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# Personality and Individual Differences

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## Mokken scaling analyses of the Personal Disturbance Scale (DSSI/sAD) in large clinical and non-clinical samples

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### ABSTRACT

The responses of a predominantly British sample of 479 persons undergoing psychiatric treatment (as in- and out patients), and two British samples from the general population, on the Personal Disturbance Scale (DSSI/sAD), were separately subjected to Mokken scale analyses. In all three instances, moderately strong, reliable and statistically significant Mokken scales were produced from the 14 item pool. These scales showed strong similarity in having seven items in common from their respective 10, 10 and 9 item Mokken scale solutions. These results, establishing a hierarchical item ordering, offer further validation for the DSSI/sAD.

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### 1. Introduction

The Personal Disturbance Scale (DSSI/sAD) is a self-report questionnaire which assesses the mood states of anxiety and depression (Bedford & Foulds, 1978a; Bedford, Foulds, & Sheffield, 1976). It forms a part of the lowest level (dysthymic states), or most commonly occurring level of psychopathology, in the hierarchy of personal illness model (Foulds, 1976). This model posited a logically inclusive, non-reflexive relationship of illness classes ranging down from non-integrated delusions to integrated delusions, neurotic symptoms and, finally, dysthymic states. The model was explained and assessed with the responses of in-, out and day psychiatric patients and non-patients by Foulds and Bedford (1975). Given that the vast majority of responses differentiated between patients and non-patients at extremely high levels of statistical significance, and conformed to the patterns generated by this model, these anxiety and depression items were the logical and economical basis for a brief screening scale of psychological distress. A review of the subsequent widespread use of the measure in a variety of settings was reported by Bedford and Deary (1997). They also demonstrated that the sAD's item structure may be interpreted within three current conceptualisations of

mood: (1) that of general psychological disturbance; (2) that of clinical states of anxiety and depression; and (3) that of 'normal' mood dimensions of hedonic tone and tense arousal. Only the first of these concepts is the concern of the present report. This article was also one of a sequence that examined and cross-validated the factor structure of the sAD (e.g. Bedford, Grant, De Pauw, & Deary, 1999). Likewise, a series of epidemiological genetic studies involving Australian and American authors reported on sAD data gathered from the Australian National Health and Medical Research Council Twin register including factor analyses (e.g. Kendler, Heath, Martin, & Eaves, 1986, 1987; Eaves, Eysenck, & Martin, 1989). Bedford (2000) briefly updated the findings with regard to reliability and validity. Another important development was the provision of updated United Kingdom general population normative data (by age and sex) with quartile tables (Henry, Crawford, Bedford, Crombie, & Taylor, 2002).

Based on recent success in identifying hierarchical scales in some commonly used psychological inventories (Bedford et al., 2010; Stewart, Watson, Clark, Ebmeier, & Deary, 2010; Watson, Deary, & Austin, 2007; Watson, Deary, & Shipley, 2008a; Watson, Roberts, Gow, & Deary, 2008b), to be described below, we considered it of interest to investigate, through the application of one type of item response theory (IRT): the Mokken Scaling Procedure, whether there was a hierarchy of items in the sAD's items. Mokken scaling, a non-parametric variant of IRT, enables the investigator to

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examine items in a scale for rank ordering. Therefore, individuals responding to the scale may themselves be rank ordered (Sijtsma & Molenaar, 2002). As this technique is not well known compared with, for example, Guttman scaling and the various forms of factor analysis, Mokken scaling will be described below.

