Bond&FoxChapter4.pdf: Bond & Fox (2006) Applying th	ne Rasch Model Chapter 4: The BLOT Test
Bond's Logical Operations Test BLOT data Skip down to Let's remind ourselves about the BLOT test if Bond&FoxChapter4.txt and this Tutorial are already displaying on your screen. <i>Please print out the Tutorial for reference</i> . <i>Please install Bond&FoxSteps on your computer by double-</i> <i>clicking on Bond&FoxStepsInstall.exe on your CD</i>	001 1111111101101010101111111011111 002 111111111111111111111111111111111111
Launch Bond&FoxSteps from the short-cut on your desktop or from the Windows "Start" menu.	Bond&Fox Steps
The Bond&FoxSteps Control File Set-Up Screen displays. We are going to follow the instructions in the blue box.	Control and state to the two The End water to the two Section and state to the two Department The Person the two NAMELT - First person the toother NAMELT - First person toother Note toother
1. Click on the "Data files" menu. Click on "Bond&FoxChapter4.txt" - this is the Chapter 4 example	File Edit Analysis Data files Tutorials Help BondFoxAppendix2.txt TITLE= Report BondFoxChapter3.txt BondFoxChapter4.txt
The Bond&FoxChapter4.txt control instructions and data are displayed on your screen.	Bond&FoxChapter4.txt File Edit Analysis Data files Tutorials Help Bond&FoxSteps TITLE= Report title is Bond & Fox BLOT data: Chapter 4 PERSON=A data row is a PERSON=A data row is a Person IT NAME1= First person label column 1 1 r NAMELEN= Person label length 4 XWIDE Number of data columns 39 XWIDE Column: 1 2 3 4 5 6 7 8 9 10 111 12 Person: 1 2 4 5 6 7 8 Label: 0

Click on the "Tutorials" menu. Click on "Bond&FoxChapter4.pdf" - this is the Tutorial matching Bond&FoxChapter4.txt	Bond&FoxChapter4.txt File Edit Analysis Data files Tutorials Help BondFoxAppendix2.pdf BondFoxChapter2.pdf BondFoxChapter3.pdf PERSON= A date BondFoxChapter4.pdf
This PDF file displays. It is what you are reading now. <i>Please print out the Tutorial for reference</i> .	Bond&FoxChapter4.pdf: Bond & Fox (2006) Applying the Rasch Model Chapter 4: The BLOT Test Bond's Logical Operations Test BLOT data Skip down to Lef's remind ourselves about the BLOT test if Bond&FoxChapter4.txt and this Tuterial are already displaying on your screen. Please truttli Bond&FoxStepsInstalLexe on your Computer by double-clicking on Bond&FoxStepsInstalLexe on your desktop or from the Windows "Start" menu. Launch Bond&FoxSteps File Set-Up Screen displays. We are going to follow the instructions in the blue box.
Now step-by-step through this Tutorial Click "OK" on the Welcome dialog	 Welcome to Bond&FoxSteps ! Welcome to Bond&FoxSteps, a version of Winsteps customized to analyze the examples in "Applying the Rasch Model" by Trevor Bond and Christine Fox. Click on the "Data files" menu. Then click on the data file you want to investigate. Each is identified by its chapter. Click on the "Tutorials" menu. Then click on the Tutorial matching the data file. It is a PDF file and will be displayed after a few moments by Adobe Reader or equivalent. Follow the Tutorial. Download Adobe Reader OK Thanks, I don't need to see this again
Let's remind ourselves about the BLOT test. It consists of 35 items administered to 150 persons. It relates to Piagetian cognitive development – tapping the mature thinking that begins in adolescence for most. It is a multiple choice test, so answers are scored right (1) or wrong (0), i.e. dichotomous data. Let's look at the item labels. Click on "Item Labels Enter/Edit"	Pond&FoxChapter4.txt File Edit Analysis Data files Tutorials Help Bond&FoxSteps Control File Set-Up TITLE= Report tile is Sond & Fox BLOT data: Chapter 4 PERSON = A data row is a Person NAME1= First person label column NAMELEN- Person label length; 4 Number of data rows Number of data rows 150
Here are some of the 35 item labels. They are cryptic to most of us, but already far better than merely item numbers. To content experts they are highly meaningful: Inhelder & Piaget (1958) is a whole book devoted to the meaning of this system.	NumberLabel101 Negation (to negate identity)202 Reciprocal (to negate identity)303 Implication404 Incompatibility505 Multiplicative compensation606 Correlations707 Correlations808 Correlations909 Conjunction1010 Disjunction

