

Commentary on  
**The Raven's 2 Progressive Matrices Tests and Manual**  
**Pearson, 2018**

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**Abstract**

Arising out of an initial felt need to pen a personal comment on the non-matrix form of many of the items included in the *Raven's 2* test and the apparent lack of appreciation of the meaning and significance of the term "matrix", this article grew into a rather detailed comparison of the Raven's 2 with the *Standard Progressive Matrices Plus*. This in turn grew into something that might be viewed as a treatise on "widely neglected considerations in test construction". These have resulted in serious errors in research (eg when comparing the differential effects of remedial programmes on "more" and "less" able students) and in practical applications (such as making life-changing decisions about individuals whose scores fall in the tails of the distribution). The article concludes with a discussion of the extent to which the *Raven's 2*, in comparison with the SPM+, facilitates avoidance of these pitfalls.

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I feel obliged to write some kind of commentary on Pearson's *Raven's 2 Progressive Matrices* tests and *Manual* in part because we had earlier developed tests (the *Parallel Coloured* and *Standard Progressive Matrices* and the *Standard Progressive Matrices Plus*<sup>1</sup>) to meet the needs<sup>2</sup> the authors advance to justify the production of the new tests, and in part because I feel somewhat embarrassed to find my name, and that of *Progressive Matrices*, attached to tests many of the items of which bear little resemblance to those in the *Raven Progressive Matrices*.

While I have little doubt that the new tests will serve the purposes for which the *Progressive Matrices* are most commonly used, it is less clear that they will be as well suited to the purposes for which the tests were originally developed or, indeed, to some specialised uses to which the tests are currently put.

It cannot be too strongly emphasised that J.C.Raven's tests (which include his *Vocabulary* scales) were developed as theoretically-based tools for use in research and not primarily as tools for practical applications such as in personnel selection. As such, particularly in the context of the cross-cultural and historical data that have accumulated, they have proved of inestimable value. I am much less sure about the ethics of many of their practical applications<sup>3</sup>.

It is not at all clear that the *Raven's 2* tests will be able to contribute in the same way to the advance of scientific understanding.

*First, a brief description of Raven's 2.*

The *Raven's 2* suite of tests depends on a pool of 329 items all of which have been assessed for conformity to the "Rasch" measurement model<sup>4</sup> and assigned difficulty levels determined through the application of Item Response Theory.

From this pool it is possible to extract thousands of individual constellations of items which differ from each other in specific content but are nevertheless statistically equivalent. As a result, it is not possible for any one individual to have memorised the answers or to copy from his or her neighbour.

The on-line program routinely constellates a set of 60 items arranged in five Sets, roughly equivalent to the *Standard Progressive Matrices*.

However, users can request a test consisting of three Sets of easier items (total 36 items) (for children and the less able) and four Sets (48 items) of more difficult items for adults.

Each of these extracted sets of items is virtually unique so, although no two people take "the same" test, each set of items is equivalent in terms of difficulty and other properties as judged in Item Response Theory terms. Time limits are set for the testing sessions, although most people finish well within those limits. In other words these are not timed tests.

Although the computerised administration incorporates a "discontinue" rule whereby testing stops if the respondent gives 6 incorrect responses in a row, the administrations are not "adaptive" in the sense that such programs present additional items around the point at which the respondent begins to fail and, in this way, generate a more accurate score.

There is also a published, printed, set of 60 items drawn from the full set of 329 items and arranged, as in the *Classic Standard Progressive Matrices* test, in five sets of 12 items which increase in difficulty within each Set and then revert to easier items at the beginning of the next Set.

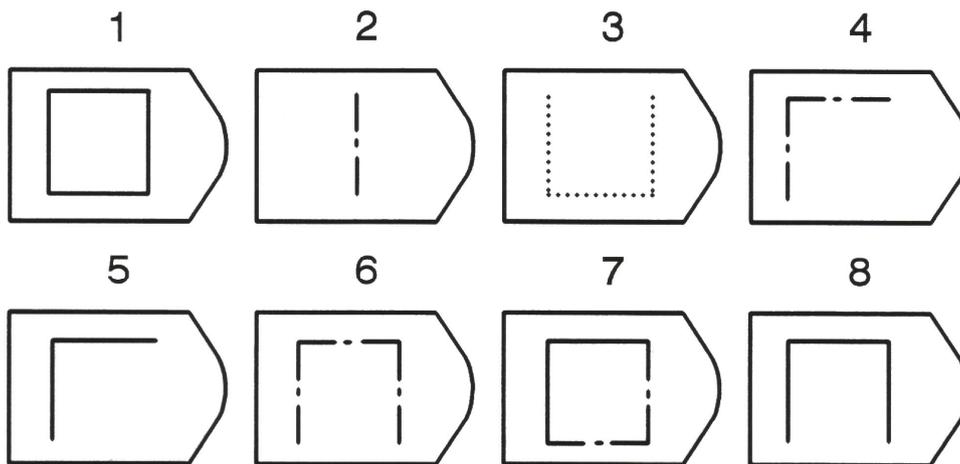
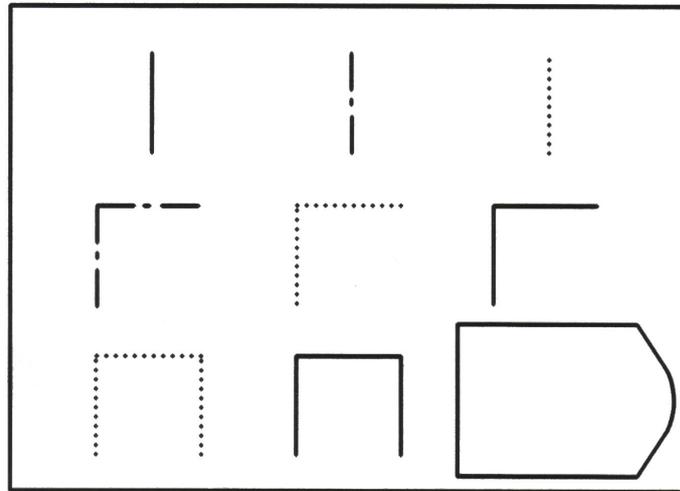
Testing can be arranged such that only Sets A, B, and C are administered to younger children or B, C, D and E to older children and adults.

### *The Items*

Raven's *Progressive Matrices* tests<sup>5</sup> consist of a series of 2x2 or 3x3 dimensional matrices, or patterns, the cells of which display non-verbal figures showing progressive change following the same logic in two dimensions (vertically and horizontally). The bottom right hand cell is left empty and the person taking the test is asked to choose from a number of options that which is required to logically complete the pattern.

An example, not from any of the tests is shown below.

Figure 1  
**An Illustrative Progressive Matrices Item**



Many of the items included in the *Raven's 2 Progressive Matrices* (and incidentally, also in the "Matrix Reasoning" subtest of the *Wechsler Adult Intelligence Test*), do not follow this format but consist of a one-dimensional, linear series of figures such as would be obtained by extracting the bottom row of the stimulus matrix shown Figure 1 (although the series presented consist of six rather than three cells).

This suggests that the authors have not fully grasped what the term "matrix" is intended to imply.

Although it has a number of uses, the term typically refers to an array of figures, symbols, organs, or tissues bearing some meaningful relationship to each other.

When, in mathematics, the terms in the matrix bear some mathematical relationship to each other the array, or matrix, is referred to as a determinant.

In the Raven *Progressive Matrices* tests, the patterns in the cells of the array display the same progressive change in two dimensions and thus uniquely determine the nature of the piece required to complete the overall pattern, or matrix.

The nature of the piece required to complete the matrix, or pattern, is determined by the features of the matrix presented and can be generated without reference to the range of options presented<sup>6</sup>.

It is not clear that all the items of the Raven's 2 have this property. These items can thus be said to be indeterminate.

A "solution" which fails to complete the progression in *both* rows and columns using the same logic is unsatisfactory.

This has the great advantage that whoever is taking the test can, by checking in two (or three) directions, be *certain* that he or she has the correct answer.

But, to set this *commentary* in context, the matrix display can itself be used to illustrate what the test is intended to measure<sup>7</sup>.