Mokken scaling is derived from Guttman scaling (Stouffer et al., 1950), but is distinct in that it is stochastic rather than deterministic (Mokken & Lewis, 1982), and is able to analyse polytomous items (Sijtsma, Debets, & Molenaar, 1990). The outcome of a Mokken scale can be considered like the rungs of a ladder. In this analogy, height is the latent trait and the rungs of the ladder are the items. When the ladder is vertical, the rungs are ranged from low to high and all the rungs represent a particular height on the ladder. Clearly, there is a relationship between the rungs and the ladder: as you climb the ladder you gain more height and the rungs of the ladder are related to one another through their relative positions on the ladder. Returning to questionnaires and the measurement of latent traits, Mokken scaling procedure analyses multivariate datasets for items that are related to one another by the extent to which they measure the underlying latent trait. For example, recent studies of some very extensively used psychometric inventories have revealed such relationships for the General Health Questionnaire (GHQ)-30 items (Watson et al., 2008a), the personality traits of the NEO-FFI (Watson et al., 2007) and of the EPI (Watson et al., 2008b), and for psychological distress as assessed in the CORE-OM questionnaire (Bedford et al., 2010). Using the example of mental health as measured by the GHQ-30, Watson et al. (2008a) demonstrated that there was a hierarchy of nine items ranging from being unable to face problems, through increasing levels of poor mental health such as loss of confidence up to suicidal ideation. Thus, the ordering of the items describing aspects of mental health along the latent trait of mental ill health was demonstrated. Similarly, with the widely employed CORE-OM questionnaire, a six-item scale was derived from the total scale (34 items), which ran from mild distress through to “Making plans to end my life” and, from the 28 non-risk items, an eight-item scale was obtained running from feelings of unease through to feelings of “Panic or terror” (Bedford et al., 2010).

## 2. Method

### 2.1. Subjects

(a) Bedford and Foulds (1978b) provided sAD data on members of the general population, which were re-analysed in the present investigation. The 234 non-patient subjects (female = 148, male = 86) were a convenience sample of United Kingdom residents, being non-graduate hospital personnel or attenders at educational and recreational classes. Their mean age was 27.3 years (SD = 10.1).

(b) Henry et al. (2002) collected sAD data from 758 members of the British general adult population (females = 422, males = 336). Participants were recruited from a wide range of sources including commercial and public service organizations, community centres, and recreational clubs. The mean age of the sample was 39.9 years (SD = 15.8) with a range of 16–91 years.

(c) Bedford and Foulds (1978b) also provided sAD data on psychiatric patients, which were similarly re-analysed in the present investigation. These were 253 in-patients at English, Scottish and Canadian hospitals assessed within one week of admission (females = 142, males = 111). One hundred and eighteen outpatients were seen at their first appointment (female = 59, male = 59), and 109 day patients within their first week of attendance (female = 64, male = 45). The total number of patients was, therefore, 479 with mean age 33.6 years (SD = 12.2).

### 2.2. Measure

The sAD is a 14 item self-report questionnaire, consisting of seven items each to assess anxiety and depression. If a statement is endorsed as being “True”, as opposed to “False”, the respondent chooses between three options regarding the degree of severity (e.g. “This has upset me” – “A bit, A lot or Unbearably”). Scoring per item is, therefore, zero to three and, for the total sAD scale, zero to 42.

### 2.3. Mokken Scaling Procedure (MSP)

Data were stored on SPSS databases and saved in tab-delimited form with the spreadsheet option turned off. This produced a file that could be imported to the Mokken Scaling Procedure (MSP) for Mokken scaling analysis. Recent experience with MSP (Watson et al., 2007, 2008a, 2008b) indicates that the default settings in the program are sufficient for robust analysis; therefore, these were used for the present analysis.

The MSP generates a range of criteria related to scalability of items ( $H$ ; which should be  $>0.3$ ), reliability ( $\rho$ , which should be greater than 0.7) and probability ( $p < 0.05$ ) which takes into account the multiple iterations involved in the procedure. In addition, the MSP allows inspection of criteria related to IRT that indicate the monotone homogeneity of items: the extent to which an item score increases as the latent trait increases; and the double monotonicity: the extent to which the items in a scale do not intersect. Both monotone homogeneity and double monotonicity are desirable properties of a good scale and the analysis involves removing items individually which violate either or both of these criteria until a good scale is produced. All 14 items were entered into the MSP to investigate the relationship, in hierarchical terms, of items from both the anxiety and depression aspects of the DSSI/sAD.

### 2.4. Invariant item ordering (IIO)

In view of recent criticism of the methods used to investigate monotone homogeneity and double monotonicity and some confusion over their relationship to the ordering of items in a Mokken scale (Meijer, 2010; Watson & Deary, 2010) we consider that these criteria should be considered in some detail here. In so doing we express our gratitude to Meijer and colleagues for their attention to these issues in our previous papers, already cited above.

