Country Specific Addendum: The Development, Validity and Reliability of the German Version S3.1 of the Insights Discovery Evaluator

Dr. Stephen Benton

Director of The Business Psychology Centre (bpc),

The University of Westminster, 309 Regent Street, London, W1B 2UW, UK

Dr. Corine van Erkom Schurink

Director of the Analytical Research Bureau (Pty) Ltd,

16 Central Avenue, Pinelands 7405, South Africa

Stewart Desson

Head of Learning, Insights Learning & Development Ltd,

Jack Martin Way, Dundee, DD4 9FF, Scotland, UK

This addendum presents key data on the psychometric properties of the German version of the Insights Discovery Evaluator (IDE). It draws upon an extensive research and development programme undertaken between Insights Learning & Development Ltd. and the University of Westminster, aimed at the development of a psychometrically robust evaluator. This paper assumes the reader has first read "An Overview of the Development, Validity and Reliability of the English Version 3.0 of the Insights Discovery Evaluator" produced at the University of Westminster's Business Psychology Centre (bpc).

This report presents information covering reliability and validity. Key statistics have been computed on:

- Norms data by gender
- Reliability
    - Split-half correlations
    - Cronbach Alpha coefficients
    - Test-retest analysis
- Validity - Factor Analysis

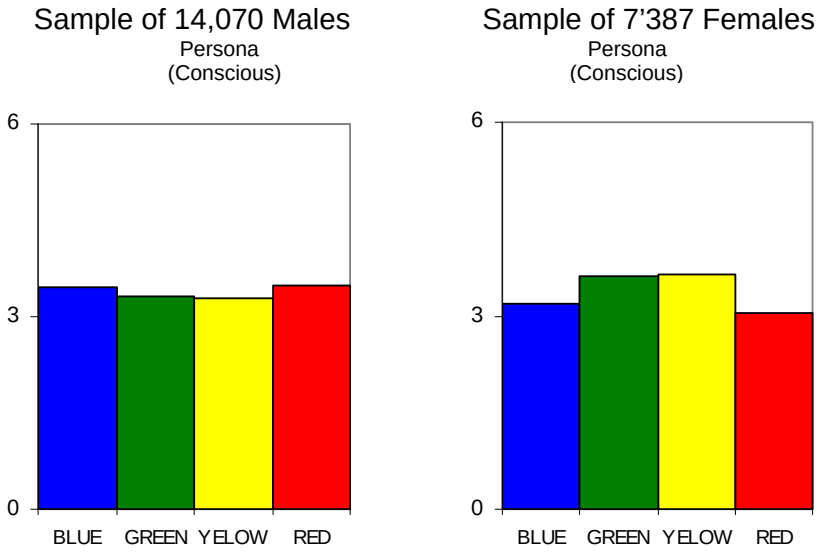
Data on Norms

Presented in Figure 1, is an example specific to the German S3.1 IDE, providing norms data by gender.

The samples are all taken from the management communities of large multi-national and German organisations. This sample is not intended to be representative of German people overall; it is however, a very useful overview of the German clients Insights Learning and development work with.

Please note that while this data indicates that people of a certain gender tend to have a preference for certain colours, it does not correlate or necessarily relate to how well they do their job or how capable they are of fulfilling a particular role.

On average, females have lower scores for blue and red, and higher scores for green and yellow. This data is consistent with other instruments that suggest gender differences in personality. Hammer and Mitchell's research done on the distribution of MBTI types by ethnicity and gender in the US show that women indicated a higher preference for extraverted feeling (f:31.1%, m:16.2%) and introverted feeling (f:29.9%, m:15.2%). In a similar vein men showed a preference for extraverted thinking (f:15.9%, m:29.2%) and introverted thinking (f:22.9%, 39.4%)[1]. Rubinstein and Strul found similar gender differences in their study carried out with the NEO-PI-R, women had a significantly higher preference for agreeableness and neuroticism attributes that have both been linked to the Jungian attitudinal function of feeling[2].



3.45	3.31	3.28	3.50
57%	55%	55%	58%

3.19	3.61	3.65	3.05
53%	60%	61%	51%

Figure 1 - A graphical view for the norms of Males vs. Females for the German S3.1 IDE

[1] Hammer, A. L., Mitchell, W.D. (1996) *The Distribution of MBTI Types In the US by Gender and Ethnic Group*, Journal of Psychological Type, Vol.37, 2 – 15.

[2]Rubinstein, G., Strul, S. (2006) *The Five Factor Model (FFM) Among Four Groups of Male and Female Professionals*, Journal of Research in Personality, Vol. 41, 931-937

Reliability: Cronbach-Alpha Coefficients

This coefficient measures the error variance on the average inter-item correlation. When the error variance is low, which is desirable, the alpha coefficient approaches 1.0. A value of 0.70 is the commonly accepted inferior limit[3]. Analysing 21,417 completed German S3.1 IDE reported in Table 1 shows the four colours to have high Cronbach-Alpha coefficients between 0.90 and 0.91, providing evidence of excellent reliability.