In technical terms the *Raven Progressive Matrices* tests were designed to measure *eductive* ability, a term which Spearman<sup>8</sup> introduced to refer to one of the two major abilities constituting *g*. The other component being *reproductive* ability<sup>9</sup>.

The first major component, *eductive* (not *educative*) ability consists of the ability to educe, or draw, meaning out of, apparent confusion, draw logical conclusions from the insights gained, and test those conclusions.

Unfortunately, the phrase "make and test logical inferences" already leads us into a trap because it seems to imply verbalisation which is not necessarily the case.

In much of life – in the booming, buzzing, confusion in which we live – the elements of the multi-dimensional matrix around us are not pre-formulated and have to be educed, or abstracted, from the whole. A recursive process which involves paying attention to the whole to discern, and conceptualise (beware the verbalisation overtones of the term) the parts, and then using that conceptualisation of the parts to reconceptualise the whole is needed.

This is essentially the process of perception itself.

Contrary to what was once taught in elementary psychology courses the visual field is not projected onto the retina in something like a photographic image and from there transmitted to the brain.

The retina consists of an overlapping array of different types of nerve endings with a major gap at the point of entry of the optic nerve and sparse provision at the periphery.

The brain has to make sense of the complex and distorted information it receives. It fills in gaps so that we see what is not there and does not see things that are there.

It is misleading to call variance in the ability to do these things “cognitive ability”.

Yet it is this very process that the *Raven Progressive Matrices* sets out to measure.

When most readers of this article look at the easier items in the RPM, the whole process takes place automatically, unconsciously. Many deride the items as “merely perceptual”. But, as the item analysis<sup>10</sup> shows, this is anything but the case for the less able individuals.

When they come to more difficult items many more able individuals<sup>11</sup> begin to ask themselves (often in non-verbalised form) “What is going on here? If I am right, I should pay attention to this and this and *this* should happen. Whoops. No. That does not work. Let’s try again. Now I am attracted by *this* idea”. And so on. Certain details of the pattern come to attract and demand attention. Feelings of excitement, elation, frustration, and satisfaction wax and wane.

This is not the kind of process which comes to mind when one hears the term “cognitive ability”

Yet it is the process which occurs as people set about “intuitively” organising their lives to achieve their often unclear goals.

They say to themselves “There are many things going on here, but for this purpose I need to concentrate on these and these things ... and change my perceptions if things don’t work out as I expect”.

The more things they consider, the more systemic their thinking.

And it is the quality and comprehensiveness of their perceptions and inferences which determines their success.

Unfortunately, everyday observation tells us that many of those who (for example) make vital policy decisions have *not* considered the whole, taken account of multiple “variables”, or checked their inferences from a range of perspectives<sup>12</sup>.

All of these processes are required to engage with the classic *Progressive Matrices* items but are much less likely to be called upon in relation to items which consist merely of linear series.

### ***The internal properties of the Raven’s 2 test.***

#### *Range of item difficulties*

One of the reasons we set about developing the *Standard Progressive Matrices Plus* was to introduce more difficult items to compensate for what has become known as the “Flynn effect”, i.e. for a, previously unsuspected, inter-generational secular increase in performance on measures which relied on, or indexed, eductive ability<sup>13</sup>, i.e. the ability to make meaning out of confusion (which, as we have seen, Spearman had identified as one component of *g*).

From the point of view of evaluating the *Raven’s 2* test it is important to note how it came about that we were among the first to demonstrate this increase. It stemmed, at least in part,

from the fact that the same (unchanged) test had been widely used in the same way in many different countries<sup>14</sup> over a long period of time. Note that this calls into question the wisdom of making fundamental changes to the test.

More specifically, we were able to compare the results of a 1979 UK-wide norming study with data collected some 40 years earlier.

We published our data in tabular form and focussed on the differential increase at different levels of ability.

We did not express the overall increase in terms of the percentage of test variance that the increase represented – and would, in any case, have been reluctant to do so because, as will be seen from Figure 2 below, the scores are not Gaussianly (often misleadingly called “normally”) distributed. This renders the application of the statistical procedures traditionally used to summarise data – i.e. means and standard deviations – inappropriate.

As it happened, Thorndike had documented a similar effect with the Stanford-Binet test a few years earlier<sup>15</sup>, and Flynn<sup>16</sup> had become seriously concerned about the implications of the increases.

Undeterred by statistical niceties, Flynn converted our data to means and standard deviations.

The results were striking. As reported by Flynn, scores were increasing at about 1 Standard Deviation per generation. Some fifty percent of our grandparents would have been consigned to special education classes had their scores been judged by reference to the more recent norms.

The graphs in Figure 2 below show the rise in *Standard Progressive Matrices* (SPM) scores across the best part of a century

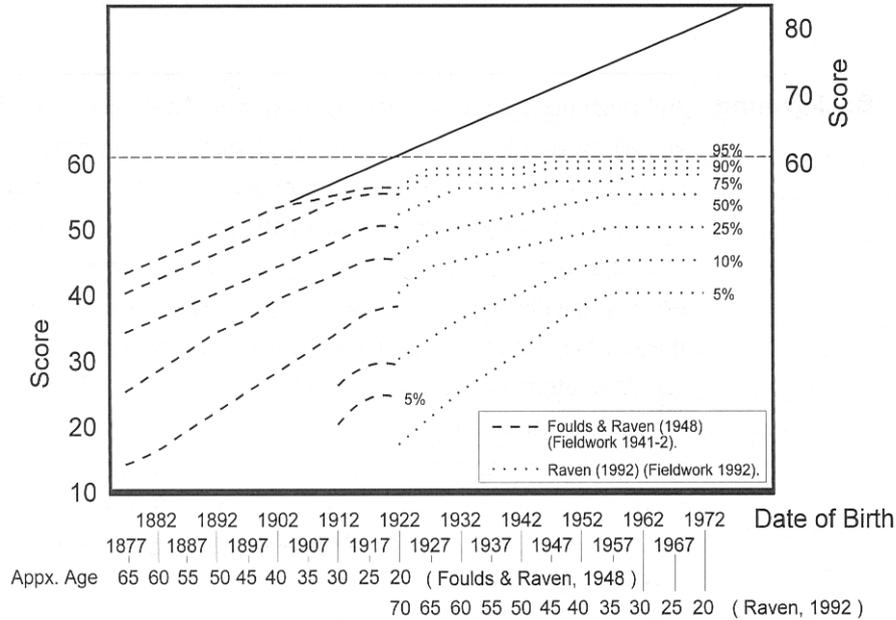
The X axis shows both the age of the respondents at the time of testing and the years in which they were born.

The graphs to the left come from data collected between 1941 and 1942 (as reported in 1948) and those to the right from the 1979 study.

As the graph shows, the main result of the increase has been to undermine the SPM’s ability to discriminate among more able adolescents and adults. (Since the test has 60 items there is a marked ceiling effect.)

As shown by the solid line to the right (which shows a projection of the increase in scores for the 95<sup>th</sup> percentile) a dozen or so additional, more difficult, items would be required to restore the test’s ability to discriminate among high-scoring individuals.

Figure 2  
*Classic Standard Progressive Matrices*  
**Rise in test scores over 100 years.**  
**With projection of true score increase for 95<sup>th</sup> percentile.**



Generating additional difficult items turned out to be more easily said than done and, as reported in our Manual<sup>17</sup>, we had great difficulty ... indeed found it impossible ... to generate items that were more difficult than the most difficult items of the *Advanced Progressive Matrices*.

So the question we have for the *Raven's 2* is whether its authors have succeeded not only in this task but also in making provision for further increases in the future.

So far as I can make out from Table A1 in their Manual, the last two or three items in the paper version of their test are indeed extremely difficult.

Few of those in the standardisation sample (and they are actually the 25 year olds) have abilities, expressed in IRT terms, of above 650. This corresponds to a raw score of 45 on the "adult" selection of items included in the paper version of the test.

There does therefore seem to some room for a further increase in scores as per the "Flynn effect".

It is important to note that, expressed in IRT ability terms, there is a big jump in the abilities required to progress from raw scores of 45 to 46, 46-47 and 47-48, i.e. in the difficulty levels of the three most difficult items.

One implication of this is that, if scores continue to increase, it will, once again, be impossible to discriminate between more able individuals.

I will return to this in a moment.

