealed by these analyses.

Further work is now needed to replicate the present analyses, and many researchers have the data necessary to do this. It is also necessary to assess the plausibility of the OSI model, possibly using structural equation modelling with the new subscales. However, even if the model proves to be plausible, since most of the existing data are cross-sectional, and by definition self-reported, this would not constitute a definitive test, and further research would be needed using longitudinal research designs (Zapf, Dorman, & Frese, 1996) with objective as well as subjective measures.

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Appendix: Revised OSI score key using item numbers from the OSI

1. How you feel about your job

Extrinsic job satisfaction: 1 2 3 7 8 9 10 13 17 18 20 21 Intrinsic job satisfaction: 4 5 6 11 12 14 16 22

2. How you assess your current health

Part A: How you feel or behave

Mental ill-health; as for OSI score key

Part B: Your physical health

Physical ill-health; as for OSI score key

3. The way you behave generally

Type A: + ve 2 3 6 7 10 13 14; - ve 1 4 9 12

4. How you interpret events around you

External locus of control: + ve 1 2 4 6 8 10 12; - ve 11

5. Sources of pressure in your job

Managerial pressures: 3 5 14 19 25 32 34 36 38 41 46 49 50 51 55 56 57 59 60 Employee pressures: 2 8 9 10 11 12 16 18 22 27 30 33 35 39 52 58 Workload: 1 17 21 23 28 40 42 44 45 47 48 61

6. How you cope with stress you experience

Lifestyle coping: 4 7 11 12 13 16 17 20 23 25 28 Occupational coping: 1 8 9 15 19 21 22