Developing a Psychometric Model for Risk Assessment: The Case of the RAMAS.

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ABSTRACT

An application of a psychometric model of psychiatric risk is presented. The particular model used is a stochastic cumulative item response model. It is argued that, given our current state of knowledge in risk assessment, psychometric modelling has much to offer in complementing the more typical prediction/classification approaches that dominate actuarial research in risk assessment.

The present model is applied to the risk checklist component of the Risk Assessment, Management and Audit System (RAMAS). The model is fitted using Multiple Mokken Scaling analysis and a clear construct validity emerges. The relationship of the risk scales to clinical judgements and patient presenting problems is examined and provides further support for the model. The potential for applying more sophisticated cumulative models is discussed with particular emphasis on longitudinal assessment.

Background

The literature on psychiatric risk assessment reveals a host of difficulties which have militated against the practical application of much of the interesting research. There appear to be 4 main difficulties. First, the constructs of dangerousness and risk are not well defined. Second, the outcomes by which risk assessments may be validated are often unclear and unreliable. Third, there is still insufficient understanding of the interaction between risk indicators. Finally, the essentially normative focus of much risk assessment research does not always map onto the essentially idiographic task of assessing an individual patient.

There have been a number of reviews of the history, philosophy and legal implications of dangerousness (McGinley 1995) which serve merely to highlight the diversity of the concept. The Butler Committee (1975) defined dangerousness as *"a propensity to cause serious physical harm or lasting psychological harm*" while Scott (1977) defined it as "*an unpredictable and untreatable tendency to inflict or risk serious, irreversible injury or destruction, or to induce others to do so*". These definitions are widely used but they are not universally accepted (Faulk 1988).

The bulk of the literature on risk assessment either, explicitly or implicitly, rejects the use of Scott's term *unpredictable.* Resource and effort are expended in order to clarify those characteristics that may be utilised in the prediction of dangerous behaviour (Klassen and O'Connor 1988; Clark, Fischer and McDougall 1993; Monahan and Steadman 1994; Harris, Rice and Quinsey 1993). McGinley (1995) argues that '*..if dangerousness is by definition unpredictable, in the fullest sense of the term, referring to the irreversible injury of the index offence and the possibility of its re-occurrence, then only the option of total and limitless secure provision would be available to guarantee the protection of the public.'*

What emerges from this literature is that measures of risk are contingent on the judgement of observers that problematic behaviour may reoccur in the future. Furthermore these judgements are based largely upon what the subject has done, or threatened to do (Copas, Ditcburn and Marshall 1994; Clark et al 1993; Monahan and Steadman 1994). This implies that dangerousness is a latent characteristic of the person in question.

The focus of most research into psychiatric risk is mainly centred upon dangerousness or the risk of violence or harm to others. This emphasis is understandable given growing public concern towards acts of violence perpetuated by psychiatric patients in the community (Richie, Dick and Lingham 1992; Reed 1992; O'Rourke, Hammond and Davies 1997). However, it serves to hide other important areas of risk that pertain to the psychiatric services. Thus the risk of self-harm and suicide also takes a central place in risk assessment (Strosahl, Chiles and Linehan 1992; Banger 1994). Equally, the risk of mental deterioration and impending breakdown is a vital aspect of monitoring care in the community (Department of Health 1993; O'Rourke 1995).

A further problem facing those wishing to integrate the literature of risk assessment into their own practice is the discrepancy between the practitioner with an inherently idiographic problem and the researcher who typically approaches the problem from a normative perspective. Research in psychiatric risk assessment has been widely concerned with building statistical models for the prediction of a dangerous or problematic behaviour (Hassin 1986; Christiansen 1986; Monahan and Steadman 1994; Copas, Ditchfield and Marshall 1994; Harris and Rice 1997) and these require analysis of substantial samples from which generalisations are to be drawn.

An assumption upon which these analyses are based is that the outcome, or dependent, variable, is reliably identified and measured. Unfortunately this assumption is often difficult to justify. Putting aside problems in defining the outcome variable there are issues concerning the independence of the predictor variables with each other and also with the therapeutic context. Thus, for example, if a patient begins to show the precursors to self harming behaviour, health care practitioners will act to minimise this occurrence. In this way research within a clinical context is never likely to provide the background for the random effects that prediction/classification models often require.

Since Paul Meehl's seminal monograph in 1954 in the area of clinical decision making, there has been a clear divide between the procedures of clinically informed judgement and statistical prediction. It is generally found that statistical prediction is more accurate than pure clinical judgement and this has led to suggestions that risk assessment must be actuarially based and built around a transparent statistical model (Monahan 1981; Miller and Morris 1988; Klassen and O'Conner 1988; Monahan and Steadman 1994). The typical statistical approach is to build a linear or logistic regression model. However, a number of clinicians are uneasy about this trend since it relies very heavily on normative information and ignores valuable idiographic insights (Pollack 1990; Hammond 1995b). Thus, findings drawn from large scale statistical models, while of some general use, may not be directly applicable in a specific individual assessment. For example, Mullen (1984) has argued that dangerousness is a quality of an individual's actions rather than of the individual himself. The question to be posed in clinical practice is not "*is this person dangerous*?" but rather "*might this person in certain circumstances behave in a dangerous way?"* (Mullen 1984). Given that these circumstances are likely to be specific to the patient in question, it is important to recognise the value of the idiographic context in making an assessment of risk for a specific patient.