In the present study we used  $H$  (Loevinger's coefficient)  $>0.3$ , the default setting on the MSP, to establish if there was a hierarchical ordering of people responding to a set of items from the database. Such an observation is the minimum requirement in establishing the existence of a possible Mokken scale. However, further diagnostic procedures, available in the MSP, are required to establish monotone homogeneity of items and non-intersection of items. In the present analysis we used the summary per item score output in the MSP to assess monotone homogeneity. This output produces a diagnostic ‘Crit’ value for each item which, according to the MSP5 for Windows manual (Molenaar & Sijtsma, 2000; p. 66) “combines evidence about the item's  $H$ -value, the frequency and the size of the violations and their significance”; Crit values  $<40$ , while not perfect, are acceptable for the retention of items in the putative Mokken scale. For the estimation of double monotonicity of the item step response functions we used the rest-score method, described by Molenaar and Sijtsma (2000). The rest-score method produces a Crit diagnostic which can be used in the same way as in the check for monotone homogeneity. While the methods outlined above are not perfect in terms of estimating IIO of items (they analyse item step response functions) and can, at best, imply it – they are the best available methods at the time

of conducting the present analysis. We are aware of a more sophisticated method of estimating IIO on the horizon which analyses the DMM of polytomous items directly where first IIO is investigated and then the coefficient  $H^T$  is used that checks the ordering of respondents on the items to see if the item response functions intersect. However, at the time of conducting the present analysis, this had not been fully published (Sijtsma, Meijer, & van der Ark, in press), nor available in the MSP5 programme (Molenaar & Sijtsma, 2000).

### 3. Results

The outcomes of the Mokken scaling analyses are shown in Tables 1–3. Table 1 shows the analysis of the Bedford and Foulds (1978b) convenience sample, Table 2 shows the analysis of the Henry et al. (2002) general population sample and Table 3 shows the analysis of the Bedford and Foulds (1978b) clinical sample.

In both non-clinical samples (Tables 1 and 2), 10 of the 14 items are retained in the Mokken scales, with eight items being common to both scales. The ‘anchoring’ first three items (most difficult items with lowest mean scores) involve identical items being 6, 13 and 14. These items describe suicidal ideation (‘So depressed that I thought of doing away with myself’), the contemplation of death as an escape from problems (‘Gone to bed not caring if I never

**Table 1**  
Mokken scaling analysis of Bedford and Foulds (1978b) convenience sample.

Item number	Mean score	H	sAD item abbreviated content
6	0.03	0.57	Gone to bed not caring if I never woke up
14	0.06	0.45	So depressed that I thought of doing away with myself
13	0.07	0.48	So anxious that I couldn't make up my mind about the simplest thing
2	0.10	0.37	So miserable that I have had difficulty with my sleep
4	0.13	0.36	So 'worked up' that I couldn't sit still
1	0.15	0.43	I have worried about every little thing
7	0.15	0.44	For no good reason, I have had feelings of panic
10	0.16	0.31	The future has seemed hopeless
8	0.19	0.50	So low in spirits that I have sat for ages doing absolutely nothing
5	0.23	0.51	Depressed without knowing why

$n = 234$ ;  $p = 0.00034$ ;  $H = 0.43$ ;  $\rho = 0.86$ ; mean = 1.3 (SD = 2.6); Skewness = 3.41; Kurtosis = 15.05.

**Table 2**  
Mokken scaling analysis of Henry et al. (2002) general population sample.

Item number	Mean score	H	sAD item abbreviated content
14	0.12	0.48	So depressed that I thought of doing away with myself
13	0.16	0.45	So anxious that I couldn't make up my mind about the simplest thing
6	0.16	0.46	Gone to bed not caring if I never woke up
7	0.17	0.40	For no good reason, I have had feelings of panic
1	0.28	0.41	I have worried about every little thing
5	0.29	0.47	Depressed without knowing why
2	0.38	0.44	So miserable that I have had difficulty with my sleep
11	0.43	0.41	Worrying has kept me awake at night
9	0.48	0.36	I have had a pain or tense feeling in my neck or head
8	0.55	0.41	So low in spirits that I have sat for ages doing absolutely nothing

$n = 758$ ;  $p = 0.0005$ ;  $H = 0.42$ ;  $\rho = 0.83$ ; mean = 3.0 (SD = 4.4); Skewness = 1.89; Kurtosis = 3.29.