Let's close the item label window.	🎟 Item Labels: Enter/Edit
Click on "Item Labels OK"	Edit NI = Number of Items= 35 Item Labels OK
	NumberLabel101 Negation (to negate identity)202 Reciprocal (to negate identity)303 Implication404 Incompatibility505 Multiplicative compensation
Let's perform the Analysis of these data. Click on "Analysis" menu Click on "Exit to Analysis (does not Save)" - we don't want to make any changes at this point	Bond&FoxChapter4.txt File Edit Analysis Data files Tutorials Help Save control with data file and exit to Analysis Save control file without data and exit to Analysis Save control file without data and exit to Analysis TITLE Save data-only file and exit to Analysis State Analysis (does not "Save") Exit to Analysis (does not "Save") Exit to Analysis (does not "Save")
File Setup closes, and the Analysis phase begins. If this is the first time you have run an Analysis, it checks your computer for available resources	Bond&FoxChapter4.txt File Edit Diagnosis OutputTables OutputFiles Batch Help Specification Plots SAS/SPS: Constructing Bond&FoxSteps.ini C:\Program Files\Microsoft Office\Office\EXCEL.EXE found C:\Program Files\Windows NT\Accessories\wordpad.exe found
Bond&FoxSteps - Analysis phase - correctly reports that the analysis control file is Bond&FoxChapter4.txt. "Report output file name"? Press your Enter key "Extra specifications"? Press your Enter key	Bond&FoxAnalysis Version 1.0.0 Aug 16 5:42 20 Current Directory: 0:\Bond&FoxSteps\Bond-data\ Name of control file: C:\Bond&FoxSteps\Bond-data Bond&FoxChapter4.txt Current Directory: C:\Bond&FoxSteps\Bond-data\ Refort output file name (or press Enter for tem Extra specifications (or press Enter):
The BLOT data are Rasch-analyzed. Measures (person abilities, item difficulties) are constructed.	1 299 .00 .0000 135 28* 1 300 .00 .0000 125 28* 2 300 .00 .0000 125 28* 2 300 .00 .0000 125 28* 2 300 .00 .0000 125 28* 2 Calculating Fit Statistics
Bond & Fox Figure 4.1 Pathway Bubble chart Click on "Plots" menu Click on "Bubble chart"	Bond&FoxChapter4.txt File Edit Diagnosis Output Tables Output Files Batch Help Specification Plots SAS/SPSS Gr 289 .00 .0000 125 20* Compare statistics 290 .00 .0000 112 28* Lobel chart

"Bubble Chart Specifications": The options are correctly pre-selected, so Click "OK"	Bubble Chart Specifications ▼ Display a Bubble Chart for: □ □ Persons (Rows in data) □ Items (Columns in data) Display bubbles: ○ ○ Measures vertically, Fit horizontally ○ Measures vertically, Fit vertically Fit statistic type: ○ ○ Outfit (unweighter)] ○ Infit (informatior-weighted) Fit statistic expression: ○ ○ Standardized (t, ZStd) ○ Mean-square (interval scaled = log) ○ Mean-square (chi-square/d.f.) OK Cancel
"Plot data-point label"? Click on "Entry number"	Plot data-point label How are the plotted datapoints to be labeled? Marker Entry number Help Label Entry+Laber Cancel Only part of the label?
After a little delay, the Excel plot displays.	ITEMS
The bubbles are located vertically by measure and horizontally by fit. The bubbles are too large. The diameter of each bubble should be twice the measure standard error. The biggest bubble should have a diameter of about 1 logit according to Table 14 (soon to come). Let's use the Excel functions to correct the plot.	t Infit Zstd