The dominance of the prediction/classification approach to risk assessment has led to a dearth of research exploring actuarial alternatives. It is perhaps not surprising, therefore, that there has been very little work on psychometric risk modelling. Under this approach the problem of risk assessment shifts from the *prediction or classification* of harmful behaviour to the *measurement* of underlying latencies. A psychometric latency is best viewed as a potential. Thus, a latent trait of dangerousness is a measurable construct indicating the potential for dangerous behaviour. The measurement is not direct but involves the modelling of a number of indicators to provide a reliable estimate of the trait.

Many existing risk assessment devices are simply lists of risk indicators or items, chosen for their perceived importance but not related to each other through any theoretically defensible structure. Risk scores are then commonly generated by a weighted or unweighted summation of the indicators (Nuffield 1989;

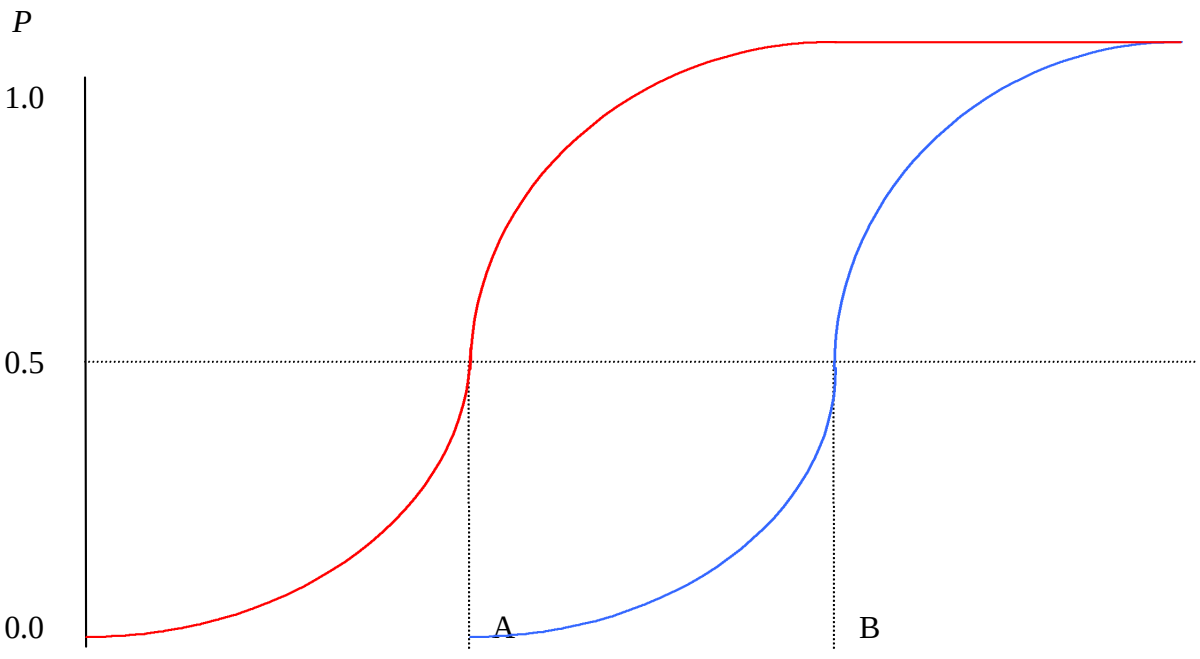
Harris, Rice and Quinsey 1993; Copas, Ditchfield and Marshall 1994). Two serious limitations of this approach exist. First, this approach implies that the indicators conform to an additive measurement model and yet this assumption is rarely tested. Second, the underlying latent structure, defined by the relationships between the indicators, is rarely made explicit so the construct validity of the resulting scores is usually suspect.

One of the founding fathers of modern psychometrics, Louis Guttman (1941) stated that, in the absence of reliable criteria for validation, one has to look at the relationships between the items themselves. This is a widely supported position (Niemuller and van Schuur, 1983; De Jong and Molenaar 1987**)** and is the basic premise of all latent trait models of measurement. Fitting empirical data to an a-priori model of systematic relationships between risk indicators (items) allows the construct validation of a risk assessment device. In addition, such a model can be used empirically to evaluate any theoretically justified ordering of items.

Psychometric modelling of risk has a number of distinct advantages over the traditional statistical models of prediction and classification. First, it imposes a clear and transparent measurement model on the assessment procedure which may utilise a mixture of clinical judgement and actuarial data. Secondly, the relationships between the risk factors or predictors is explicitly modelled. This provides the means examining the structure and meaning of the risk behaviour under examination. Third, using appropriate item response theory models it is possible to generate a statistical estimate of the underlying latent trait of dangerousness which is sample independent. Based on this principle the assessor is able examine the degree to which an individual patient fits the model, thus, unpredictable, ill-fitting, profiles can be readily identified. Finally, the reliability and validity of the risk assessment may be easily estimated using standard psychometric procedures.

