Technical Note 40

Young Lives

Equating Test Scores for Receptive Vocabulary Across Rounds and Cohorts in Ethiopia, India and Vietnam

Juan Leon and Abhijeet Singh

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About Young Lives

Young Lives is an international study of childhood poverty, following the lives of 12,000 children in four countries (Ethiopia, India, Peru and Vietnam) over 15 years. **www.younglives.org.uk**

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Abhijeet Singh is a post-doctoral researcher in Economics Development at University College London, and was previously a Research Officer with Young Lives. His research applies micro-econometric methods to the study of salient issues of policy interest in developing countries, focusing especially on issues relating to the economics of education and child health and the delivery of public services.

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1. Introduction

In longitudinal studies such as Young Lives, getting comparable measures of children´s cognitive abilities over time is essential for identifying individual, household, and school-level factors that affect children´s development. Few longitudinal studies that follow birth/age cohorts include comparable cognitive measures across waves, and those studies that are available are mainly from developed countries. Young Lives provides a unique opportunity to explore the development of value added or growth curve modelling analysis aimed at identifying variables at different levels and across time and space, associated with children's learning outcomes, in developing countries.

This Technical Note discusses the construction of cognitive scores that are comparable across rounds and age cohorts for Young Lives in Ethiopia, India (the states of Andhra Pradesh and Telangana) and Vietnam. Young Lives gathers information from children and their families through individual and household questionnaires, including different cognitive and achievement tests. The Peabody Picture Vocabulary Test (PPVT) is the one test that is common across rounds and cohorts. Therefore, this test was selected to build cognitive measures comparable across Rounds 2, 3 and 4, and age cohorts (the Younger Cohort, born in 2001/02, and Older Cohort, born in 1994/95) employing Item Response Theory (IRT) to achieve standardised cognitive measures. Scores were estimated using a three-parameter model which considers the item's difficulty, discrimination, and pseudo-guessing as parameters to estimate the individual's ability. The second step was to perform a Differential Item Functioning analysis (DIF) by cohort and survey round in order to identify possible item bias and correct it. The last step consisted of equating the scores of common items (anchor items) as a means of obtaining comparable PPVT scores across rounds and cohorts without cohort and round biases.

This note has five sections. The second section presents a brief description of the Peabody Picture of Vocabulary test. Then, Section 3 presents the methodology of analysis and Section 4 explains the main results. Section 5 provides some final remarks on the main findings of the analysis performed.

2. The Peabody Picture of Vocabulary Test - III (PPVT - III)

The Peabody Picture Vocabulary Test (PPVT) is a widely used test to measure receptive vocabulary. It was originally developed in English in 1959 and has been updated several times. This study used version III (Dunn and Dunn 1997) in Ethiopia, India, and Vietnam; this was the version available for Rounds 2, 3 and 4. The PPVT test is administered individually, orally, untimed, and norm-referenced, where the test taker selects the picture that best represents the meaning of a stimulus word presented orally by the examiner. Not all the items in the PPVT are expected to be administered. Instead, the examiner administers enough items to establish both a ceiling and a baseline. The rule to set the baseline is based on making one error or no errors, in a set of 12 items. The rule to set the ceiling, on the other hand, is based on making eight or more errors in a set of 12 items. Non-administered items below the baseline are automatically given a score of 1, given that they are expected to be easier, while items above the ceiling are given a score of 0, given that they are more difficult. The raw score is formed by all the items given a score of 1 (i.e. answered correctly or below the basal item).

3. Methodology

3.1. The Young Lives study

Young Lives is a longitudinal study of childhood poverty that examines the development of around 12,000 children, from two cohorts born in 1994 and 2001, over 15 years in Ethiopia, India (in the states of Andhra Pradesh and Telangana), Peru and Vietnam.