N=21,417 German S3.1 IDE	Colour preference			
	Cool Blue	Earth Green	Sunshine Yellow	Fiery Red
Cronbach-Alpha Coefficients	0.908	0.909	0.906	0.910

Table 1 – Cronbach-Alpha coefficients

Reliability: Split-Half Coefficients

The final measure of internal consistency that supports the case for reliability is the 'split-half' measure. In split-half reliability we randomly divide all items that are thought to measure the same construct into two sets e.g. we create two sets of Fiery Red items. We test the evaluator on a sample of people and compute the total score for each randomly divided half. The split-half assessment of reliability is based on how well these two total scores correlate.

The split-half measures for the IDE were achieved by splitting the 25 frames into two groups of 12 and 13. The colour results are computed for each of the two groups and then correlated. A high correlation suggests high reliability i.e. the higher the association (correlation coefficient) between the two data sub-sets, the higher the internal consistency of the scale. The analysis of the German IDE reported in Table 2 shows high coefficients for the IDE, with coefficients being:

- Cronbach-Alpha Coefficients between 0.80 and 0.85 for each half
- Pearson Correlation Coefficients between 0.82 and 0.84 i.e. the 2 halves correlate highly

	N=21'417 German S3.1 IDE	Colour preference			
		Cool Blue	Earth Green	Sunshine Yellow	Fiery Red
Part 1	Cronbach-Alpha coefficient N of Items	0.811 13	0.801 13	0.847 13	0.844 13
Part 2	Cronbach-Alpha coefficient N of Items	0.849 12	0.865 12	0.806 12	0.828 12
	Pearson Correlation coefficient between halves	0.84	0.82	0.83	0.82
	Tot. N of Items	25	25	25	25

Table 2 – Split-Half coefficients

Reliability: Temporal Stability – Test / Re-test Correlations

'Temporal stability' or 'test/re-test' reliability is determined through the administration of the same evaluator across time and it helps us gauge how robust the items are. A sample of 437 people who completed the German IDE twice (with at least 3 months gap) had their original and re-tested colour scores assessed through a Pearson correlation analysis. Reliability is expressed as correlation coefficients, ranging from 1 to 0. Temporal stability tests are generally expected to yield reliability coefficients ranging between 0.70 and 0.90.

The results of the Test / Re-test analysis performed on the four colour scores of the German IDE, and reported in Table 3 show a high reliability, translating into Pearsons' correlation coefficients ranging from 0.81 to 0.84.

N = 437	RETEST Cool Blue	RETEST Earth Green	RETEST Sunshine Yellow	RETEST Fiery Red
TEST Cool Blue	**0.82**	-0.33	-0.67	0.24
TEST Earth Green	-0.28	**0.84**	0.09	-0.68
TEST Sunshine Yellow	-0.66	0.11	**0.81**	-0.19
TEST Fiery Red	0.22	-0.66	-0.21	**0.84**

All correlations in this table are significant at the 0.01 level (2-tailed).

Table 3 – Test re-test correlation

Validity - Confirmatory Factor Analysis

Confirmatory Factor Analysis was used to test the hypothesized factor structure of the Insights Discovery model. Specifically, it is hypothesized that the four sets of 25 colour based items in the IDE, should load onto the factors such that:

- The polar opposite nature of the 'Fiery Red' vs. 'Earth Green' items is apparent
- The polar opposite nature of the 'Sunshine Yellow' vs. 'Cool Blue' items is apparent
- 'Fiery Red' items should not load significantly onto any factor that 'Cool Blue' and/or 'Sunshine Yellow' items load onto
- 'Earth Green' items should not load significantly onto a factor that 'Cool Blue' and/or 'Sunshine Yellow' items load onto
- 'Sunshine Yellow' items should not load significantly onto any factor that 'Fiery Red' and/or 'Earth Green' items load onto
- 'Cool Blue' items should not load significantly onto a factor that 'Fiery Red' and/or 'Earth Green' items load onto

The results that follow successfully confirm this hypothesized structure and offer evidence for the construct validity of the German S3.1 IDE.

A four factors solution accounts for 39% of the variance, while a two factors solution accounts for 31% of the variance. Generally factor loadings equal or greater than 0.30 are considered to meet the minimal level for significance required[4]. Using these criteria the statistically significant factor loadings have been highlighted with greyed background in the Table 4 below.