This paper proposes a cumulative model of risk for psychiatric risk assessment. This is the simplest and strictest psychometric model and comes in a variety of forms, all of which have the advantage of simplicity and ease of interpretation as well as enabling clear additive measurement. A probabilistic, or stochastic, cumulative model is expressed in figure 1 where two risk factors are plotted in terms of their probability of occurrence (p) against the underlying latent risk (θ), in this case dangerousness. It should be seen that p, the probability that a given patient presents with a specific risk indicator, is a function of the incidence of the indicator (δ) and the degree of dangerousness (θ). These probability functions are known as the trace lines or item characteristic curves (ICCs).

Figure 1
The Trace Lines of 2 Risk Factors Demonstrating Double Monotonicity



δ_A δ_B

Risk (q) - - - - >

The major constraint imposed by the model is double monotony. This assumes that the risk indicators are ordered according to their incidence so that the probability of a low incidence risk indicator occurring is *always* lower that the probability of a high incidence indicator. Thus, the function for every item is assumed to have equivalent slope and we may assume that the trace lines for each risk indicator are essentially parallel to each other.

This is known as a one-parameter model because the only parameter that differentiates the items is the position along the θ axis. It is due mainly to Rasch (1966) and is sometimes termed the Rasch model. It reflects a probabilistic extension of an earlier deterministic model proposed by Guttman (1950) often termed the scalogram model. Procedures for fitting this model have been developed Rasch (1960), Fischer (1976) and Kelderman (1984). These provide the opportunity for generating powerful fundamental and additive measurements, however, they make quite specific assumptions about the distribution of the latent trait in question which cannot be taken for granted in psychiatric risk, the distribution of which has been under-explored. A more realistic model, given the exploratory nature of this study, is the cumulative stochastic model proposed by Robert Mokken (1971). This model is non-parametric in that it does not assume an underlying normal distribution for the latent risk.

Mokken's (1971) model may be fitted by applying the concept of psychometric homogeneity. The overall fit of the model is evaluated by the following formula:

$$H = \frac{\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \left(p_{ij} - p_i p_j \right)}{\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} p_i \left(1 - p_j \right)}$$

Where

p_i *= The proportion of times item i occurs,*

p_{ij} *= The proportion of times item i occurs and item j does not.*

An index for each item may be readily derived from this additive formula and a statistical index of fit may also be derived (Mokken 1971; Sijtsma and Molenaar 1987).

The purpose of the study reported here is to attempt to fit risk indicators derived from a well-used community psychiatric risk assessment device to a cumulative model. The cumulative model anticipates that certain behavioural and historical indicators will serve as the basic platform upon which risk analysis may be built. Degree of risk may then be viewed as an ordered accumulation of risk factors.

The risk indicators are taken from the Risk Assessment, Management and Audit System (RAMAS) which is grounded in theory and is designed for applicability to Mental Health, Probation, Police, GP and Social Work practice (O'Rourke 1995; Hammond 1995). The RAMAS seeks to improve upon and complement existing practices by being an objective and comprehensive approach which will ultimately allow actuarial audit of professional judgement of risk to be possible. It attempts to provide a profile of client's risk factors together with demographics, specific risk indicators and needs assessment. It also summarises vital information to enable practitioners to plan targets for intervention and change and to monitor and manage risk effectively.

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As such the RAMAS does not depend totally on its risk indicator checklist in order to make an assessment of risk, however, the scores derived from the checklist are designed to inform the clinical judgement of the assessor. The scale score indicates how far along the risk continuum the patient is and the assessor must then make a clinical judgement of the best action for managing that patient. The greater the objectivity and

reliability of the scale structure the more powerful the information. If a cumulative model can be fitted to the scales then the user has the added benefit of truly additive scales as well as the possibility of identifying ill-fitting individuals who may manifest idiosyncratic and unpredictable profiles.

Method

Risk Indicators

The 66-indicator checklist of clinical risk factors of the RAMAS was used for this study. These indicators were derived from the clinical and research literature and are described in detail in O'Rourke (1995). .

Data Collection

Sixty-six mental health practitioners working in a variety of mental health teams completed the RAMAS on patients on their caseload. The number of patients assessed by each practitioner for this study ranged between 1 and 7. Assessors were nurses, psychologists and a small number of medically trained personnel. Each assessor had completed a training course on the use of the RAMAS.

Two-hundred and fifty-eight completed forms were submitted for analysis. The patients in question were drawn from both inpatient and community populations and came from 4 sources, the crisis response service, forensic outpatients, the Community Mental Health Team and forensic inpatients. The percentage of the sample from each source is presented in table 1.

Table 1
Sources of Patient Information

Service	% of sample
Crisis response Service	32.25
Forensic Outpatients	22.58
Community MH Teams	17.20
Training Sessions	15.05
Forensic Inpatients*	12.90

**The Forensic Inpatient unit was a close supervision unit offering care to both mentally disordered offenders, and patients who had become difficult to manage in more open hospital environments.*

An additional 72 patients were identified for whom RAMAS forms were completed by more than one practitioner.

