Technical Whitepaper

15

March 6th, 2020

The Nature of Schizotypy

Verification of the data analyses reported in: Eysenck, H.J. & Barrett, P.T. (1993) The nature of Schizotypy. *Psychological Reports*, 73, 59-63.

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Preamble

This is not one of my usual Technical Reports – but I didn't know what else to do with it except label it as such.

It was written in response to an entry I saw on the list of all Eysenck (as author/co-author) papers that have been retracted, or where a publisher has published an "Expression of Concern":
http://retractiondatabase.org/RetractionSearch.aspx#?auth%3dEysenck%252c%2bHans%2bJ

The background to all this can be read in two articles in Retraction Watch:

https://retractionwatch.com/2020/02/12/journals-retract-three-papers-by-hans-eysenck-flag-18-some-60-years-old/

https://retractionwatch.com/2020/02/26/journal-founded-by-hans-eysenck-issues-expressions-of-concern-for-his-papers-despite-calls-by-university-to-retract/

Ignoring the specific issue of the veracity of Grosssart-Maticek's data, I was curious to see this entry in the Retraction Watch Database – not least because it had my name attached to it, with that "Concerns about the data and the Results".

The Nature of Schizotypy
(HSC) Medicine - Psychiatry; (SOC) Psychology;
Psychological Reports --- *SAGE Publications*
Institute of Psychiatry, University of London

And:

+Concerns/Issues About Data	Hans J Eysenck Paul Barrett
+Concerns/Issues About Results	
+Investigation by Company/Institution	

The paper in question being:
Eysenck, H.J. & Barrett, P.T. (1993) The nature of Schizotypy. *Psychological Reports*, 73, 59-63.

So, I took a look at the original article. The only data analysed in this paper was a 14-variable correlation matrix presented within a Kendler and Hewitt paper (p. 7, Table 2).
Kendler, K.S. and Hewitt, J. (1992). The structure of self-report schizotypy in twins. Journal of Personality Disorders, 6, 1, 1-17.

I have no memory at all of working on this except my analytical/computational fingerprints are all over it! Given I was just about still working in the Biosignal Lab in 1992/3 (it closed in 1993 with me jobless), I suspect I just did the analyses and sent/gave the output to Hans, who wrote it all up.

Anyway, I wondered whether Hans had for some reason presented incorrect results output etc., or maybe I'd made some kind of awful analysis error/s, so I coaxed my old 1980/90s Fortran Factor and Rotate programs into life again and typed the matrix into Statistica v.13.5– and ran a PCA from there. I then converted the correlation matrix into the old PsWin software Factor input file format, and ran the analysis again, running a Direct Oblimin rotation with swept delta (as described in the 1993 paper) to obtain the factor rotation solution.

I've detailed some head-to-head comparisons here. The old Fortran program outputs, the 1992 and 1993 paper, along with an earlier 1982 one to which I refer, are all provided in a zipped archive which accompany this report.

Are these Data and Results Trustworthy?

Basically, it's a case of "nothing to see here". **But there are some minor 'exceptions'.**

Table 1 in the 1993 paper reports:

TABLE 1
PRINCIPAL COMPONENT ANALYSIS OF 14 SCALES

Variables	Factor 1	Factor 2	Factor 3	Communality
Hallucination	-0.723	-0.308	-0.130	0.6345
Perceptual Aberration (Chapman)	-0.723	-0.074	0.135	0.5461
Magical Ideation (Chapman)	-0.744	-0.328	0.152	0.6835
Social Anhedonia	-0.478	0.564	0.209	0.5911
Physical Anhedonia	0.193	0.571	0.366	0.4969
Nonconformity	0.655	0.021	0.510	0.6904
Magical Ideation (Claridge)	-0.654	-0.442	-0.059	0.6261
Perceptual Aberration (Claridge)	-0.743	-0.122	-0.055	0.5692
Paranoid Ideation (Claridge)	-0.679	0.367	-0.153	0.6194
Extraversion	-0.033	-0.739	0.315	0.6469
Neuroticism	-0.702	0.240	-0.344	0.6684
Psychoticism	-0.339	0.280	0 743	0.7453
Anxiety	-0.766	0.118	-0 308	0.6958
Depression	-0.747	0.196	-0 361	0.7272
Hyperplane Count	1	2	2	
Variance	5.487	1.933	1.521	

Statistica analysis reports:

Variable	Factor Loadings (Unrotated) (Correlation matrix, 14vars, p. 7, 1992) Extraction: Principal components (Marked loadings are >.700000) Factor 1	Factor 2	Factor 3	Communality
Hallucination	-0.723	-0.308	0.130	0.6345
Perceptual Aberration	-0.723	-0.074	0.135	0.5461
Magical Ideation	-0.744	-0.328	0.152	0.6835
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Paranoid Ideation	-0.679	0.367	-0.153	0.6194
Extraversion	-0.033	-0.739	0.315	0.6469
Neuroticism	-0.702	0.240	-0.344	0.6684
Psychoticism	-0.339	0.280	0.743	0.7453
Anxiety	-0.766	0.118	-0.308	0.6958
Depression	-0.747	0.196	-0.361	0.7272
Expl.Var	5.487	1.933	1.521	
Prp.Totl	0.392	0.138	0.109	

From the old "Factor" program – which used to run on an IBM mainframe back in the 1980s, then a Unix minicomputer in the Biosignal Lab, then a PRIME minicomputer, then finally in Windows (I made it all work back in 2017, using the Approximatrix Simply Fortran program).

EIGENVALUES EXTRACTED
****

Dataset Title: Kendler-Hewitt 1992 correlation matrix, 14 vars, Table 2, p.7

NO.	EIGENVALUE	ARMOR THETA	% VARIANCE	CUMULATIVE %
1	5.486981	0.880654	39.192724	39.192724
2	1.932670	0.519703	13.804787	52.997511
3	1.521079	0.368923	10.864847	63.862358
4	0.831606	-	5.940040	69.802398
5	0.678496	-	4.846402	74.648800
6	0.642444	-	4.588888	79.237688
7	0.508058	-	3.628989	82.866677
8	0.479239	-	3.423135	86.289812
9	0.419276	-	2.994825	89.284638
10	0.410809	-	2.934350	92.218987
11	0.351169	-	2.508351	94.727338
12	0.296196	-	2.115689	96.843027
13	0.255709	-	1.826490	98.669517
14	0.186268	-	1.330484	100.000002

So, all OK there. Now to Table 2 in the 1993 paper:

TABLE 2
OBLIMIN ROTATION OF TABLE 1

Variable	Factor 1	Factor 2	Factor 3
Hallucinations	-0.524	-0.679	0.275
Perceptual Aberration (Chapman)	-0.583	-0.491	0.382
Magical Ideation (Chapman)	-0.530	-0.710	0.293
Social Anhedonia (Chapman)	-0.502	0.144	0.616
Physical Anhedonia (Chapman)	0.155	0.493	0.458
Nonconformist (Chapman)	-0.415	-0.452	0.692
Magical Ideation (Claridge)	-0.494	-0.709	0.038
Perceptual Aberration (Claridge)	-0.655	-0.503	0.219
Paranoid Ideation (Claridge)	-0.759	-0.054	0.328
Extraversion	0.273	-0.676	-0.060
Neuroticism	-0.815	-0.131	0.131
Psychoticism	-0.114	-0.114	0.855
Anxiety	-0.828	-0.272	0.133
Depression	-0.850	-0.188	0.117
Hyperplane Count	1	4	6
Variance	4.277	2.660	2.004

Factor Correlation Matrix

1.0000	0.2246	-0.2156
0.2246	1.0000	-0.0459
-0.2156	-0.0459	1.0000

I ran my old Rotate program (again, modified suitably to run in Windows back in 2017), and nearly fainted! The final solution and its hyperplane maximization delta etc. were OK, as was the factor correlation matrix, but the pattern matrix was completely different.

Rotated Factor Pattern Matrix

VARIABLES	FAC. 1	FAC. 2	FAC. 3
Hallucin	-0.354	-0.591	0.172
Perceptu	-0.439	-0.380	0.270
Magical	-0.350	-0.623	0.189
Social A	-0.448	0.269	0.531
Physical	0.158	0.481	0.514
Nonconfo	-0.193	-0.380	0.633
Magical	-0.368	-0.630	-0.070
Perceptu	-0.553	-0.375	0.083
Paranoid	-0.750	0.122	0.172
Extraver	0.447	-0.776	0.001
Neurotic	-0.837	0.054	-0.047
Psychoti	0.095	-0.095	0.871
Anxiety	-0.818	-0.091	-0.048
Depressi	-0.866	0.003	-0.069

FACTOR CORRELATION MATRIX

COLUMN***	1		
1*	1.0000	2* 0.2246	3*-0.2156

COLUMN***	2		
1*	0.2246	2* 1.0000	3*-0.0459

COLUMN***	3		
1*	-0.2156	2*	-0.0459 3* 1.0000

Then, it struck me that maybe Hans had for some reason reported the factor structure matrix. I have always reported a factor pattern matrix for oblique rotations (I took Cattell's viewpoint from his 1983 textbook on Factor Analysis).