**Table 3**  
Mokken scaling analysis of Bedford and Foulds (1978b) clinical sample.

Item number	Mean score	H	sAD item abbreviated content
6	0.70	0.46	Gone to bed not caring if I never woke up
14	0.82	0.43	So depressed that I thought of doing away with myself
13	0.98	0.48	So anxious that I couldn't make up my mind about the simplest thing
2	1.05	0.44	So miserable that I have had difficulty with my sleep
11	1.12	0.45	Worrying has kept me awake at night
7	1.14	0.39	For no good reason, I have had feelings of panic
1	1.19	0.43	I have worried about every little thing
5	1.24	0.42	Depressed without knowing why
10	1.35	0.46	The future has seemed hopeless

$n = 479$ ;  $p = 0.0005$ ;  $H = 0.44$ ;  $\rho = 0.86$ ; mean = 9.6 (SD = 6.6); Skewness = 0.35; Kurtosis = -0.75.

woke up’), and a gross impairment in decision making (‘So anxious I couldn't make up my mind about the simplest thing’). The hierarchical nature of the latent trait that both scales describe is very similar. The least difficult items in both scales (i.e. those with the highest mean scores) describe inactivity or low spirits (‘So low in spirits that I have sat for ages doing absolutely nothing’). As the difficulty of the items increases, anxiety and worries are described through problems with sleeping, irrational fears (‘For no good reason I have had feeling of panic’) and fretting (‘I have worried about every little thing’). Therefore, in the general population, there is a hierarchy of personal disturbance running from generalised low spirits through anxiety to thoughts of death or suicide. There are only two items which do not appear in either scale; these are item three, ‘Been breathless or had a pounding of my heart’ and item 12, ‘Lost interest in just about everything’, which may refer to different aspects of psychopathology.

For the Bedford and Foulds (1978b) clinical sample (Table 3), nine of the 14 items are retained and this scale has seven of the same eight items in common with both of the scales in Tables 1 and 2. The first three anchoring items in this scale are identical to those in the non-clinical samples being items 6, 13 and 14. The items retained in the scale are all, obviously anxiety and depression related running from a sense of hopelessness (‘The future has seemed hopeless’) through anxiety (‘For no good reason I have had feelings of panic’) and sleep disturbance (‘Worrying has kept me awake at night’) to thoughts of suicide and death. The clinical sample, therefore, appears to order this set of very focused items hierarchically. The excluded items are as before 3 and 12, to which are now added items 4 (‘So ‘worked up’ that I couldn't sit still’), 8 (‘So low in spirits that I have sat for ages doing absolutely nothing’) and 9 (‘Had a pain or tense feeling in my neck or head’).

In the absence of any formal methods to assess the similarity between analogous Mokken scales, as is possible in the evaluation of congruence in factor analysis using Wrigley and Neuhaus (1955) coefficients, the following procedure – previously reported by Watson, Deary, and Lea (1999) – was adopted. To quantify the similarity between the three derived Mokken scales, the eight items in common were rank ordered and Spearman correlations were computed separately between each pair of scales. The correlation between the two non-clinical samples was 0.64, between the convenience sample and the clinical sample it was 0.96, and between the general population sample and the clinical sample it was 0.68. This method provides a crude estimation of the extent to which items, common to a set of Mokken scales, appear in the same rank order and provides some insight into the similarity between scales obtained from very different populations.

**Table 4**  
Percentage of items retained in a range of Mokken scales.

Scale	Number of items	Percentage of original
<i>Symptom-state measures</i>		
sAD <sup>†</sup>	9	67
sAD <sup>‡</sup>	10	71
sAD <sup>#</sup>	10	71
GHQ	9	30
CORE-OM (risk)	5	34
CORE-OM (non-risk)	8	28
<i>Personality trait measures</i>		
EPI (N)	12	50
EPI (E)	5	24
NEO-FFI (C)	11	92
NEO-FFI (N)	11	92
NEO-FFI (E)	6	50
NEO-FFI (O)	6	50
NEO-FFI (A)	3	25

<sup>†</sup> Clinical sample.

<sup>‡</sup> Convenience sample.

<sup>#</sup> General population sample; EPI, Eysenck Personality Inventory; NEO-FFI, NEO Five-Factor Inventory; N, Neuroticism; E, Extraversion; O, Openness; C, Conscientiousness; A, Agreeableness.

The only distinguishing feature between the scales of the clinical sample and the two non-clinical samples is the considerably higher item mean score for the clinical sample. The former had a mean of 9.6 (SD = 6.6) compared with the latter which had means of only 1.3 (SD = 2.6) and 3.0 (SD = 4.4) respectively. So, in all instances, moderately strong, reliable and statistically highly significant Mokken scales are produced and the scales from the three databases show remarkable similarity.