The practitioners were also asked to use their clinical judgement to indicate on a crude 3-point scale the degree of risk that they felt the patient in question presented. This scale was based on the categories Low, Medium or High risk. Clearly, this is a very subjective judgement but, made within the context of a consideration of patient data necessary for completing the RAMAS, it is perfectly in keeping with the rather subjective procedures practised widely in forensic psychiatry.

Data Analyses

A descriptive analysis of the sample and of the frequencies of the 66 risk factors was carried out. The structure of the RAMAS is examined in order to identify the most appropriate integration of the 66 risk factors into a meaningful index of risk. The cumulative Mokken scaling model was applied. Internal consistency indices of reliability and degree of model fit were calculated to provide estimates of psychometric quality.

Results

Background Information

The sample for these analysis consists of 258 patients receiving care by the Heathlands Mental Health Trust. The median age of the sample was 35 with the youngest patient at 16 years of age and the oldest at 88. Over half of the sample (66.42%) were married and 40.87% live with their partner. It was found that 29.24% of the sample live alone. This has some implication for risk assessment since the likelihood of support is lower for this group and early warning signs have a greater probability of being missed. A greater dependence on bed and breakfast and hostel accommodation than would be expected in the general population was found (14.38%). This highlights the likelihood of lower domestic stability among the

patient population with its attendant role in the risk of self harm and neglect. The mental health problems presented by the sample are reported in table 2. The highest incidence of problems was observed for diagnoses of Depression, Personality Disorder and Psychosis. The lowest incidence was for Abuse/Trauma and Eating Disorder.

Table 2
Presenting Problems of the Sample

Presenting Problem	%
Depression	31.4
Anxiety/ Stress/ OCD	12.7
Anorexia/ Eating Problems	2.5
Abuse/ Trauma	2.0
Mental Impairment/ Dementia	7.8
Personality Disorder	29.4
Substance Misuse	11.3
Psychosis/ Schizophrenia/ Hypomania	27.9

Note that some patients will have more than one problem.

Clinical Judgements
The practitioner ratings are presented in figure 2. Over 25% of the patients (26.7) were regarded as a low risk and approximately the same (27.1) were felt to present a medium risk. A lower percentage (12.4) were felt to present a high risk. One important finding on this question however was the high number of respondents who did not answer this question (33.7%). This may be viewed as a disturbing lack of compliance but feedback from the training sessions provided a more considered explanation. Many of the respondents did not feel competent to make a judgement of risk without input from other colleagues and they were justifiably concerned that their imprecise view was registered on a patients form. This highlights the need for the RAMAS to be used in the context of a team. Indeed, this is the context that it was originally developed for.

Incidence of Risk factors
The perceived incidence of each factor for the current sample is presented in table 3. The most frequently occurring indicators are the existence of some form of psychiatric medication (65.5%), a history of mental illness (65.13%) and current mental illness (63.57%). Given the source of the sample and the high incidence of psychotic and depressive presenting problems this is not a surprising finding. The least frequent risk factors concerned arson and hostage taking.

What is notable about these risk factors is the range of their frequency ranging from 1.55% (Recent fire setting) through to 65.5% (psychiatric medication). Risk factors of note are Threats to Injure (30.23%), Threats to Kill (18.60%) and Predatory Behaviour (13.95) as well as Suicidal Ideation (36.43%) and Risk to Self (41.47%).

Table 3
Percentage Incidence of RAMAS Indicators

Indicator	%	Indicator	%
11. On psychiatric medication	65.50	43. Considers staff helpful	24.42
1. History of mental illness	65.12	64. Unstable environment	24.42
2. Current mental illness	63.57	31. Drug problems	24.03
19. Anger/emotional problems	63.57	54. Multiple problems	24.03
55. Interpersonal conflicts	58.14	24. Considered risk to family and friends	23.26
20. Low self esteem	51.94	25. Considered risk to staff	21.71
18. Unpredictability	51.16	65. Denial of problems/risk	21.71
13. Recent hospital admission	49.61	14. History of childhood abuse	21.32
56. Social Isolation	20.16	49.61 23. Considered risk to patients	
9. History of aggression /violence	18.60	46.13 52. Threats to kill	
5. Unstable mental condition	43.02	61. Legal problems/cases pending	18.60
29. Impulsive	42.64	4. Atypical excitement or passivity	18.22
22. Considered risk to self	41.47	47. History of absconding	18.22
6. Paranoia	40.70	57. Recent bereavement	18.22
21. Unreliable	39.53	66. Refuses treatment	17.83
16. History of overdose or suicide attempt	39.15	44. Considers staff as a threat	16.28
15. History of self neglect	38.37	28. Disinhibited	15.89
3. Psychotic symptoms	37.21	39. Low IQ	15.50
10. Communication/Expression Problems	36.82	63. Predatory behaviours	13.95
17. Suicidal ideation	36.43	48. Recent absconding	13.18
8. Personality Disorder	35.66	58. Carries weapons	9.30
42. Unrealistic expectations	33.33	62. Criminal lifestyle preference	9.30
30. Alcohol problems	32.95	59. Use of force or weapons	8.91
53. Facing high levels of stress	32.17	34. Metabolic or endocrine disorder	7.75
7. Treatment unstable/failure	31.78	35. Organic illness/dementia	6.59
51. Threats to injure	6.02	30.23 33. Epilepsy or similar disorder	
12. Refusal/non-compliance with medication	28.29	36. Head injury	5.81
40. Problems with negotiation/compliance	27.52	37. Hearing sight problems	5.81
60. History of criminal convictions	25.97	49. History of hostage taking	5.04
26. Considered risk to strangers	25.58	38. Learning disability/chromosomal disorder	
	4.26		
32. Aggressive when intoxicated		25.58 45. History of arson	
	3.88		
27. Noncompliant/Uncooperative	24.81	50. Recent hostage taking	2.33
41. Oversensitive to advice/suggestions	24.42	46. Recent fire setting	1.55