But first let us note that the normative data published in the *Raven's 2 Manual* actually suggest that such an increase is likely – because the top scores in the norm table decline from age 25 onward!

This may sound like an odd statement.

And so it would be but for the fact that what Flynn showed (and what Figure 2 above shows) is that the cross-sectional data that had previously been interpreted as indicating a decline in scores with advancing age in reality represented mainly an increase with date of birth.

This is of profound significance because what it reveals is that *there had always been* massive amounts of evidence for the “Flynn effect”! It just had not been recognised for what it was.

Very many authors had reported from one-off, cross-sectional<sup>18</sup>, norming studies that scores on many tests – especially those which rely heavily on eductive (meaning-making) ability [in contrast with reproductive ability (ability to store and retrieve information)] – declined with age.

If graphed and the X axis renamed “date of birth” instead of “age” (as has been done on the X axis on the Graph shown in Figure 2 above) the graphs reveal an unmistakable increase with the date of birth of the respondents.

When the data the available for many tests are re-plotted in this way it quickly becomes apparent which scores have been increasing over the years and which have not.

A brief summary of the outcome of doing this is that, by and large, eductive (meaning making) ability has been increasing while reproductive ability (knowledge) has not.

While our ability to make sense of the world has increased, it seems that we cannot register and retrieve any more information than we could a century ago.

We can run faster and think better but do not retain more in our heads. Why not?

This, not the “Flynn effect”, is the real puzzle to be addressed by psychologists.

But will the *Raven's 2* test be able to register the increase which the authors' own data suggest is likely to occur?

Yes ... And No.

### *Fluid and Crystallised Intelligence*

At this point it is useful to go on a slight digression before we consider the terminology in the *Raven's 2 Manual*.

It is important to caution against the substitution of the words “fluid” and “crystallised” “intelligence” for the terms eductive and reproductive ability.

Although Horn, along with Cattell, was responsible for introducing the fluid/crystallised terminology, Horn<sup>19</sup> later joined Spearman in emphasising that reproductive ability is not a crystallised form of “fluid” ability. The abilities differ at birth, have different genetic origins, are influenced by different things in the environment, and predict different things in life. They simply work closely together (see endnote 9)<sup>20 21</sup>.

And, as to the word “intelligence”, Spearman had long ago shown that this was such a slippery concept, being used by different people to refer to different things and by one person to refer to different things at different points in the same discussion<sup>22</sup> that it was best to avoid the use of the word at all costs.

### *The terminology in the Raven’s 2 Manual*

With this behind us, let us consider the terminology in the *Raven’s 2 Manual*.

The very first sentence in that *Manual* immediately leads into a quagmire.

It says:

“The Raven’s Progressive Matrices 2 ... is a nonverbal assessment of general cognitive ability”.

The problem could be partially corrected by inserting the words *one component of* before “cognitive ability”.

Unfortunately, the term “cognitive ability” is itself used, measured, and understood in many very different ways. This leads to endless disputes and misunderstandings between researchers, educational administrators, school psychologists, and in courts of law.

The authors then proceed to rescue themselves in the remainder of the paragraph. But the gain is short-lived. A few sentences later they are talking about “mental ability” as if this were some kind of unitary “thing”. They even write about “a full range of cognitive ability”.

They then fully exonerate themselves by introducing material which looks as if it was copied out of the main Raven, Court and Raven Manual for the Raven Progressive Matrices tests<sup>23</sup>.

However even the intrusion of a paragraph referring to “the contemporary theory of intelligence” suggests that they have not fully understood and accepted what is being said.

As one progresses through the Raven’s 2 Manual, the authors drift back into the *general cognitive ability* terminology, implying that the Raven’s 2 test provides an index of this.

The nature of the authors’ thoughtways emerges clearly on page 43 where, under the chapter heading *Interpretive Considerations*, they repeat:

“*The Raven’s 2 is a nonverbal assessment of general cognitive ability ...*”

The question of terminology (and associated thoughtways) is no academic matter.

It acquires profound significance as one enters the endless quagmire of contradictory legislation and cut-off points relating to access to different types of educational provision and other administrative procedures relating to access to, and compulsion to engage in (or be excused compliance with) social provisions ... including such things as whether or not one is “too dumb to die”<sup>24 25</sup>.

Such terms as “IQ” and “Cognitive Ability” are used and understood by researchers, legislators, school administrators, school psychologists, lawyers, judges, and jurors in very different ways. There are serious questions about how substitutable the results of one test are for another. It behoves the writers of test Manuals to be as clear as they can about what their tests do, and do not, measure.

J.C.Raven claimed only that the *Progressive Matrices* measures “the ability to perceive and think clearly” ... technically *eductive* ability<sup>26</sup>. This is only one component of *g* – which is itself only one kind of “intelligence”. Which is itself concerned with only one domain of “ability”.

In contrast, the term “cognitive ability” is deeply contested and sloppily used ... for example educational credentials (which mainly measure *reproductive* ability) are often used as a sufficient index of it<sup>27</sup>.

Although they are not alone in this, the authors’ failure to choose and use their words carefully is, to say the least, alarming ... particularly because the *Raven Progressive Matrices* tests are used to take decisions which strongly influence the lives and livelihoods of millions of people’s and thus the operation of whole societies and the future of the planet<sup>28</sup>.

In the past, the RPM has intruded directly into the lives of billions of people worldwide and had a dramatic influence on their lives and careers. Via its use in the allocation of personnel in the military systems of many countries it has probably even had a major influence on the outcomes of wars<sup>29</sup>.

*Language free and culture free.*

The notion that the tests are “*nonverbal*” has been widely disputed by researchers, some of whom argue that language is required to solve the problems.

Yet the fact that the *Raven Progressive Matrices* tests are, in some sense, language free is readily apparent.

Unfortunately, this has led many to believe that it is “culture free”.

This again turns out to be an ambiguous term carrying with it many varying assumptions and overtones.

The briefest dip into research shows that there are huge differences between the scores obtained by different cultural groups<sup>30</sup>.

The ramifications and implications of this are far from obvious.

The *Raven’s 2* manual offers only overall US norms, not broken down by cultural group.

The implication seems to be that these can be used, without further ado, to do such things as assign pupils to educational programmes or to select personnel.

But think about this.

Readers of the *Raven's 2 Manual* are referred to the *Research and References* sections of the *Raven, Raven, & Court Manual* for evidence on the validity of the test<sup>31</sup>.

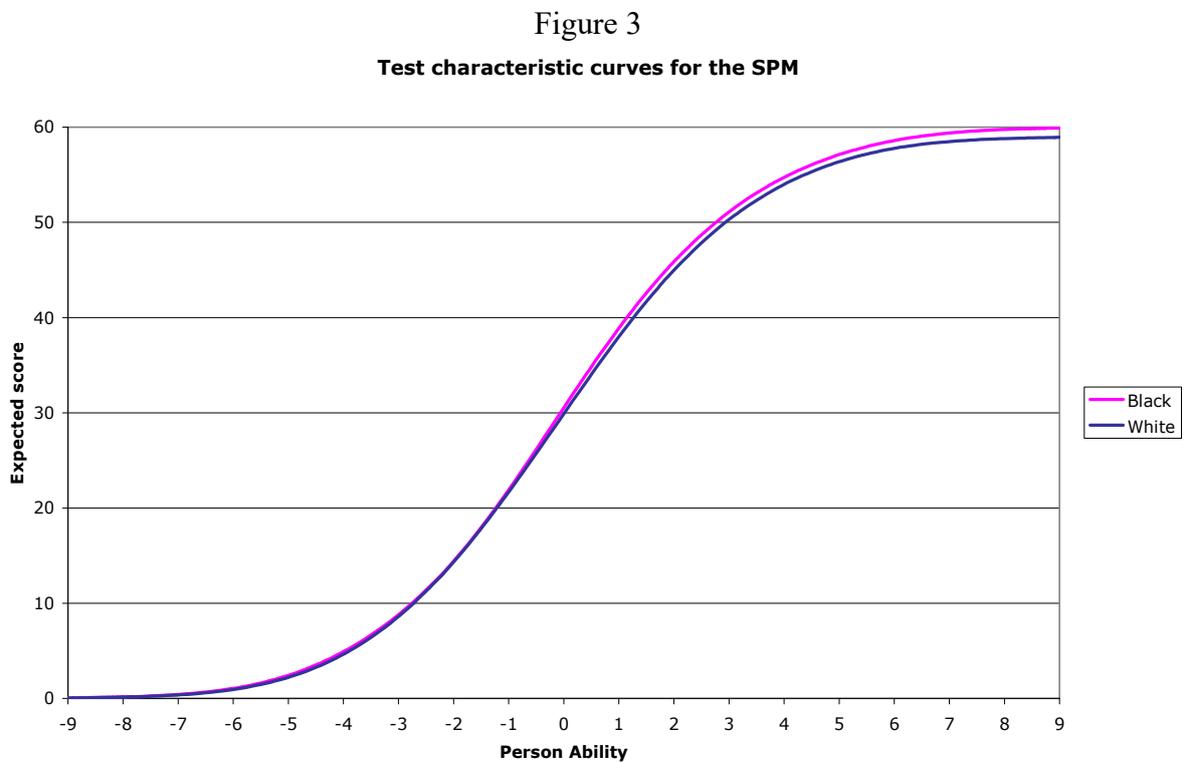
If one visits this material, what quickly emerges is that, whatever about the language-free nature of the test, different cultural groups within the United States of America, never mind elsewhere, achieve very different scores.