ormat Data Seri "Options" tab ? × "Scale bubble size to:" Type in "60" Axis X Error Bars Y Error Bars Patterns Click on "OK" Data Labels Series Order Options Size represents Show negative bubbles Area of bubbles Vary colors by point • Width of bubbles 60 📑 Scale bubble size to: % of default Items t Infit 7st Measures -1 Cancel OK t Infit Zstd And we see a much better looking pathway. The diameter of the • biggest bubble is about 1 logit (vertically). ø The most difficult item is the highest vertically. This is item 21. The easiest item is the lowest vertically. This is item 6. Measures The most predictable item is the left-most item. It is item 17. The least predictable item is the right-most item, again item 21. Items along the vertical 0 line exhibit the degree of predictability that accords with the Rasch model - an impossible standard for a whole test. Close windows at any time - you can always get them again! Х You can quickly get back to the Analysis by clicking on Bond&FoxChapter4.txt "Bond&FoxChapter4.txt" on the Windows Taskbar The standard way of representing a Rasch-analyzed variable has Bond&FoxChapter4.txt come to be known as a "Wright map" (named after Benjamin D. File Edit Diagnosis Output Tables Output Files Batch He Wright of the University of Chicago, for forty years the leading _____ > advocate of Rasch measurement). Other names are "variable map" 293 3.2 Rating (partial credit) scale or "item-person map". _____ > .2.0 Measure forms (all) 294 2 Bond & Fox Figure 4.2 Item map is one such map. 295 1 Click on the "Output Tables" pull-down menu 10. ITEM (column): fit order > -----Click on "12. ITEM: Map". 13. ITEM: measure T 296 14. ITEM: entry >= ____ ,15, ITEM; alphabetical 297 .25. ITEM: displacement >=== ====== 298 .11. ITEM: responses I >== _____ .9. ITEM: outfit plot 299 I .8. ITEM: infit plot > 12. ITEM: map 300

1

22 ITEM: principal contract

The item map displays.	TABLE 12.2 Bond & Fox BLOT data: Chapter 4 ZOU452WS.TXT A INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Items 2
The item map on Table 12.1 matches Bond & Fox Fig. 4.2 (except we now have the benefit of the BLOT item names).	Persons MAP OF Items <more> <rare> 4</rare></more>
Item 21 is the most difficult item at over +2 logits.	
Items 30 and 32 are at the same measurement level, slightly above +1 logits. The vertical divider is omitted to show this.	1 #### 1 3 + 51
And the easiest BLOT item for this sample, item 6, is way down at the bottom, well below -2 logits.	.### .########### 21 Correlative + negation > equilibrium
	.## M 28 Non-implication
	.***** Image: Constraint of the second sec
Let's look at analysis details for the BLOT Items. There are several	Bond&FoxChapter4.txt
Tables that present this same information in different ways. We can	File Edit Diagnosis Output Tables Output Files Batch H
follow the authors by looking at the parallel of their Bond & Fox	1 297 Request Supplies
Table 4.1 Item difficulty listing.	>=====================================
	298 2.0 Measure forms (all)
Click on the "Output Tables" pull-down menu	>============
Click on "14. Item: entry".	
	300 3 Item: measure
	+
	Calculating I Threemendy
Table 14.1 is displayed by WordPad. It shows the item statistics:	TABLE 14.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.T INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Item
scores, measures, standard errors and fit statistics.	
raported in the order that the children completed them: #1 first and	Item STATISTICS. ENTRY ODDER
#35 at the bottom of the table	
"ZSTD" corresponds to "t". ZSTD means "Standardized like a z-	ENTRY TOTAL MODEL INFIT OUTFIT
statistic", i.e., a t-statistic with infinite degrees of freedom. So, for	NUMBER SCORE COUNT MEASURE S.E. MNSQ ZSTD/MNSQ ZSTD
practical purposes, "t" and "z" statistics are equivalent.	1 130 150 79 .26 .98 .0 .69 8 2 129 150 72 .26 1.01 .1 .75 6
	3 98 150 .76 .20 .982 .905 4 116 150 .000 .2211.00 .01.884
In Bond&FoxSteps Table 14.1, Item 4 has a measure of ".00A".	
reported in Bond & Fox) and so defines the location of the local	1 0 143 150 -2.49 .4/11.00 .51 .63 .01 1 7 128 150 66 .251 .97 11 .65 -1.01
origin of the scale.	I 8 95 150 .88 .19I .91 -1.111.00 .11
	Bonds.Fov/bastov/.tut
As we noted above, there are several Tables that present this same	Reference Character Action Control Con
below has the items ordered by difficulty	,Request Subtables
On the Analysis screen	3.2 Rating (partial credit) scale
Click on "Output Tables" menu	
Click on "13. Item: measure".	292 10. ITEM (column): fit order
	13. ITEM: measure