In order to identify which factors affect children's development, it is necessary to have comparable measures of children's cognitive abilities over time. Table 1 shows the measures of abilities and achievement administered by round and cohort. Because the PPVT is the one test that has been administered consistently across rounds and cohorts, we selected it in order to build comparable cognitive measures for Rounds 2, 3 and 4, and for both the Younger and Older Cohort. The PPVT, however, was administered only to the Younger Cohort in Round 4. This change was informed by the ceiling effects observed for the Older Cohort in Round 3 (see Cueto and Leon 2012).

It is important to note that the PPVT was originally developed to measure receptive vocabulary in English. The versions of the test administered in Ethiopia, India and Vietnam were therefore translated into the main languages in each country. However, it became evident that some items did not keep the same cognitive equivalence (or level of difficulty) as in the original tests; much less between languages. Therefore, in Round 4, a subsample of the original 204 items was selected for each country. Only Peru administered the full set of items of the PPVT since they use the Spanish version of the test. For Ethiopia and India, around one quarter of the total number of items were selected, while in Vietnam a third were selected. The selection criteria were: (i) adequate item fit using data from Round 2 and 3; (ii) items without DIF by round and cohort using data from Rounds 2 and 3; and (iii) items across the different range of item difficulty.

Table 1. *Measures of abilities and achievement administered in Young Lives*

Round	Cohort	Cognitive	Reading	Mathematics
Round 1	Younger Cohort	NA	NA	NA
	Older Cohort	Raven's Progressive Matrices for children	One item on reading One item on writing	One item on multiplication
Round 2	Younger Cohort	PPVT	NA	CDA
	Older Cohort	PPVT	One item on reading One on writing	One multiplication item and maths test
Round 3	Younger Cohort	PPVT	One item on reading One item on writing The Early Grade Reading Assessment (EGRA)	One multiplication item and maths test
	Older Cohort	PPVT	Cloze test of reading comprehension	Maths test
Round 4*	Younger Cohort	PPVT	Reading comprehension	Maths test
	Older Cohort	NA	Reading comprehension	Maths test

Notes: NA = Not administered.

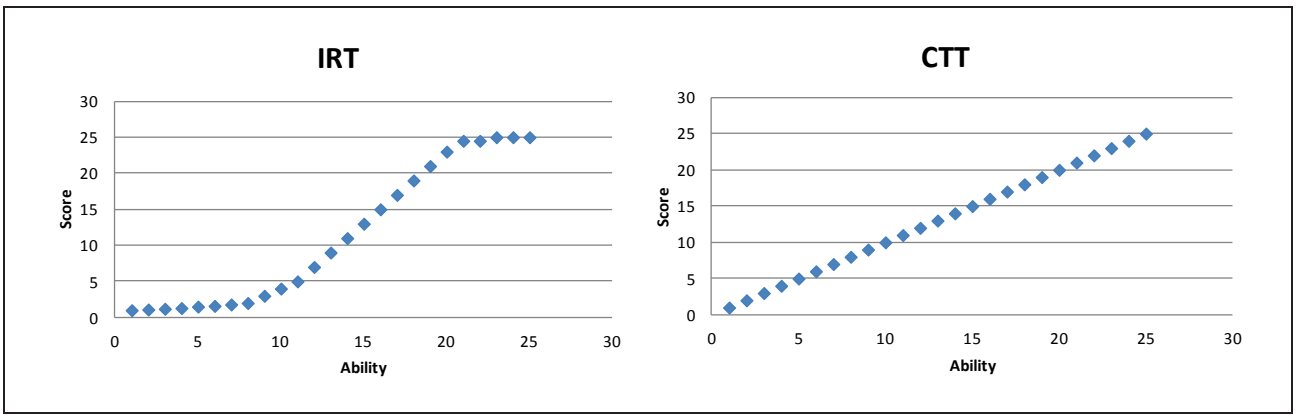
*Round 4 considered PVVT for only 125 items in Peru, unlike other countries where a sub-sample of the original 204 items was administered.