*Stability of Internal properties.*

Yet the test works - scales - in much the same way in most of the groups that have been studied.

We checked that, however different their mean scores, the sequence of item difficulties was much the same in many cultural groups, but the point is neatly illustrated in the following graph generated by Nicola Taylor<sup>32</sup> from data derived from applicants for jobs in the mines of South Africa<sup>33</sup>.

But, before looking at it, note that there are huge differences in the mean scores of miners from different backgrounds.



*Predictive Validity*

Not only does the SPM, to all intents and purposes, have the same internal properties within different cultural groups, it also has similar predictive validity to external criteria within the groups.

Figures 4 and 5 show the regression lines for Anglos and Hispanics for the RPM against a couple of scores on the California Achievement Test in Douglas, Arizona around 1990<sup>34</sup>.

Figure 4 shows the regressions of CAT Math scores on the Coloured Progressive Matrices among first-grade students. Figure 5 shows the regressions of CAT Reading scores on the Standard Progressive Matrices among fourth-grade students. Similar graphs are available for other subject areas (Redrawn from Hoffman, 1990).

Figure 4

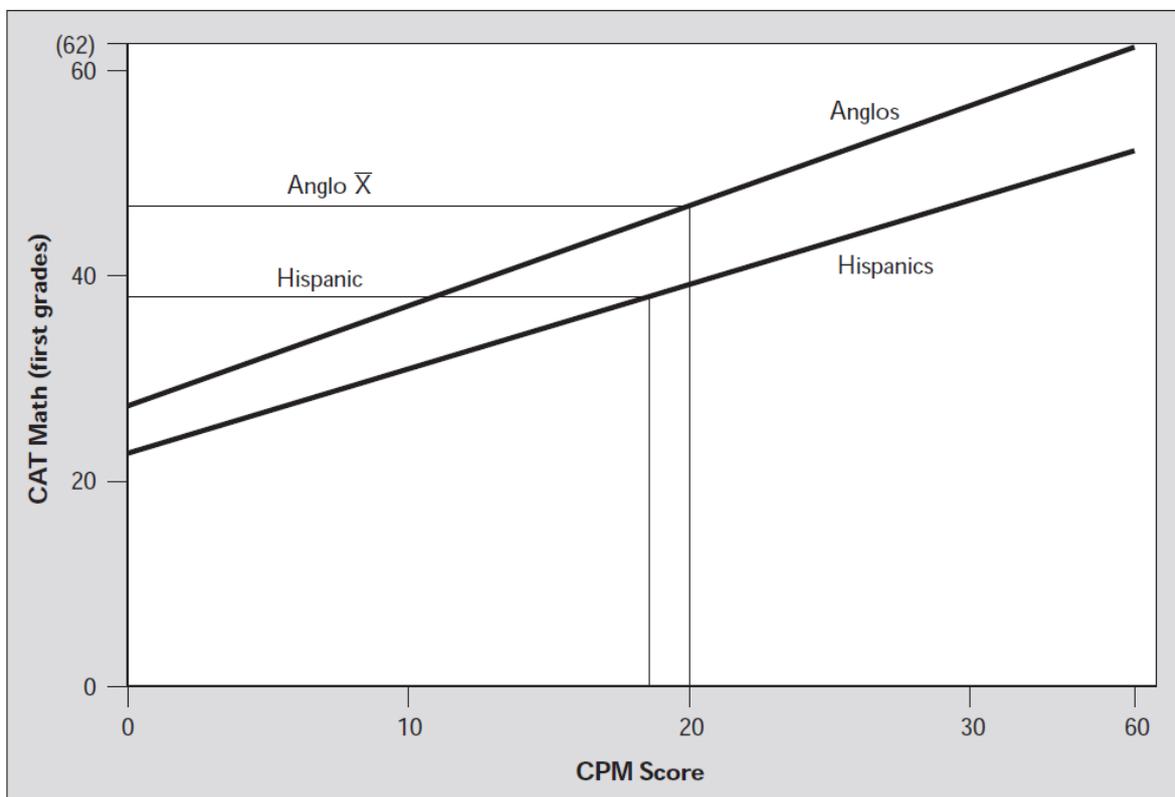
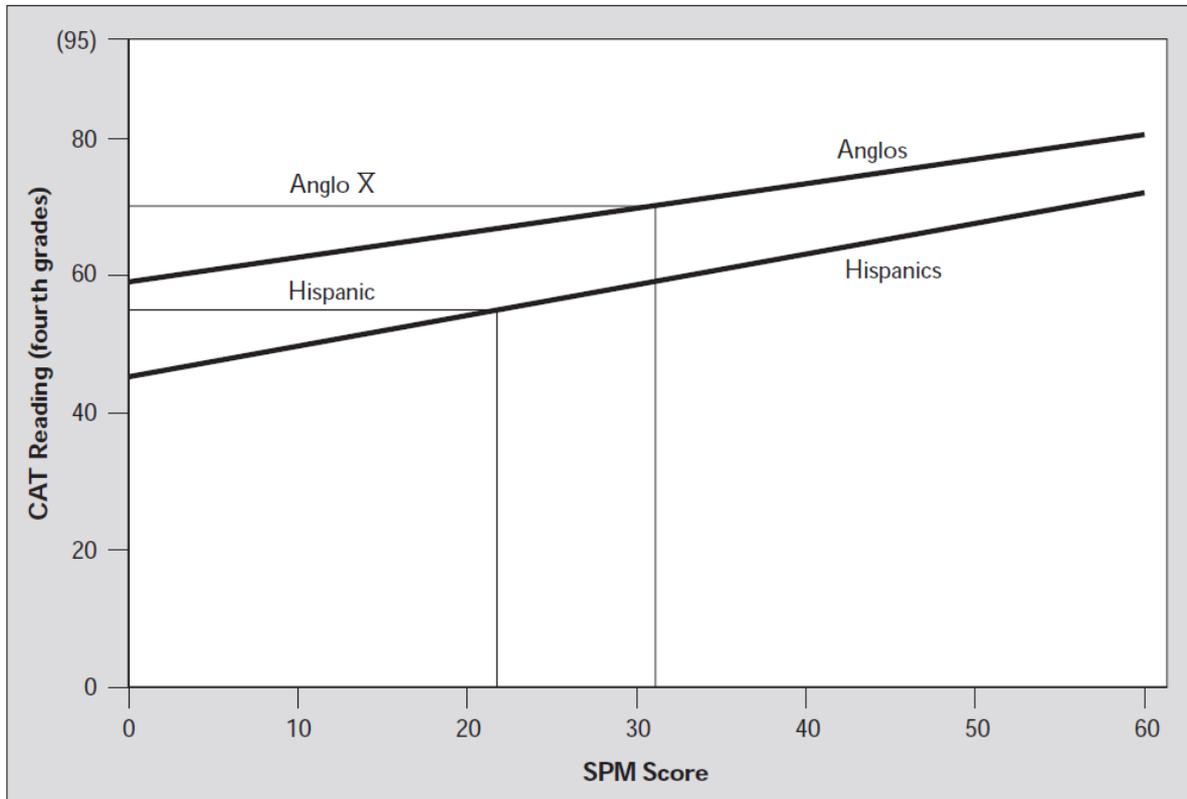


Figure 5



The graphs are essentially parallel but operate at different levels of ability.