Indeed, in the 1993 article, Hans has reported the factor ***structure*** matrix (yes, it's absolutely correct to all those decimal places-but differs slightly from the pattern matrix because the factors are correlated). Which matrix you report is an option, depending upon what you on want to discuss (regression beta weights in the Pattern matrix or correlations (between a factor and a variable in the factor structure matrix.)

FACTOR STRUCTURE MATRIX
=======================

VARIABLES	FAC. 1	FAC. 2	FAC. 3
Hallucin	-0.524	-0.679	0.275
Perceptu	-0.583	-0.491	0.382
Magical	-0.530	-0.710	0.293
Social A	-0.502	0.144	0.616
Physical	0.155	0.493	0.458
Nonconfo	-0.415	-0.452	0.692
Magical	-0.494	-0.709	0.038
Perceptu	-0.655	-0.503	0.219
Paranoid	-0.759	-0.054	0.328
Extraver	0.273	-0.676	-0.060
Neurotic	-0.815	-0.131	0.131
Psychoti	-0.114	-0.114	0.855
Anxiety	-0.828	-0.272	0.133
Depressi	-0.850	-0.188	0.117
HYP.CT.			
******	0	1	2
VARIANCE.			
********	4.277	2.660	2.004

Those Minor Exceptions

OK – now we go through the 1993 paper results-reporting with a fine-tooth comb!

❶ 1993 paper, p. 60, lines 6-9:

"Table 1 shows the unrotated matrix, using principal component analysis. Certain features are noteworthy. On the Kaiser-Guttman, Kaiser Alpha, Velicer MAP, and the Autoscree tests, **three factors are indicated**, so we have not attempted to over-extract factors."

In fact, the output shows:

EIGENVALUES EXTRACTED
****

Dataset Title: Kendler-Hewitt 1992 correlation matrix, 14 vars, Table 2, p.7

NO.	EIGENVALUE	ARMOR THETA	% VARIANCE	CUMULATIVE %
1	5.486981	0.880654	39.192724	39.192724
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12	0.296196	-	2.115689	96.843027
13	0.255709	-	1.826490	98.669517
14	0.186268	-	1.330484	100.000002

My older version program reported "Kaiser Alpha" rather than Armor Theta. For some reason I can't remember, I must have changed it way back when! I can say this with some certainty because I went back to an older 1982 paper in which I was using the same software:

Barrett, P.T. & Kline, P. (1982) An item and radial parcel factor analysis of the 16PF questionnaire. *Personality and Individual Differences,* 3, 259-270. See page 260, Eq 1.

Factor extraction tests

For both the PCA and IFA three tests of factor extraction were undertaken:

(a) The Kaiser factor alpha criterion (Kaiser, 1960; Kaiser & Caffrey, 1965; Barrett and Kline, 1982). This criterion is based upon Kaiser's derivation of coefficient alpha for a factor. For each eigenvalue $\lambda_1, \lambda_2, \ldots, \lambda_n$, a coefficient alpha estimate of reliability can be computed using:

$$\alpha\lambda_i = \left(\frac{n}{n-1}\right)\left(1 - \frac{1}{\lambda_i}\right) \qquad (1)$$

Note that Armor's theta is defined equivalently to the Kaiser-Alpha:

Given a set of p items and a single-factor solution with root λ_1, the reliability of the composite scores based on this factor is given by

$$\theta = [p/(p-1)][1-(1/\lambda_1)] \quad (9)$$

where λ_1 is the first root of a principal-component solution. Although this formula is not new, it is little known in sociology (Bentler, 1968). It is mathematically equivalent to alpha for a composite scale formed by weighting items according to their principal-component factor loadings; this has been shown by Lord (1958) to be the maximum possible

On page 28, in: Armor, D. J. (1974). Theta reliability and factor scaling. Sociological Methodology, 1973-1974, 5, 1, 17-50.

Ordinarily one would interpret the result as one might interpret any reliability coefficient .. values above about 0.6 or so would be indicative of reasonable internal consistency, so instead of reporting the result as 3 factors, one might report it as indicating 1 factor.