To place the current results in the context of similar studies it is appropriate to examine their item retention rates i.e. the number of items constituting a derived Mokken scale as a percentage of the number of items in the initial item pool. The relevant figures for the current findings and earlier cited published studies involving symptom-state and personality trait measures are shown in Table 4. The three sAD Mokken scale retention rates greatly exceed those of the other three symptom-state scales and compare favourably with the seven scales of the two personality trait scales.

#### 4. Discussion

Each of three separate samples produced a highly satisfactory Mokken scale of 9–10 items from the 14 items of the sAD. Seven items were common to all three solutions and were anchored by the same three items whose content involved the severest levels of psychological distress namely suicide and nihilism. This fatalism is precisely that found in the Mokken scaling exercises with both the GHQ-30 items (Watson et al., 2008a) and the CORE-OM items (Bedford et al., 2010), confirming that this is the nadir of psychological disturbance, distress and despair. By contrast to this high concordance between the results of the three MSP analyses, two items failed to feature in any scale. These were item 3 'Been breathless or had a pounding of my heart' and item 12 'Lost interest in just about everything'. There is an obvious weakness in item 3 because of its dual aspect (but this equally applies to item 9) and, of course, it can be endorsed positively by those with common medical ailments. Item 3, while an expression of anxiety, is somatic as opposed to purely psychological and may not scale consistently with the remaining items. Item 9, referring to 'pain or tense feeling in neck or head' (also a dual item and somatic) did appear but only in one of the scales (Table 2). It is also possible that item 12 ('Lost interest in just about everything') does not scale consistently with the remaining items as it is not clear where it might sit hierarchically in the scale. Loss of interest could occur early or late in personal disturbance or may result from phenomena other than

personal disturbance. It may, therefore, be more individually determined than items which are unequivocally anxiety/depression related.

While new hierarchical information about a questionnaire's items is gained through a Mokken scaling analysis other information is lost in that some items are discarded. Conversely, in the initial test construction the intention will have been to represent the concept as fully as possible whilst excluding irrelevant items. This is referred to by Messick (1994) as "Authenticity" versus "Directedness". "Authentic" items are those which fully describe the latent trait, but which may do so at the expense of also describing other traits. "Direct" items relate only to the latent trait but may not describe it fully. In factor analytic terms the former have appreciable cross-loadings and the latter do not.

In questionnaires where a high percentage of items are retained after Mokken scales, as in this study, a high percentage of the original items are good direct descriptions of the unidimensional trait i.e. personal disturbance.

#### 5. Conclusion

Bedford and Deary (1997) provided detailed information on the application of the sAD with a variety of general population, medical and clinical samples from English and non-English speaking countries. These studies contain data pertaining to the various forms of test reliability and validity. Subsequent research added to the accruing supporting evidence. However, at that time the item pool had not been examined in terms of its items' hierarchical properties as can be ascertained by the Mokken scaling procedure. The current study fills that omission and thus adds substantially to the empirical evidence validating the sAD scale as a measure of psychological distress.

Additionally, the findings now offer the possibility of deriving an sAD Mokken scale per individual by selecting items from the existing questionnaire, the items being 1, 2, 5, 6, 7, 13 and 14. It is hoped to produce relevant normative data to enable such usage.

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#### Appendix. Personal Disturbance Scale (DSSI/sAD) items

The state of anxiety items are indicated by an asterisk.

1. Recently I have worried about every little thing.\*
2. Recently I have been so miserable that I have had difficulty with my sleep.
3. Recently I have been breathless or had a pounding of my heart.\*
4. Recently I have been so 'worked up' that I couldn't sit still.\*
5. Recently I have been depressed without knowing why.
6. Recently I have gone to bed not caring if I never woke up.\*
7. Recently, for no good reason, I have had feelings of panic.\*
8. Recently, I have been so low in spirits that I have sat for ages doing absolutely nothing.
9. Recently I have had a pain or tense feeling in my neck or head.\*
10. Recently the future has seemed hopeless.
11. Recently worrying has kept me awake at night.\*
12. Recently I have lost interest in just about everything.\*
13. Recently I have been so anxious that I couldn't make up my mind about the simplest thing.\*
14. Recently I have been so depressed that I thought of doing away with myself.

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