Fitting the Cumulative Model

The results of the Mokken scale analysis were extremely satisfying. Three scales were clearly identified by an iterative process of scale refinement (Mokken and Lewis 1986). The first scale contained items relating to the harm of others and this is labelled the *Dangerousness* scale. The second scale contained items relating to mental illness stability is labelled the *Mental Instability* scale. The final scale contained items relating to the harm of self is labelled the *Self Harm* scale.

The parameters derived from the analysis of these scales shown in tables 4, 5 and 6 respectively in which the risk factors are listed in frequency order to identify the cumulative structure. The homogeneity index is

a coefficient indicating the degree to which each risk factor fits the specified model. Mokken argues that this coefficient should exceed 0.30 for a reasonable fit. In fact, the delta value gives a statistical test of fit. Delta is approximately normal with a mean of zero and a standard deviation of 1. This means that if delta is greater than 1.96 we have a statistical significance of $p<0.05$.

Table 4
The Dangerousness Scale

No.	Indicator	Homogeneity Index	Delta
59.	Use of force/weapons	0.47	21.08
58.	Carries weapons	0.45	20.61
62.	Criminal lifestyle	0.50	22.77
63.	Predatory behaviour	0.38	21.09
28.	Disinhibited	0.40	23.48
44	Considers therapist a threat	0.41	24.10
66	Refuses treatment	0.31	18.70
4	Atypical excitement	0.32	19.64
52	Threats to kill	0.43	26.35
61	Legal problems	0.36	22.40
23	Risk to other patients	0.40	25.13
25	Risk to staff	0.48	30.79
24	Risk to family	0.41	26.47
43	Considers therapist unhelpful	0.39	25.55
27	Non-compliant	0.36	23.35
26	Risk to strangers	0.52	33.47
32	Aggressive when intoxicated	0.30	19.51
60	History of criminal convictions	0.42	27.37
51	Threats to injure	0.54	34.11
7	Treatment unstable/failure	0.39	24.55
42	Unrealistic expectations	0.41	25.58
8	Personality disorder	0.37	22.71
21	Unreliable	0.47	28.11
6	Paranoia	0.46	27.22
29	Impulsive	0.53	30.85
9	History of aggression/violence	0.60	33.33
13	Recent hospital admission	0.34	17.68
18	Unpredictability	0.62	31.60
19	Anger/emotional problems	0.55	22.12
	Mokken's Homogeneity	= 0.52	
	Mokken's Delta	= 25.91	
	Mokken's Rho	= 0.93	
	Cronbach's Alpha	= 0.85	

Clearly, the items in the dangerousness scale all fit the model well and we can have a reasonable degree of confidence in the scale. The overall homogeneity of 0.52 and its attendant delta of 25.91 affirms the good psychometric quality of this scale. In addition, now that we have a specified structure we can assess the internal consistency of the scale. Two measures are used, Mokken's rho and Cronbach's alpha. Both of these coefficients provide evidence of good reliability.

The table reveals the order of the indicators in terms of their incidence. Thus the indicators at the top of the table are more extreme and atypical and the picture emerges that the dangerous individual is, at base, likely to manifest behavioural and psychological features of anger, unpredictability and a history of

aggression. The model tells us that it is most unlikely that an individual will present with one or more of the very serious indicators without also manifesting large numbers of those lower down the scale.

Table 5
The Mental Health Instability Scale

No.	Indicator	Homogeneity Index		Delta
48	Recent absconding	0.48	11.49	
47	History of absconding	0.42	11.80	
12	Non-compliance with medication	0.31		11.46
3	Psychotic symptoms	0.37	12.53	
5	Unstable mental condition	0.35	11.25	
2	Current mental illness	0.37	10.45	
1	History of mental illness	0.38	10.81	
11	On psychiatric medication	0.34	9.41	
	Mokken's Homogeneity	= 0.43		
	Mokken's Delta	= 21.19		
	Mokken's Rho	= 0.82		
	Cronbach's Alpha	= 0.76		

The Mental Instability scale contains fewer items than the other two but it still manifests a high degree of psychometric quality. Again, the data fit the model well and the internal consistency estimates of reliability, although lower than the Dangerousness scale, are still within the generally recommended range for reliable instruments (Nunnally 1978).