As to the **Velicer MAP test**, its results were unambiguous:

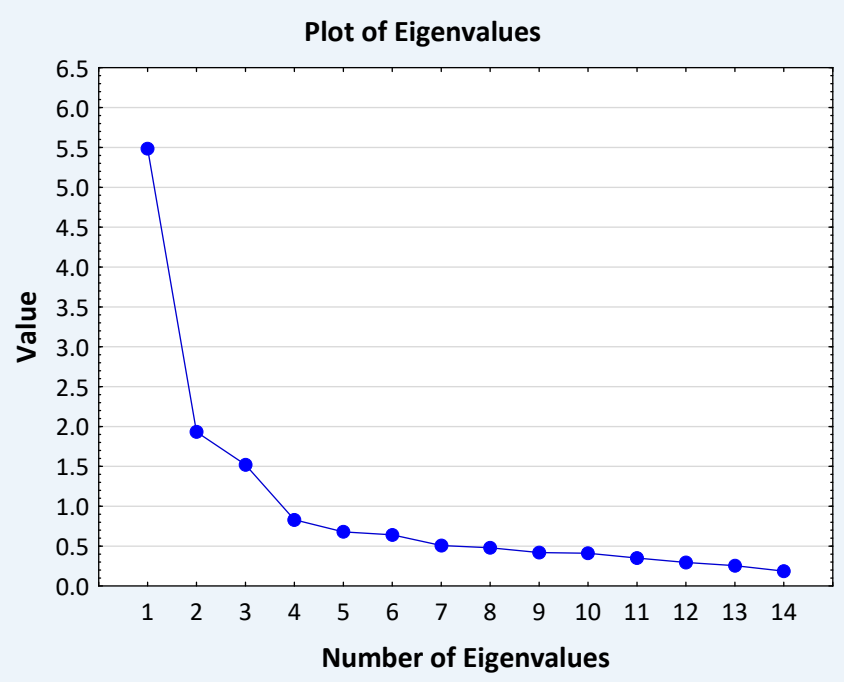
```
VELICER Minimum Average Partial correlation factor extraction test results

FACTOR NO.         Criterion
----------         --------

     Now beginning the VELICER test calculations
    1            0.13661538
    2            0.13661538


MAP INDICATES ***   1 *** FACTORS WITH A FUNCTION VALUE OF <  0.13661538>
```

The Kaiser-Guttman rule indicates 3 factors.

AUTOSCREE my computational version of a scree test (described in excruciating detail in the 1982 Radial Parcel 16PF Paper, p.262!!) showed:

```
                                SCREE ANALYSIS...TOTAL INFORMATION PRINTOUT
                                *******************************************

Dataset Title: Kendler-Hewitt 1992 correlation matrix, 14 vars, Table 2, p.7

        OPTIMUM DECISIONS - TOTAL SCREES =
        *********************************

             DECISION  1=         FACTORS RETAINED=  3 WITH AN OCCURRENCE OF   78,......= 86.67 PERCENT
             DECISION  2=         FACTORS RETAINED=  6 WITH AN OCCURRENCE OF   12,......= 13.33 PERCENT
             DECISION  3=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
             DECISION  4=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
-------------------------------------------------------------------------------------------------------------


                  LOWER angular search...1.0*2.0*3.0 degrees concensus print
                  **********************************************************

        OPTIMUM DECISIONS - TOTAL SCREES =
        *********************************

             DECISION  1=         FACTORS RETAINED=  3 WITH AN OCCURRENCE OF   42,......= 77.78 PERCENT
             DECISION  2=         FACTORS RETAINED=  6 WITH AN OCCURRENCE OF   12,......= 22.22 PERCENT
             DECISION  3=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
             DECISION  4=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
-------------------------------------------------------------------------------------------------------------


                  UPPER angular search...3.0*4.0*5.0* degrees concensus print
                  **********************************************************

        OPTIMUM DECISIONS - TOTAL SCREES =
        *********************************

             DECISION  1=         FACTORS RETAINED=  3 WITH AN OCCURRENCE OF   54,......=100.00 PERCENT
             DECISION  2=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
             DECISION  3=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
             DECISION  4=         FACTORS RETAINED=  1 WITH AN OCCURRENCE OF    0,......=  0.00 PERCENT
-------------------------------------------------------------------------------------------------------------
```

So, clearly 3 factors .. especially given the scree plot itself:



So, with respect to p. 60, lines 6-9:
"Table 1 shows the unrotated matrix, using principal component analysis. Certain features are noteworthy. On the Kaiser-Guttman, Kaiser Alpha, Velicer MAP, and the Autoscree tests, three factors are indicated, so we have not attempted to over-extract factors."

More correctly it would be stated that the scree-plot, Kaiser-Guttman and Autoscree tests indicated 3 factors, with Armor's theta and the Velicer MAP test just 1.