3.2. Why IRT scores instead of CTT scores?

Unlike Classical Test Theory (CTT), Item Response Theory (IRT) is more focused on the item rather than the test. Moreover, the standard error of measurement in IRT is a function of the ability of individuals, therefore it varies at each level of ability. Thus, IRT estimates the probability of answering the item correctly through a logistic function based on the difference between the item difficulty and the individual´s ability. The idea is that individuals with higher ability will have a greater probability of answering correctly easier items than difficult ones.

Figure 1 shows the relationship between the ability and the score in CTT as well as in IRT. In the case of CTT, we observe that the raw score increases in the same proportion as the ability, thus it follows a linear and monotonic trend. In contrast, in IRT we observe that as the ability increases the score does not increase in the same proportion, in other words the growth of scores is nonlinear. This implies that, under CTT, an individual will have the same ability if it changes from 10 to 15, or 20 to 25. However, under IRT an individual's ability will not be the same since it follows a different functional form that relies on the characteristics of the items.

Figure 1. *Functional form between scores and ability, by theory*



The main advantages of using the IRT statistical technique instead of CTT are: (i) the item parameters do not depend on an individual's ability, being invariant over different samples of examinees, and an individual's ability does not depend on the items presented, being invariant over different samples of items (i.e. principle of invariance); (ii) it allows comparisons of individual's ability from different populations if tested with instruments that have common items; and (iii) it allows the allocation of individuals' ability and items difficulty in the same scale or metric, creating an interval scale in logits for both scores. Thus, using this statistical technique, we were able to build comparable scores by cohort and round.

3.3. The IRT model: the three-parameter model

The IRT model relies on two main assumptions. First, the model assumes *local independence*, which means that the probability of answering an item correctly depends on an individual's ability only and not on his/her answer to other items. Second, it assumes *unidimensionality*: the model considers that only one latent trait is measureable across all items or that at least one dominant factor is observed behind the set of items tested. Of these

two assumptions, the latter is the most difficult to accomplish since different factors could be affecting the individual performance (for example, test anxiety).[1]

Under the IRT model used in this note, an individual's ability depends on three item parameters – item difficulty, item discrimination, and item guessing. Item difficulty refers to the proportion of individuals who get each item right. Item discrimination indicates how well an item discriminates between high and low achievers, while the guessing parameter refers to the chances that an individual has to get an item right. This parameter is mainly considered for multiple choice tests since these allow examinees to guess.[2] These parameters and the individual's ability level are part of the Item Characteristic Curve (ICC) that defines the probability that each individual has to get an item right given the item characteristics (difficulty, discrimination and guessing) and individual ability. The following equation represents the general ICC model:

$$P_i(\theta) = c_i + (1 - c_i)\frac{e^{a_i(\theta - b_i)}}{1 + e^{a_i(\theta - b_i)}} \quad i = 1,2,\dots,n$$

$P_i(\theta)$: the probability that an individual with ability θ get item i right

a_i : item discrimination

b_i : the item difficulty

c_i : guessing parameter

n : the number of items in the test

θ : individual´s ability parameter

The two-parameter model uses the same equation but assumes that the guessing parameter (c_i) is equal to zero, while the one-parameter model not only assumes a guessing parameter (c_i) of zero but also that the item discrimination (a_i) is constant across items.