The scale also makes perfect sense in that the basal features are psychiatric medication, history of mental illness and current mental illness. More extreme warning signs are non-compliance and attempts at absconsion (which may not be applicable to many community patients).

Table 6
The Self Harm Scale

No.	Indicator	Homogeneity Index		Delta
14	History of childhood abuse	0.34	12.90	
54	Multiple problems	0.40	16.24	
41	Oversensitive to advice	0.29	11.88	
64	Unstable environment	0.32	13.19	
40	Problems with negotiations	0.30	12.78	
53	Facing high levels of stress	0.31	13.38	
17	Suicidal ideation	0.29	12.39	
15	History of self neglect	0.36	15.51	
16	History of suicide attempts	0.39	16.88	
22	Risk to self	0.39		16.22
20	Low self esteem	0.37	13.25	
55	Interpersonal conflicts	0.46	15.01	
	Mokken's Homogeneity	= 0.42		
	Mokken's Delta	= 34.67		
	Mokken's Rho	= 0.86		
	Cronbach's Alpha	= 0.81		

The Self Harm scale also manifests good psychometric properties with slightly better internal consistency estimates than the Mental Instability scale. The fit of these indicators to the cumulative scale model is also good.

It is not surprising that a basal feature of self harm are interpersonal conflicts nor that multiple problems sit ate the extreme end of the continuum. However, it is rather more surprising to find history of child abuse at this extreme as we would anticipate that the historical variables would tend to be lower down the scale. The suggestion is that patients with a history of child abuse are likely to manifest all the risk indicators that are also associated with self harm. Also a history of child abuse is a very critical indicator itself in the practice of self harm.

The three scale scores for the 72 patient profiles that were double rated were computed and correlations between the two forms were obtained. These emerged as 0.81 (Dangerousness), 0.77 (Mental Instability) and 0.81 (Self-Harm). These indicate that, despite some disagreement at the item level, there is a high degree of consistency between the scores obtained on different judges for the 3 cumulative scales. This is further proof of the reliability of the measures and demonstrates the utility of working with the super ordinate scale scores**.**

Concurrent Validation of the RAMAS Scales
In table 7 the correlations between the RAMAS scales and the Clinical Judgement are shown. The correlation between Self-harm and Mental Instability is 0.06 and is the only correlation that is not statistically

Table 7
Kendal Correlation Coefficients Between RAMAS Scales And Clinical Judgement

	Dangerous	Mental Ill	Self Harm	Judgement
Dangerous	0.81*			
Mental Ill	0.31	0.77*		
Self Harm	0.39	0.06	0.81*	
Judgement	0.51	0.24	0.28	0.69*

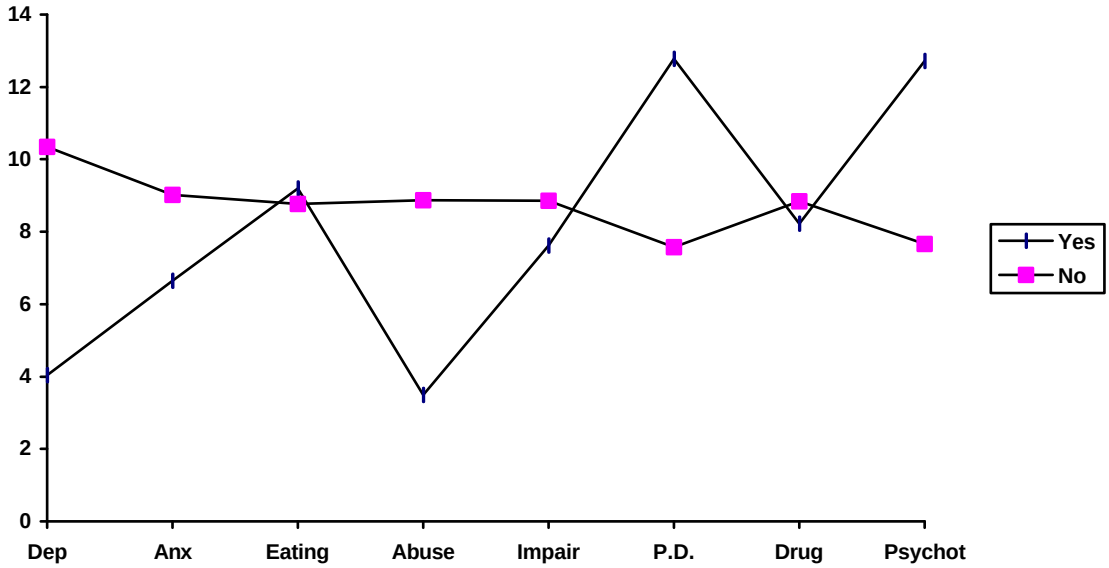
*Inter-Judge consistency is presented in the diagonal

significant. Nevertheless the correlations are not large. Of particular note is the finding that Dangerousness has the greatest correlation with clinical judgement of risk while the other two scales are less associated. This implies that the clinicians providing a risk judgement are concentrating on risk to others.