In other words, despite the fact that the test is not “culture free” in the sense in which that term is commonly understood, the test works, and works in the same way, for different cultural groups and also has similar predictive validity to external criteria within those groups.

*Some implications*

So far, so good.

But what happens when the overall norms are used, for example, to assign pupils from different cultural backgrounds to mandated variance in educational provision (such as programmes for those deemed in need of “special” or “gifted” education) or to select people for jobs?

Well, obviously, a disproportionate number of the highest scoring group are going to be selected for “gifted” programmes and vice versa for allocation to “special education”.

*And that decision will indeed be a valid decision when evaluated against performance criteria.*

Hmmm.

There appears to be a danger of, in this way, perpetuating the very social differences which may have contributed to the differential scores in the first place<sup>35</sup>.

In short, one has to challenge the widespread unverballed assumption that, once one has a “language free” test, one has solved the problem – that that is the end of the matter. It clearly is not ... and the issue merits explicit discussion<sup>36</sup>.

*The Test Characteristic Curve and the meaning of “difference” or change scores.*

I turn now to another question about the internal properties of the test.

It has to do with the regularity of the increase in item difficulty from item to item and thus the relative meaning of any given *increase* in raw score at different points in the scale.

For example: Is a raw score increase from say 8 to 11 in any way the same as an increase from 48 to 51?

It has taken many years for the significance of this question to become fully apparent although its neglect has resulted in endless misleading conclusions being drawn from research (such as in the assessment of the relative impact of remedial or educational enrichment programmes on the more or less able) and in the unjustifiable advocacy of a number of derivative (difference) scores (such as “Learning potential” or “sensitivity to stress”) where a given difference is assumed to have meaning and predictive validity (correlation with other variables) regardless of the point on the scale at which the difference occurred. It also shows up in legal procedures relating to claims about such things as the effects of accidents or injuries on mental abilities, where much turns on the magnitude of the decline in scores from before till after the injury.

Although J.C.Raven and others involved in the development of the tests mentioned trying to make sure that the items were “as far as possible” equally spaced in difficulty, no great attention was paid to doing this and there was no recognition whatsoever of the implications of not doing so.

In short, the problems involved in the measurement of change were simply not recognised.

We were fortunate in having the matter forcefully drawn to our attention by a student of G.H.Fisher who happened to get involved in our work via the Schuhfried Company in Vienna.

He illustrated the problem by means of the following graphs.

Figure 6 illustrates the problem in connection with trying to evaluate the impact of a managerial development programme on high ability personnel and Figure 7 on low ability personnel.

If we employ a test having the Test Characteristic Curve shown on the left in Figure 6, the mean scores of the high ability group increase from A at the pretest (i.e. before training) to B at posttest (i.e. after training). This is a relatively small increase. But if we use the more difficult test shown on the right, the same increase in score on the latent trait of the high ability group shows up as a *huge* increase in raw score, moving from X to Y.

Figure 6  
Illustration of changes in raw scores on “easy” and “difficult” IRT-Based tests of cognitive ability for identical changes in latent ability  
*High* ability group only

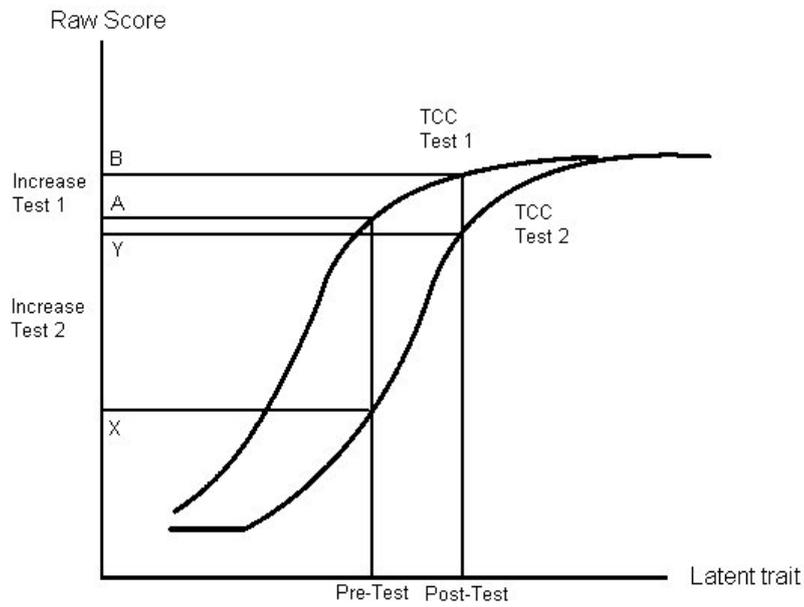
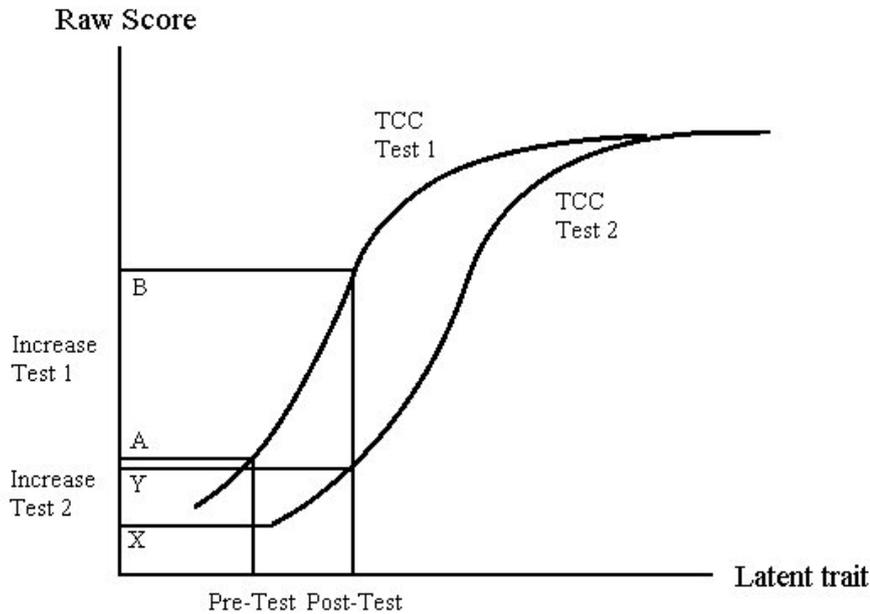


Figure 7  
 Illustration of changes in raw scores on “easy” and “difficult” IRT-Based tests of cognitive ability for identical changes in latent ability  
Low ability group only



As can be seen from Figure 7, exactly the opposite effect occurs at the other end of the scale. The apparent increase in score from pretest to posttest is huge on Test 1 and trivial on Test 2.

Putting the two cases together, it is obvious that, if a researcher employs Test 1 to assess the impact of a training (or other) programme, the relative gains of the low ability group are huge while those of the high ability group are trivial. On the other hand, if the researcher employs Test 2, exactly the opposite findings emerge.

The general, and vitally important, conclusion which emerges from these examples is that the apparent magnitude of any real increase in latent ability arising from a developmental experience, accident, or natural change over time depends (a) the general difficulty level of the test relative to the ability tested and (b) the distribution of the item parameters relative to the interval on the latent trait where change occurs.

This makes it virtually impossible, without employing techniques which are described in the 2004 update of the Y2K *Standard Progressive Matrices* section of the Raven Court & Raven Manual and in Prieler and Raven<sup>37</sup>, to make any meaningful statement about the *relative* magnitude of gains or losses of high, medium, and low ability groups.