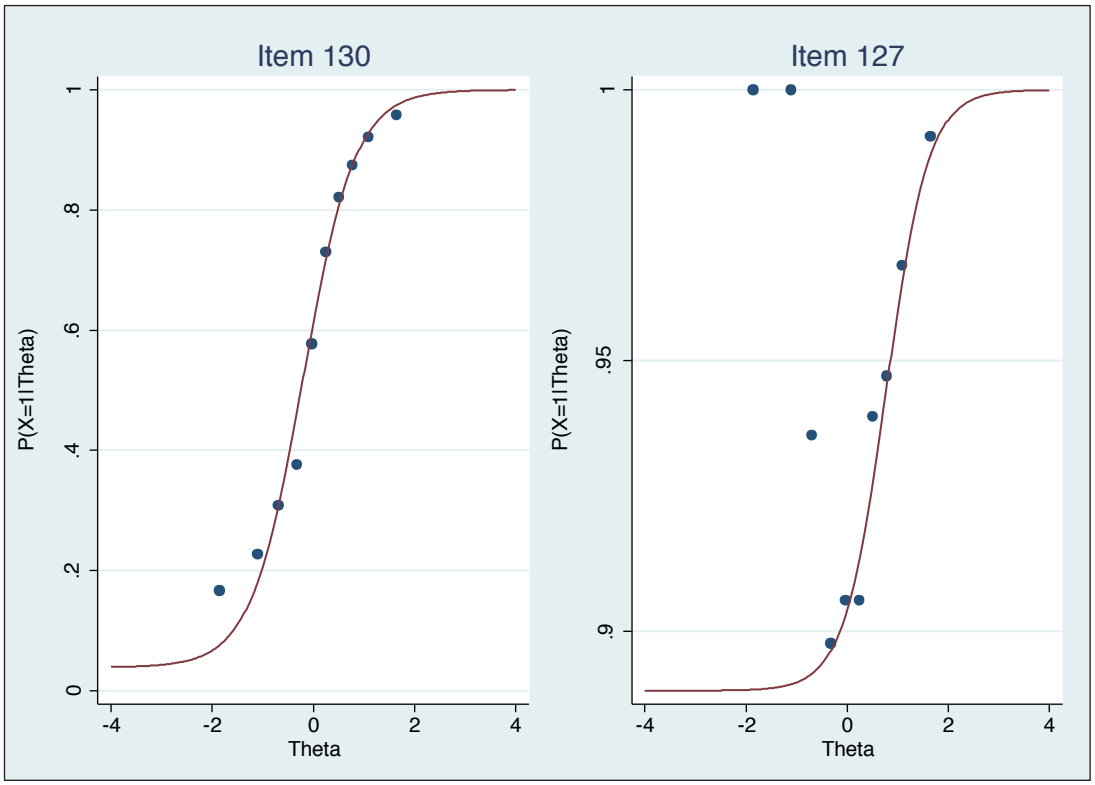
3.4. Item fit

An item has *good fit* if the ICC shows that the proportion of children who answer an item correctly varies monotonically as a function of child´s ability. As an example, Figure 2 shows an item with good fit (item 130) and an item with poor fit (item 127). We observe for the item with good fit that the proportion of children who correctly answer the item varies monotonically with the average child´s ability, while the item with bad fit shows no correlation between the proportion of children who correctly answer an item with average child´s ability.