Table 13 is displayed by WordPad.It shows the same item statistics: scores, measures, standard errorsand fit statistics, but this time the items are ordered by difficulty, sothey will match the representation of the BLOT items on thePathway plot and the Wright map.Item 21 has the lowest score, so it is the most difficult item with adifficulty measure of 2.40 logits.Bond & Fox Summary of Item EstimatesClick on the "Output Tables" pull-down menu	TABLE 13.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.T INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Item Person: REAL SEP.: 2.04 REL.: .81 Item: REAL SEP.: 3.79 Item STATISTICS: MEASURE ORDER +
Click on "3.1 Summary statistics".	3.2 Rating (partial credit) scale .2.2 General Keyform .2.0 Measure forms (all) .2.5 Category Averages 3.1 Summary statistics
Table 3.1 displays.	TABLE 3.1 Bond 6 Fox BLOT data: Chapter 4 ZOU452WS.TXT Aug 22 17:14 2006 INFUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Items 2 CATS 1.0.
The first panel shows summary statistics for the non-extreme persons. Extreme persons are those with zero and perfect scores	SUMMARY OF 147 MEASURED (NON-EXTREME) Persons
They are omitted from this panel.	Image: Contract of the state of th
We'll look at these in a moment.	MAX. 51.0 51.0 51.0 1.03 1.04 1.04 1.04 1.01 <
Scroll down to "SUMMARY OF 35 MEASURED (NON-	SUMMARY OF 35 MEASURED (NON-EXTREME) ITEMS
EXTREME) ITEMS"	RAN MODEL INFIT OUTFIT SCORE COUNT MEASURE ERROR MNSQ ZSTD MNSQ ZSTD
Table 3.1 matches the Bond & Fox summary with 35 items.	MDAR 109.9 147.0 .00 .24 1.00 .1 .95 .1 1.00 .31 .12 MDX 142.0 147.0 2.40 .47 1.27 2.6 1.75 3.7 MDX 51.0 147.0 -2.49 .19 .69 -1.4 .24 -1.6
If there were items with zero or perfect scores, their counts would be given at the bottom of Table 3.1	FEAL RMSE .25 ADJ.SD .93 SEPARATION 3.79 ITEM RELIABILITY .93 MODEL RMSE .24 ADJ.SD .93 SEPARATION 3.86 ITEM RELIABILITY .94 S.E. OF ITEM MEAN = .17
Bond & Fox Summary of Case Estimates	PABLE 3.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.TXT Aug 22 17:14 2004 INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Items 2 CATS 1.0.
Scroll back up to the top of Table 3.1	SUMMARY OF 147 MEASURED (NON-EXTREME) Persons
Since there are persons with maximum scores (in fact 3 of them),	RAW MODEL INFIT OUTFIT SCORE COUNT MEASURE ERROR MNSQ ZSTD NDSQ ZSTD
extreme scores.	MEAN 20.2 35.0 1.57 .52 .99 .1 .93 .1 IS.D. 6.2 .0 1.30 .20 .13 .6 .46 .7 MXX. 34.0 35.0 3.95 1.03 1.31 1.6 4.48 2.7 MIN. 5.0 35.0 -2.09 .37 .70 -1.5 .16 -1.4
Look at the 147 non-extreme persons. They closely match the Bond & Fox table. The person reliability is the familiar "Test Reliability".	REAL RMSE .57 ADJ.SD 1.17 SEPARATION 2.04 Person RELIABILITY .81 MODEL RMSE .56 ADJ.SD 1.17 SEPARATION 2.09 Person RELIABILITY .81 S.E. OF Person MEAN = .11 +
Scroll down to the second panel.	SUMMARY OF 150 MEASURED (EXTREME AND NON-EXTREME) PERSONS
This shows statistics for all 150 persons. The Rasch person reliability is .80, but the Cronbach Alpha reliability is .88. As <u>www.rasch.org/rmt/rmt1131.htm</u> demonstrates, Cronbach Alpha routinely <i>over</i> states reliability, and Rasch reliability <i>under</i> states it.	I RAW MODEL INFIT OUTFIT I SCORE COUNT MEASURE ERROR MMSQ ZSTD NNSQ ZSTD I MEAN 26.3 35.0 1.64 .55 IS.D. 6.3 .0 1.38 .27 I MAX. 35.0 5.2.1 1.64 I I I MIN. 5.0 5.2.1 1.64 I I MIN. 5.0 35.0 -2.09 .37 I REAL RMSE .62 ADJ.SD 1.24 SEPARATION 1.98 PERSON RELIABILITY .60 MODEL RMSE .61 ADJ.SD 1.24 SEPARATION 2.03 PERSON RELIABILITY .80 I S.E. OF FERSON MEAN = .11 .11 .41 .41 .41 .41
	PERSON RAW SCORE-TO-MEASURE CORRELATION = .95 CRONBACH ALFHA (KR-20) PERSON RAW SCORE RELIABILITY = .88