RAMAS Scales and Presenting Problems
The final analysis of this report attempts to show the relationship between the scales of the RAMAS and the presenting problems that the patients manifest. This is a more indirect concurrent validation exercise since, while we might expect patients in different risk groups to have different presenting problems, the problem itself is not a direct criterion for risk.

In figure 2 the mean Dangerousness scores for all the patients falling into each problem group are plotted (Yes). These are then compared to the mean scores of those not in that problem group (No). As expected the No patients have a flatter profile with scores averaging 8.34. The Yes patients have a much more peaked presentation. The only significant difference statistically is for depression ($t=6.85$, $p<0.01$) which shows that depressed patients are perceived as less dangerous. There is a statistically significant difference for patients presenting with personality disorder ($t=4.77$, $p<0.01$) and Psychosis ($t=4.52$, $p<0.01$) demonstrating that these patients are viewed as more dangerous.

Figure 2
Presenting Problem and Mean Dangerousness Scores



Similar analyses are shown in figures 3 and 4 for the Mental Instability and Self Harm scales respectively. Peaks for Mental Instability occur in the psychotic group ($t=9.47$, $p<0.01$). The mean score on the Self Harm scale is high for eating disorders ($t=3.02$, $p<0.01$), Psychosis ($t=2.81$, $p<0.05$) and Personality Disorder ($t=10.27$, $p<0.01$).

Figure 3
Presenting Problem and Mean Mental Instability Scores

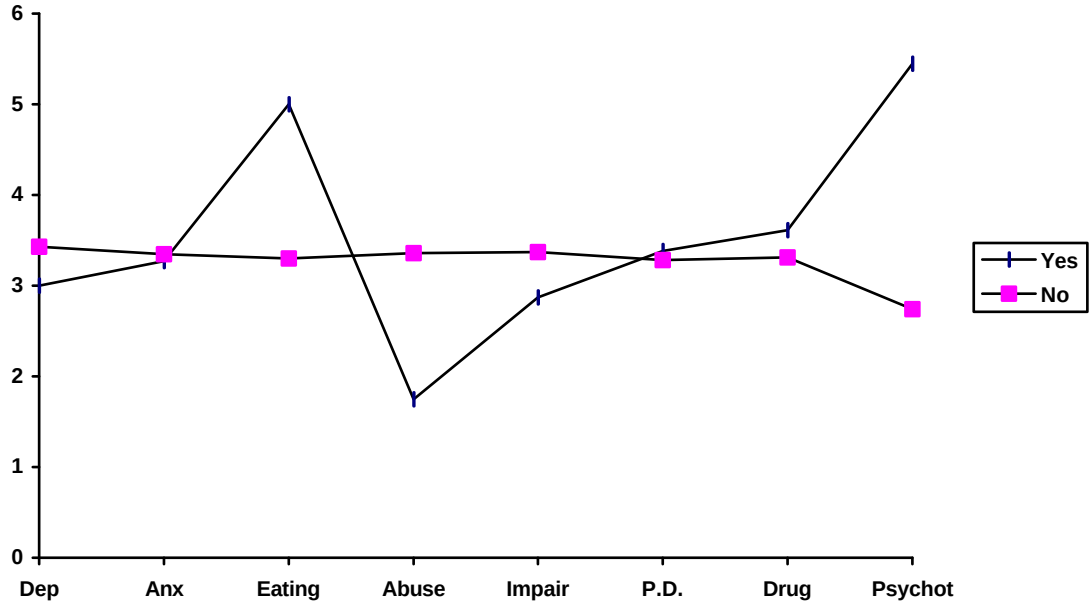
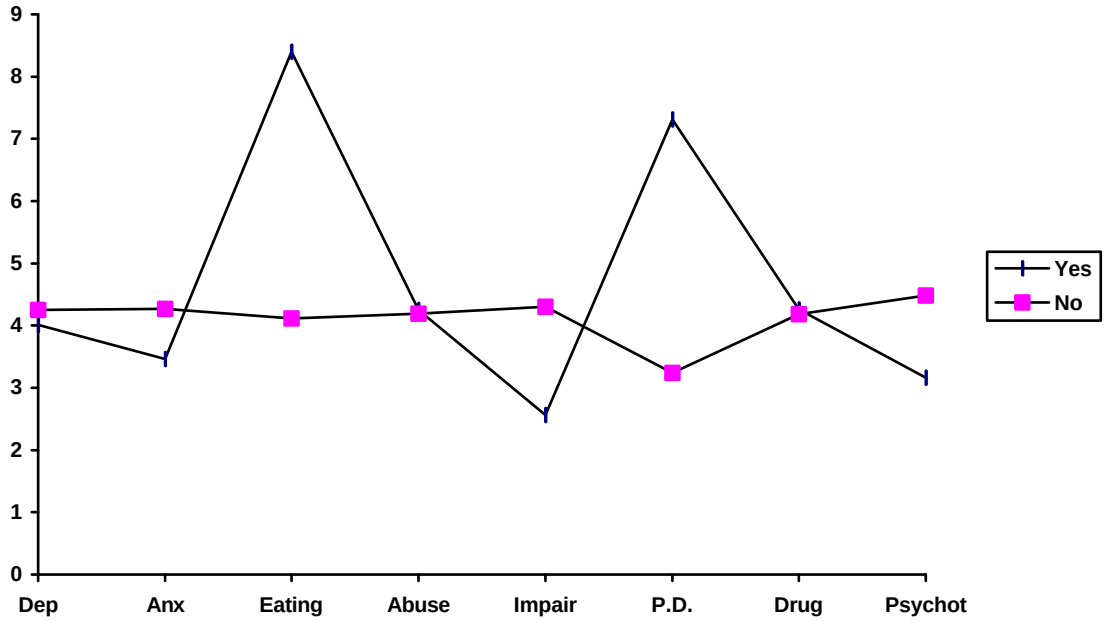