1 For more information, see Cueto, Leon, Guerrero and Muñoz (2009).

2 As PPVT is a multiple choice test, it is necessary to consider a guessing parameter.

Figure 2. *Item characteristic curves of items with good and bad fit*

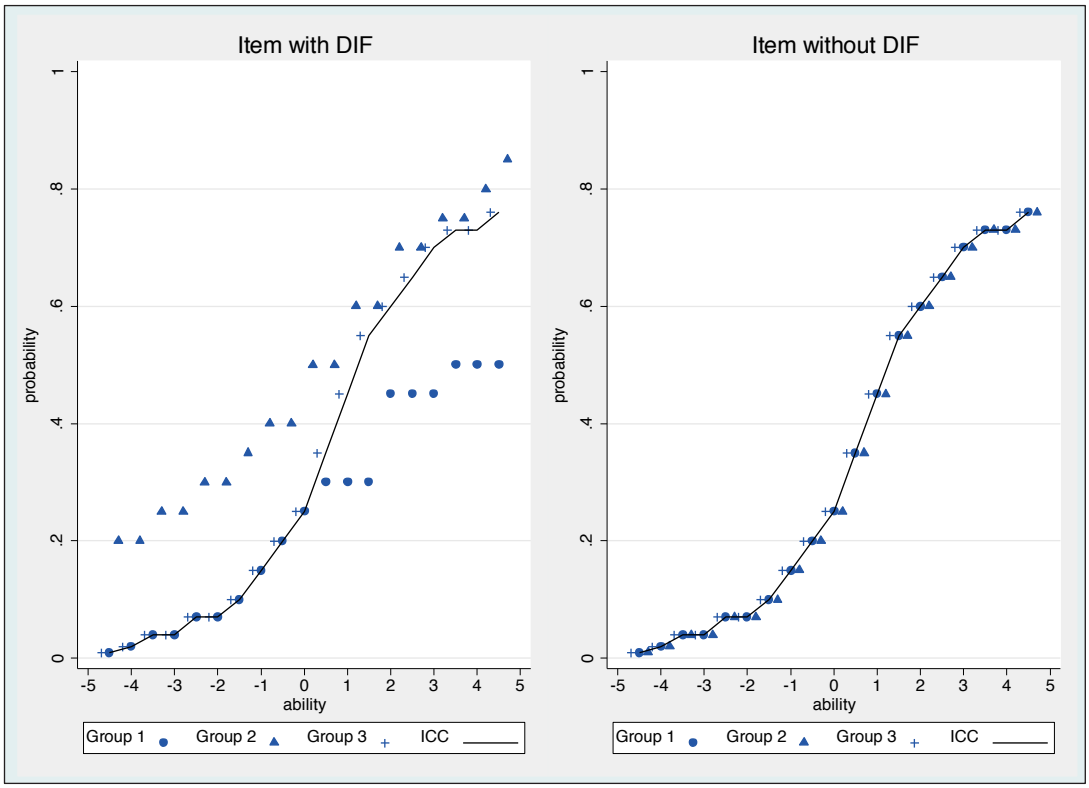


3.5. Differential Item Functioning (DIF)

An item is considered to have DIF if the probability of answering an item correctly differs across groups or memberships (for example, gender), controlling for level of ability (Hambleton and Swaminathan 1985; Dorans and Holland 1993; Linacre 2008). DIF analysis, however, could be sensitive to sample size since the standard errors of the item difficulty depend on the size of the groups that are being compared. Thus, large sample sizes could lead to the acceptance of even small differences between item difficulties as DIF. Therefore, it is necessary to use normalised standard errors in order to have better estimates of DIF between groups. The Educational Testing Services in the United States, as well as different scholars (Wright and Douglas 1976), suggest that for large sample sizes logit differences in item difficulty above 0.50 are signals of DIF between groups.

For this technical note, we used two approaches to check DIF. The first approach was graphically: we estimated the ICC for each item from the full sample and for each group (cohort and round). An item was considered with DIF if the ICC for any given group had a different shape than the ICC for the full sample, as seen in Figure 3.

Figure 3. *Item characteristic curves of items with DIF and without DIF*



The second approach was to calculate the Welch test using the one-parameter model, and an item was flagged with DIF if the difference between item difficulties across groups was statistically different at 5% according this test. Finally, in both analyses, we consider an item with DIF across groups if the number of children who took the item was equal or above 30.

3.6. Scores equating

As mentioned before, one of the main advantages of using IRT modelling is that it helps to build comparable scores using common items. Hambleton (1989) indicates that if we have different tests (with common items across them) and the items of those tests meet the IRT assumptions (good item fit indicators), then it is possible to estimate a score for each individual that is independent of the group of items that he/she answered. Thus, it is possible to use those PPVT items with adequate fit index as anchors in order to have a score that could be comparable across rounds and cohorts.

The main types of test equating are (Linacre 2008):

Common item equating: there are different examinees but common items across all tests forms. Two different type of analysis could be performed. First, the common and non-common items could be analysed simultaneously (for example, vertical test equating). Second, common items across all tests forms are analysed and calibrated in order to use them to adjust the mean and standard deviation of each test form.

Common person equating: there are different tests of the same subject (e.g. maths) but common examinees across tests. The average ability of the common examinees is used to adjust examinees' mean and standard deviations.