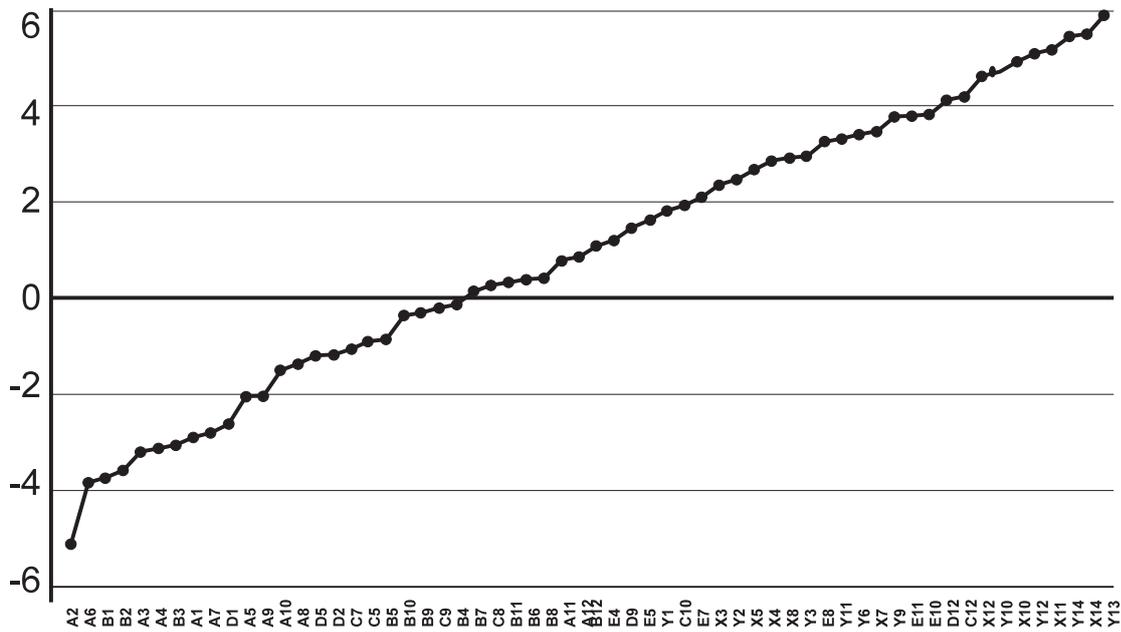
It also renders the use of most difference scores (“Learning Potential”, “Sensitivity to Stress”) untenable.

*Except* .... there remains the intriguing possibility of using a test with a *linear* Test Characteristic Curve.

The possibility of developing such a test – which is to say a test with an equal interval scale – has widely been regarded as a pipe dream in psychology.

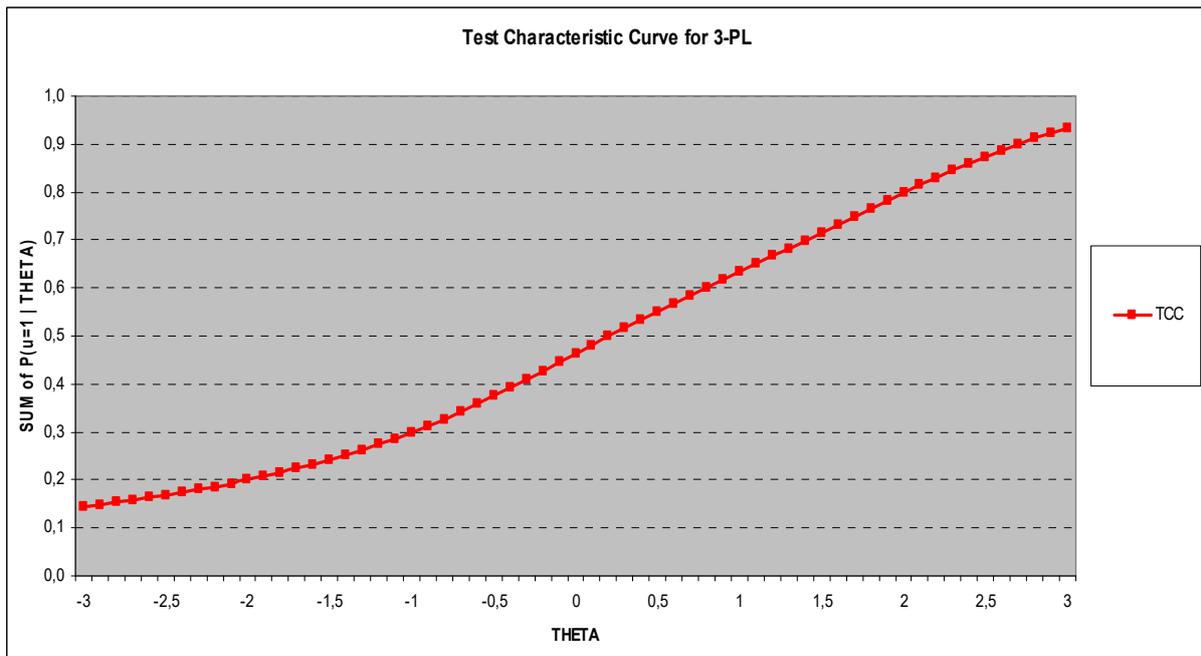
Nevertheless, the procedures employed in the development of the SPM+<sup>38</sup> resulted in the test having following graph of item difficulties:

Figure 8  
**Standard Progressive Matrices Plus**  
 1996 Item-Equating Study  
 One-Parameter Item Difficulties (in Logits): 60 Items, Including ALL from Parallel Sets A and B and 5 each from Parallel Sets C and D, Arranged in Order of Difficulty



A cross validation of the test's properties in the course of a Romanian standardisation yielded the following Test Characteristic Curve<sup>39</sup>:

Figure 9



In short, the SPM+, almost uniquely among psychological tests, offers its users something approaching an interval scale.

The question now is whether the *Raven's 2* does the same.

According to Table A1 in the *Raven's 2* Manual, there are large increases in the IRT ability indices needed to achieve a one point raw score gain in the tails of the distribution yet only a small increase in ability is needed to achieve a one raw score gain in the middle of the scale.

So, no, the *Raven's 2* test does not yield this property and so is not suitable for making easily interpretable statements about the relative effects of interventions or accidents.

*More on discrimination in the tails of the distribution: The test information function.*

Most practical uses of psychological tests are in the tails of the distributions ... where their ability to discriminate is poor<sup>40</sup>.

In other words, most tests provide poor information in the domains in which it is most needed.

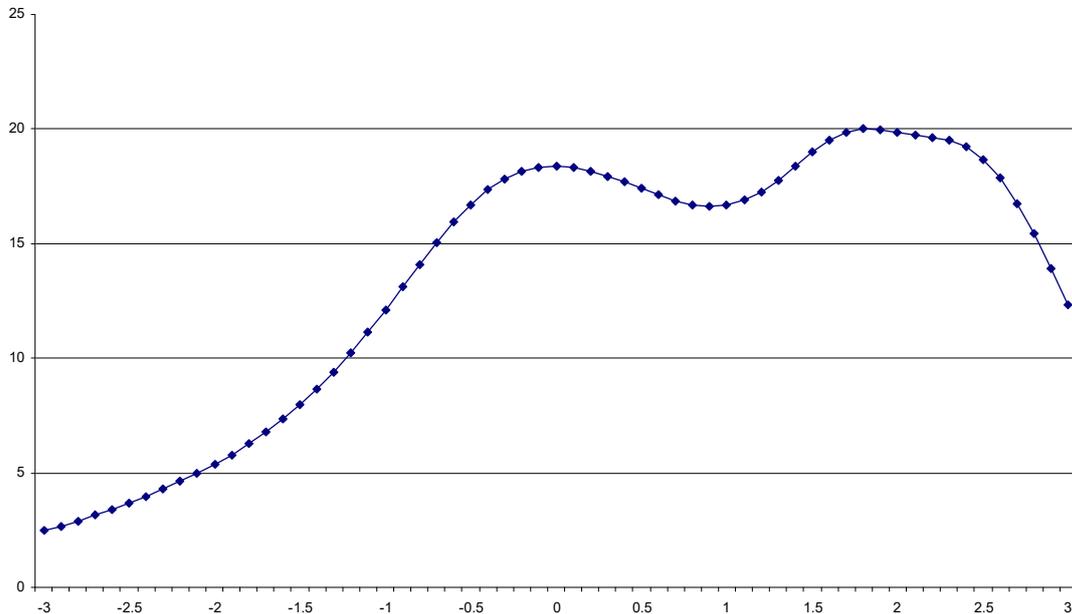
Worse, as mentioned earlier, those who use tests to make discriminations in these areas get tangled up in an impenetrable morass of legislation drawn up by a variety of administrators and legislators with varying backgrounds and objectives. They have varying levels of familiarity with the problems associated with cut off points especially in relation to eligibility for, or compulsory consignment to, "services". Small score differences in the tests used or scores in the area around cut off points (specified in different ways) can have major implications.