Figure 4
Presenting Problem and Mean Self Harm Scores



These profiles of scale scores are clearly differentiated and show a reasonable fit to expectations drawn from the literature on mentally disordered offenders.

Discussion

The present study has demonstrated that the RAMAS checklist measures three clearly identifiable latencies each related to a discrete area of risk, Dangerousness, Mental Instability, and Self Harm. The dangerousness scale identifies the risk of harming others, the mental instability scale identifies the risk of mental health crises and destabilisation and the self harm scale identifies the risk of self harm and suicide. The structure that has been identified here is perfectly rational and consistent with the psychiatric literature (Foulds 1976; Surtees and Kendell 1979; De Jong and Molenar 1987). The psychometric properties of the scales is excellent and allows for a simple integrated and discriminating risk assessment profile to be drawn up for each patient.

The fact that the RAMAS scales can be fitted to a cumulative model raises a number of interesting issues. On a practical front, the explicit ordering of risk factors enables an identification of risk level in terms of the position a patient is along the specific risk scale. It is important to remember that this is a probabilistic model and there will be patients for whom this ordering does not apply perfectly but this model is demonstrated to be sufficiently robust to accurately identify individual risk level. Furthermore it is possible to calculate the degree of misfit a patient manifests (Meijer and Sijtsma 1993). This provides a measure of the unpredictability of the patient's profile which may be important information in making a risk judgement.

Among the benefits of the psychometric modelling approach is the fact that the structures derived inform a theoretical definition of risk. It is now possible to conceptualise dangerousness as an accumulation risk factors and furthermore the order in which that accumulation typically occurs is known. This cumulative scaling of risk points to a number of potential avenues for further research. Not least among these is an empirical examination of the development of dangerous behaviour and the possibility of identifying the escalation routes of risk.

Another more obvious benefit concerns accuracy and the promise of ready evaluation and audit. The degree of accuracy of the statistical estimates of risk is directly measurable first by evaluating the fit of the

whole model to the data and second by examining the individual fit of the different patients and risk indicators themselves ; Meijer, Sijtsma and Molenaar 1996). Thus, along with the patient's risk score will come a predictability score and an index of fit.

The Mokken model applied in this study is a weaker model than the more powerful Rasch model but a cumulative structure has been clearly demonstrated for three discrete areas of psychiatric risk**.** It is now possible to consider fitting the data to a Rasch model. This would confer a number of further advantages. For example, it is then possible to derive the standard error of estimate for each patient's individual risk score. In addition, it becomes possible to propose a truly dynamic model which utilises information gathered on an ongoing basis such as the longitudinal Rasch model proposed by Fischer (1989). This offers the hope of a truly dynamic psychometric risk assessment model in which change is integrated into the estimation procedure.

It should also be stressed that the one-parameter models described here are sample free. In other words when the model is fitted, the parameters derived from the sample are statistically robust across samples. That said, a regular assessment of differential item functioning and model bias is necessary for any practical implementation of any such model. The models are mathematically transparent and, once fitted, offer a defensible basis for assessment.

Steadman et al (1993) identify 3 different strategies for studies of risk assessment.. Strategy 1 is to study the relationship of the risk factors to clinical judgement. Strategy 2 is to study the relationship of clinical judgement to the outcome criterion. Strategy 3 is to study the relationship of the risk factors to the outcome criterion. Steadman et al (1993) neglected to consider the important process of construct validation. This is all the more important in the context of risk assessment because the definitions are unclear and the outcome criteria are generally unreliable.

Nevertheless ultimate validation lies in strategy 3 which requires a prospective approach. For the purpose of this study strategy 1 was used, this must be viewed as a preliminary validation but the primary focus of this paper is the evaluation of the cumulative psychometric model. A further prospective study is currently in progress.

The validation results are preliminary but promising and suggest that there is a consistency about the way that the RAMAS scales relate to both subjective clinical judgement and the presenting problem of the patient.

In practice, risk assessment itself is informed by but not dictated by scores derived from risk indicator checklists. It will always be necessary to integrate idiographic and contextual information into any risk assessment and this will often imply the use of clinical judgement rather than statistical prediction. A full RAMAS implementation makes this process explicit but coupled with the use of cumulative scales the process of risk assessment is greatly eased and the basis for the judgement is made more transparent.

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