The four factor solution highlights the presence of the four constructs (translating into the four colour preferences), while the two factor solution highlights the bipolarity of those four constructs, as the opposite signs of these loadings (negative values highlighted with yellowed background) support the theoretical construct that 'Fiery Red' and 'Earth Green' are polar opposites. The same holds true for 'Cool Blue' and 'Sunshine Yellow'.

	Four factor solution				Two factor solution	
N=21'417 German S3.1 IDE	Average Factor Loadings				Average Factor Loadings	
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2
Earth Green	0.53	-0.10	-0.03	-0.07	-0.52	-0.03
Sunshine Yellow	-0.04	0.48	-0.23	0.05	0.07	0.51
Cool Blue	0.00	-0.26	0.48	-0.07	-0.04	-0.52
Fiery Red	-0.44	-0.01	-0.14	0.30	0.52	0.09

Table 4 – Factor Analysis

[4] Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., (1998) 'Multivariate Data Analysis', 5th ed, Prentice-Hall, Inc.

While Table 4 reports an average of the factor loadings, it is also possible to report the factor loadings for each of the 100 items in the IDE in the form of a scatter plot (both diagonal scales range from 0.8 to minus 0.8, with the axis crossing at zero). Based on the two factor solution Figure 2 shows the factor loadings onto all 100 items. The data has been superimposed onto the Insights Discovery Wheel. In the case of the German IDE most of the 100 items appear in the 'correct' quadrant.

This item level data provides further evidence of the bi-polar nature of the colour scores and the construct validity of the model.

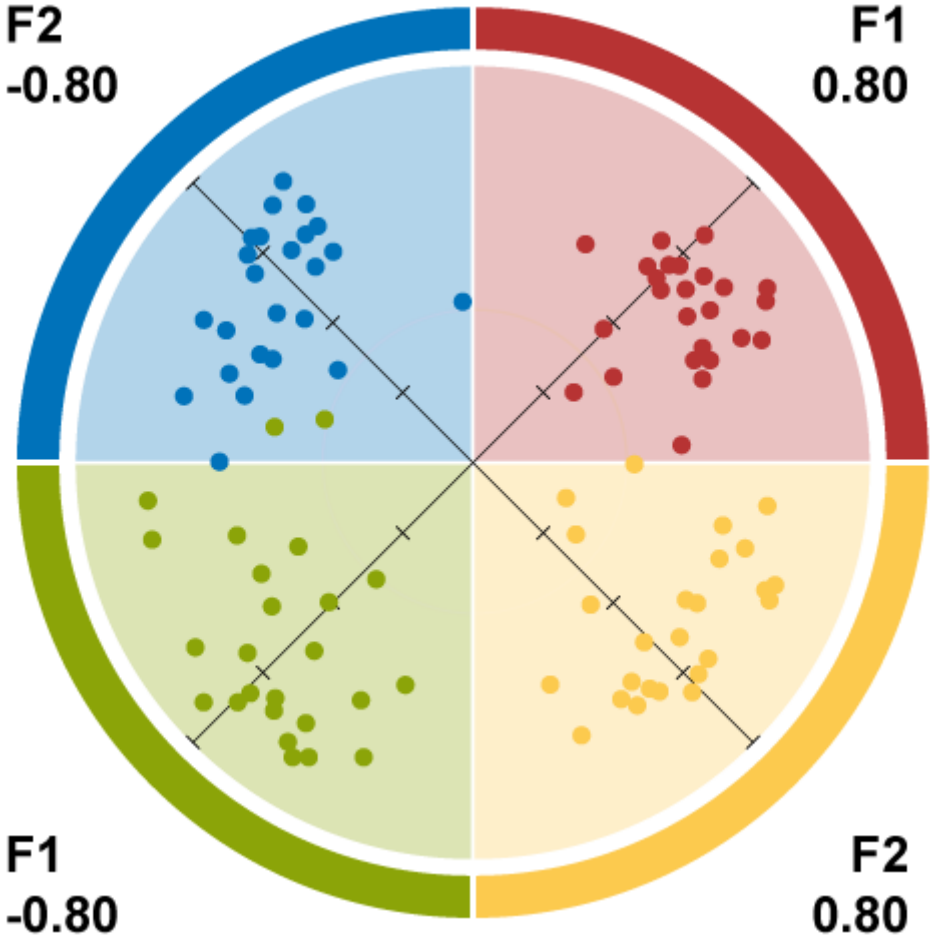


Figure 2 – German S3.1 IDE – Graph of the 100 items (25 x 4 colours) plotted against the factors

Conclusion

In conjunction with the detailed analysis of the English version of the IDE, this brief paper offers good evidence of the internal reliability (using Cronbach Alpha, Split-Half analysis and Test-retest analysis) and construct validity (using Factor Analysis) of the German S3.1 IDE.