The huge jumps in differences in ability required to secure a one raw point gain at both ends of the *Raven's 2* scale have already been noted.

Ironically, as can be seen from the graph of the test information function for the SPM+ reproduced below, the SPM+ test goes some way toward correcting this.

As discussed by Hambleton et al (1991) the ideal shape of this graph would be rectilinear; one would get as much information from scores at all points in the distribution.

Figure 10  
*Standard Progressive Matrices Plus*  
 Romanian Standardisation  
**Test Information Function**



Unfortunately, a test having a more appropriate overall Test Information Function would not necessarily yield such a function *within* e.g. age groups .... which is where such discriminations are typically made.

### Conclusion

As we have seen, the *Raven Progressive Matrices* tests have, over the years, contributed enormously to the accumulation of research insights and played a huge role in the administration of education systems, military systems, organisations, and societies.

What are the chances of the *Raven's 2* test contributing in that way?

Who is to know.

But one thing is certain. *Raven's 2* scores are not convertible to, and thus integratable with, Classic RPM scores. In contrast, not only are the *Standard Progressive Matrices Plus* scores directly convertible to scores on the classic tests, many of the items directly parallel items in those tests.

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Given that the *Raven's 2* test does not possess many of the desirable properties evinced by the *SPM+* one cannot help wondering why the staff at The Psychological Corporation/Harcourt/Pearson have chosen to go this route.

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### Endnotes

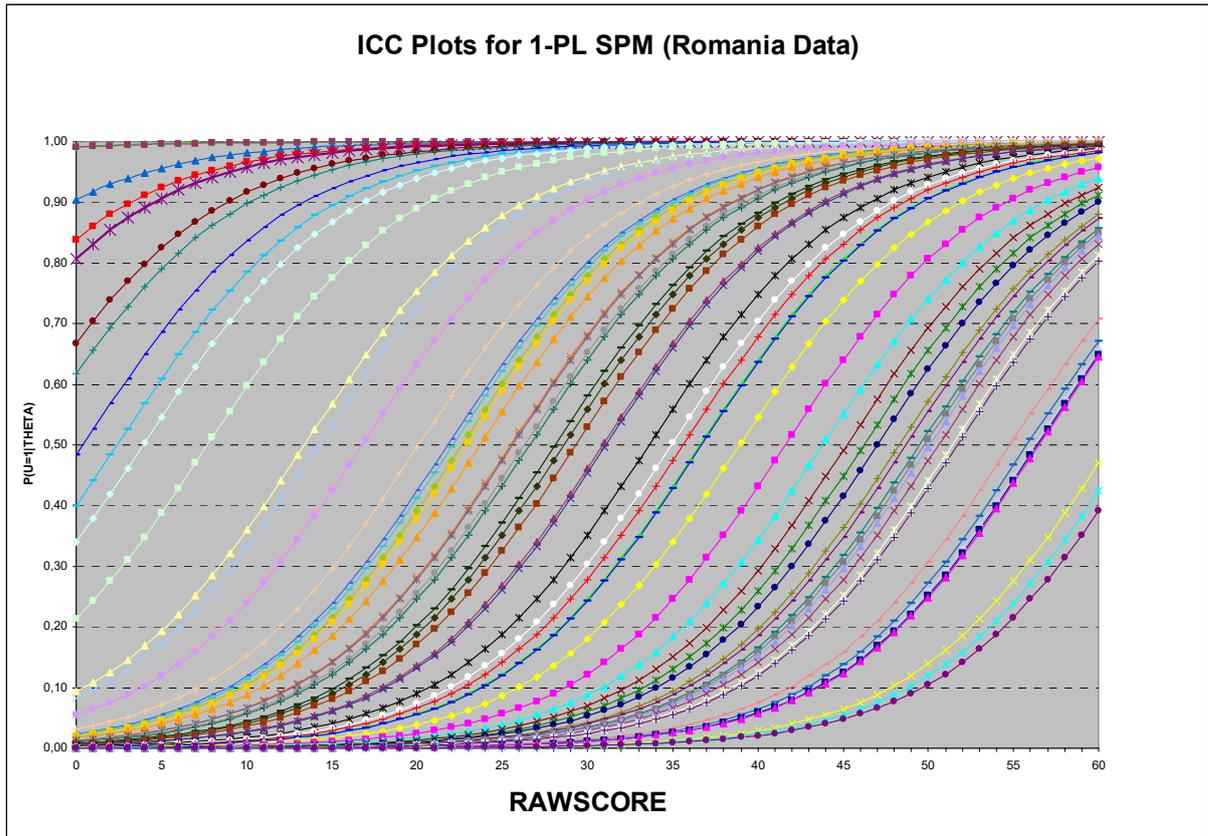
- 
- <sup>1</sup> Ironically, these tests and associated Manuals (generated by the author and colleagues) were, and are, published by Pearson US (see Raven, J., Raven, J. C., & Court, J. H. (2000, updated 2004) [Section 3] and the *SPM+* had been standardised by a team at Pearson (UK) and published in the UK (Raven, Rust & Squire, 2008).
- <sup>2</sup> These needs revolve around such things as the lack of security of the tests arising from such things as the availability of copies on the internet and the problems posed by the intergenerational increase in scores that has become known as the “Flynn effect”. As discussed below, the latter generates misleading information when old norms are used as reference data against which to view the scores of people tested more recently.
- <sup>3</sup> Some examples of these abuses are discussed in Raven (2008b) *Intelligence, engineered invisibility, and the destruction of life on earth*.
- <sup>4</sup> We are not told which application of this model was applied. As will be seen from the discussion in endnote 10, item-equivalence according to a 3-parameter model including both difficulty and shape of item characteristic curve would be extremely demanding.
- <sup>5</sup> There are, in fact, multiple versions of the tests now known as *Classic Standard*, *Coloured*, and *Advanced* versions, *Parallel* versions of the *Coloured* and *Standard SPM*, and the *Standard Progressive Matrices Plus* version.
- <sup>6</sup> It seems that more able respondents characteristically mentally “solve” the problem before looking at the options while less able are more likely to resort to looking at the options in their quest for a solution.
- <sup>7</sup> See Raven, J. (2008). *General introduction and overview* or the *General* section of the Manual for more details.
- <sup>8</sup> Spearman (1927)
- <sup>9</sup> Spearman distinguished the two as follows “*To understand the respective natures of education and reproduction – in their trenchant contrast, in their ubiquitous co-operation and in their genetic inter-linkage – to do this would appear to be for the psychology of individual abilities the very beginning of wisdom*”.
- <sup>10</sup> Although somewhat out of place in this *commentary*, it might be of interest to introduce the evidence needed to justify this statement using material drawn from Raven, Prieler and Benesch (2008).

The graphs in the Figures below are the Item Characteristic Curves for all items in the *SPM+*.

Each individual graph plots the proportion of respondents with each total score who get the item right. Thus we see that while many low ability people fail to get the easier items right, 100% of more able people do so. On the other hand, while most low ability people fail to get the most difficult items right (those that do so do so as a result of randomly selecting the correct answer from one of the options available) more of the more able do so.