I suspect Hans mistook the three displayed alphas as indicating 3 components to retain – but maybe he just got a bit sloppy, because there is no mistaking the Velicer MAP result.

Does it matter? Who knows and I couldn't care less anyway as none of this is of the remotest interest to me, not after Michell, J. (1997). Quantitative science and the definition of measurement in Psychology. British Journal of Psychology, 88, 3, 355-383.

❷ There is a slight discrepancy in the decimal value of the hyperplane count given on page 61 of the 1993 paper, line 15:
"the hyperplane of 0.050219669." The value from the current Rotate program is: 0.050219234. Looks to be just rounding error between computations implemented on the old Unix machine and its Fortran compiler vs those using my current Dell 7730 mobile workstation and the Approximatix Fortran compiler.

❸ The hyperplane count in Table 2 of the 1993 article is that for the pattern matrix, not the factor structure matrix:

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OBLIMIN ROTATION OF TABLE 1

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Magical Ideation (Claridge)	-0.494	-0.709	0.038
Perceptual Aberration (Claridge)	-0.655	-0.503	0.219
Paranoid Ideation (Claridge)	-0.759	-0.054	0.328
Extraversion	0.273	-0.676	-0.060
Neuroticism	-0.815	-0.131	0.131
Psychoticism	-0.114	-0.114	0.855
Anxiety	-0.828	-0.272	0.133
Depression	-0.850	-0.188	0.117
Hyperplane Count	1	4	6
Variance	4.277	2.660	2.004

Rotated Factor Pattern Matrix

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Magical	-0.368	-0.630	-0.070
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Neurotic	-0.837	0.054	-0.047
Psychoti	0.095	-0.095	0.871
Anxiety	-0.818	-0.091	-0.048
Depressi	-0.866	0.003	-0.069

HYP.CT.			
******	1	4	6

FACTOR STRUCTURE MATRIX

VARIABLES	FAC. 1	FAC. 2	FAC. 3
Hallucin	-0.524	-0.679	0.275
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Anxiety	-0.828	-0.272	0.133
Depressi	-0.850	-0.188	0.117

HYP.CT.			
******	0	1	2

VARIANCE.			
********	4.277	2.660	2.004

Does it affect anything – no. Because it's merely a descriptive parameter of no substantive interest; reported because it was a necessity back in the 1980s 'given' Cattell's arguments.

I leave it to others to decide whether these exceptions matter at all. My days of nit-picking over this kind of trivia are far gone. See:

Barrett, P.T. (2018). The EFPA test-review model: When good intentions meet a methodological thought disorder. Behavioural Sciences (https://www.mdpi.com/2076-328X/8/1/5), 8,1, 5, 1-22.

Maybe Hans' interpretations/theorizing are not justifiable, or maybe the evidence is not so clear-cut for 3 factors. Decades ago, years were spent by me and many others investigating which test of factor extraction quantity was best – all rather pointless really in the grand scheme of things.

And these days, other favoured approaches to such analyses might well reveal differences.

But, this report was important for me to prepare – to show that the listing of this paper in the Retraction Watch database with the reasons given, is not readily justifiable. But it's what happens when some overexcited critics extend their criticisms beyond that which the evidence actually supports *(not Retraction Watch I hasten to add; it just reports what's published/said by others).*

With regard to correcting the implied reputational damage of my scientific integrity - of the **Feynman** kind - the analyses reported in 1993 are fundamentally correct. There is no fudge, no fraud, no intent to deceive, and no major mistakes in the reporting of results information.

My personal reference for scientific integrity.

Feynman, Richard P. 1985. "Surely you're joking, Mr. Feynman!": Adventures of a curious character. New York: W. W. Norton & Co.
Feynman, R.P. (1974). Cargo Cult Science: some remarks on science, pseudoscience, and learning how not to fool yourself. Engineering and Science, 37, 7, 10-13.

"I think the educational and psychological studies I mentioned are examples of what I would like to call Cargo Cult Science. Tn the South Seas there is a Cargo Cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now. So they've arranged to make things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas -he's the controller-and they wait for the airplanes to land. They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So, I call these things Cargo Cult Science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land.

Now it behooves me, of course, to tell you what they're missing. It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty a kind of leaning over backwards. For example, if you're doing an experiment, you should report everything that you think might make it invalid; not only what you think is right about it: other causes that could possibly explain your results; and things you thought of that you've eliminated by some other experiment, and how they worked to make sure the other fellow can tell they have been eliminated.

In summary, the idea is to try to give all of the information to help others to judge the value of your contribution; not just the information that leads to judgment in one particular direction or another."