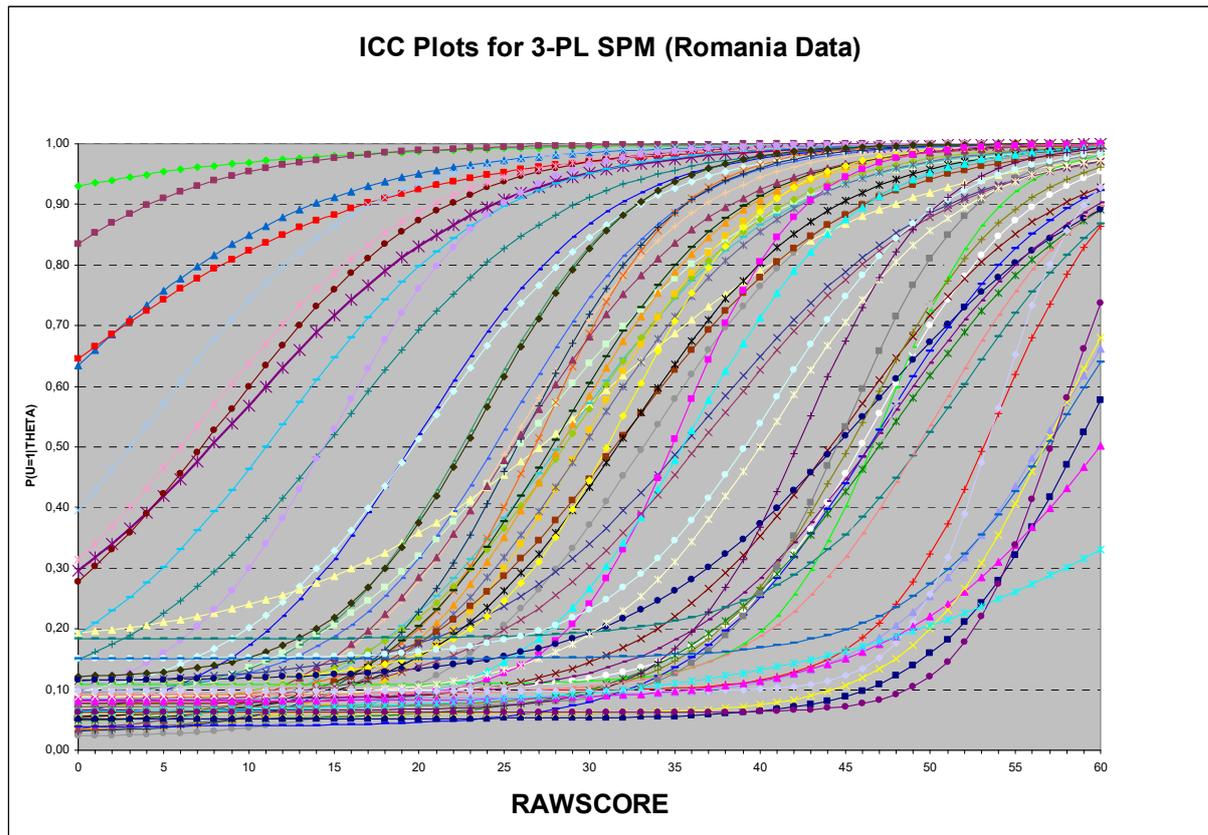
The program used to generate the graphs plotted in the first figure – known as a 1 parameter IRT model – has smoothed the raw data rather heavily.

The 3-parameter plot shown in the next Figure creates a more realistic impression.



Although few of those who use the off-the-shelf statistical packages appear to understand it, the mathematical indices generated by these packages indicate how closely the set of items in a test conform to an ideal 1-parameter IRT model.

The graphs derived from a 3 parameter plot show more deviance from this ideal.



What these Figures show is that, at least to a considerable extent, the abilities required to solve each more difficult item build on, and extend, those required to solve the easier items. No “new” abilities are required and there are no transformations or “metamorphoses” in the abilities required to solve the more difficult items. What is more, the exact same abilities are required to solve the easiest items. The psychological processes required to generate “mere perception” are the same as those required to engage in complex systemic thinking.

<sup>11</sup> Many, to the amazement of most researchers, continue simply to see even the most difficult items as patterns immediately implying the figure required to complete them.

<sup>12</sup> The failure to engage in systems (systemic) thinking lies at the heart, not only of many inappropriate policy decisions, but also at the heart of many of the erroneous conclusions drawn from “scientific” studies Raven (2019, 2020).

<sup>13</sup> Interestingly, this increase in some psychological test scores parallels a similar increase in other biological characteristics like height and athletic ability. Thus the real puzzle for psychologists is, not the “Flynn effect” but why other psychological test scores have *not* been increasing.

<sup>14</sup> The significance of the cross-cultural data became even more apparent when it came to generating an *explanation* of the “Flynn effect”. It emerged that, at any point in time, the norms for countries with a tradition of literacy were remarkably similar – this despite the fact that they had very different income levels, diets, and access to education and television. It followed that the variables usually put forward to explain the increase over time actually had very little demonstrable effect.

<sup>15</sup> Thorndike (1975)

<sup>16</sup> Flynn (1984)

<sup>17</sup> Raven, J., Raven, J. C., & Court, J. H. (2000, updated 2004). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 3: The SPM.*

<sup>18</sup> i.e. studies in which a cross section of age groups had been tested at a single time point.

<sup>19</sup> Horn (1994).

<sup>20</sup> Note that, except via the inclusion of “marker variables” they do not emerge as separate *factors* in factor analyses.

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- <sup>21</sup> J.C.Raven attached considerable importance to *discrepancies* between estimates of ability derived from *Progressive Matrices* (eductive ability) and *Vocabulary* (reproductive ability) test scores. Given that the *Raven's 2* is not accompanied by a parallel measure of reproductive ability, it will not be possible for users to generate such diagnostic information.
- <sup>22</sup> Flynn (1989 and 1999) found himself ensnared in this mess when he found himself asking whether the increase he had documented “really” represented an increase in “intelligence”.
- <sup>23</sup> Raven, J., Raven, J. C., & Court, J. H. (2000, updated 2004). *Manual for Raven's Progressive Matrices and Vocabulary Scales*. Sections 1 to 7.
- <sup>24</sup> McKinzey, R. K. (2008).
- <sup>25</sup> Serious disputes often arise around small differences in scores around legislatively prescribed cut off points. As the authors note when discussing the concept of “age equivalents”, a small difference in raw score can make a big difference to the mental age assigned. Reversing this observation, a few months difference in age can make a big difference to the standard score assigned and thus to the educational programme to which a child is assigned. This is because there are big differences in item difficulties, particularly in the tails of the distribution. The test is simply not suitable for mechanical application in such situations. Interestingly, in discussing Case Study No 3 the authors find it necessary to recommend broadening the range of assessment instruments used.
- <sup>26</sup> Interestingly enough even this is never made explicit. It is only implied by an introductory quote, which now appears in endnote 9 but which initially appeared simply as a stand-alone paragraph at the front of J.C.Raven's *Guide* to the use of the Progressive Matrices.
- <sup>27</sup> Raven (2020).
- <sup>28</sup> See Raven, J. (2008). *Intelligence, engineered invisibility ...* (Raven & Raven 2008 chapter 19) for a fuller discussion.
- <sup>29</sup> The ethics of this process has been discussed by Flynn in Flynn (2000) ... which is summarised in a chapter in our *Uses and Abuses of Intelligence* (Flynn, 2008).
- <sup>30</sup> Some of these are reported in various sections of the main Raven, Court and Raven Manual and more are available in in Raven & Raven (ed) 2008.
- <sup>31</sup> This is more than a little odd since this section was first superseded by a computerised version and then by the digitisation of the entire Raven archive by The Psychological Corporation, San Antonio.
- <sup>32</sup> Taylor, N. (2008).
- <sup>33</sup> Prospective miners still come from very different tribes who speak different languages and often do not understand each other, never mind English.
- <sup>34</sup> The Hispanic/White difference has probably declined since then, but this does not affect the point being made.
- <sup>35</sup> John Rust has drawn my attention to the way in which non-verbal algorithms (Artificial Intelligence [nb use of the term “intelligence”]) are being used to cyclically evolve discriminations (unverbalised constructs) which are then recursively accorded differential treatment on an undiscoverable basis to enhance those discriminations and without regard to their wider consequences.
- <sup>36</sup> An important discussion of this and several other issues raised in this review has been provided by Wicherts (2007).
- <sup>37</sup> Prieler and Raven (2008).
- <sup>38</sup> See Raven, J., Raven, J. C., & Court, J. H. (2000, updated 2004). *Manual for Raven's Progressive Matrices and Vocabulary Scales*. Section 3.
- <sup>39</sup> Raven, Prieler, and Benasch (2008). On the face of it, this provides a solution to our problem. Unfortunately, there can be no guarantee that, just because the overall distribution is as illustrated, the distributions for different ability groups will be similar. I leave the task of checking on this to others.
- <sup>40</sup> Raven, Prieler and Benasch (2008) but see important discussion of Test Information Function in Hambleton (1991).