Virtual item equating: there are different examinees and different tests, but both tests cover the same subject (e.g. maths). This type of equating involves identifying test pairs of items that cover the same subject and using them as pseudo-anchor items for the equating analysis.

For our analysis, we used the common item equating approach since we have the same test across cohort and rounds. It is not possible to use common person equating since having the scores of the same examinee at two different time points is similar to having different examinees.

Finally, the subsequent procedures for the equating analysis are to: (i) run the three-parameter model for the pool sample; (ii) identify those items with poor item fit, deleting them from our analysis; (iii) identify those items with DIF for all the groups, deleting them from the analysis; (iv) identify those items with the presence of DIF and consider them as different items; and (v) then run the three parameter model again using as anchor items those with the absence of DIF by round and cohort.

The item response analysis was carried out using the ado file openirt. This ado file was developed by Tristan Zajonc, who not only provided the STATA files to run the analysis but also provided technical assistance to interpret and improve the IRT analysis performed in STATA.[3]

3.7. Limitations of IRT scores

One limitation of IRT scores is that they are not comparable across languages. IRT scores are specific for each language and each scale is independent from each other. This caveat is because the PPVT test administered in Ethiopia, India and Vietnam corresponds to the English version, making it difficult to get to item cognitive equivalence across languages. Young Lives ensured the comparability of the items within each language, in order to have PPVT IRT scores comparable across rounds and age cohorts for each main language.

Therefore, we need to be careful when using IRT scores for analysis and be clear as to *what we could do* and *what not* with these scores. For example, we cannot use the IRT scores to compare the vocabulary level of children who took the test in Amharic to those who took it in Tigrinya. Instead, we can compare the vocabulary level between the children from the Younger and Older Cohort who took the test in Amharic or other main language. Also, we cannot use the PPVT standard scores or norms (those derived from the normalisation sample) since the population used for those norms (the United States) is completely different from the Young Lives study countries.

3.8. Vocabulary test approach for Round 4

The translation of the PPVT items led to changing difficulty levels of individual items and to 'disordering' the sets in Round 2 and Round 3. Given that the PPVT is one of the few cognitive longitudinal measures available in the Young Lives data, it was worthwhile to retain it, albeit with modification. With this end in mind, a subset of items which performed well in Rounds 2 and 3 were kept and administered again in Round 4 to the Younger Cohort, with the additional change that the rules to set the basal and ceiling item were also abandoned.[4]

3 See Appendix A for the steps followed in STATA to run the IRT analysis.

4 The basal set rule is one error, or no errors, in a set of 12 items, and the ceiling set rule is eight or more errors in a set of 12 items.

The criteria followed to select the subset of items within each country was: (i) IRT scores (3PL) were calculated for PPVT in Ethiopia (Amharic, Oromifa, and Tigrinya), India (Telugu) and Vietnam (Vietnamese), restricting the sample to the main languages within each country; (ii) ability cut-offs were identified that would split the full sample (combined Older Cohort and Younger Cohort, Rounds 2 and 3) into four equal bands of ability: (iii) items were sorted within these four bands based on their difficulty parameters; (iv) further, the items were sorted within these four bands based on their discrimination; (v) finally, roughly equal number of items across bins were selected, inspecting the item characteristic curves: specifically, items with bad fit, high guessing parameter, or zero variation were excluded.

4. Results

We estimated the three parameter IRT analysis for the pool sample for each of the main languages in the three countries: Amharic, Tigrigna and Oromifa, Telugu, and Vietnamese. This first analysis allows us to identify those items with poor fit that have to be dropped from each of the composite scores. Table 1 shows the percentage of items that were dropped because of poor item fit or DIF for all the comparison groups (round and cohort). The percentage of items dropped, on average, was around one third of the total items,[5] Oromifa being the language with the highest percentage (36%) of items dropped.

Table 1. *Number of items dropped by language*

Language	Total items	Items dropped	%
Amharic	204	32	16%
Tigrinya	204	53	26%
Oromifa	204	74	36%
Telugu	204	48	24%
Vietnamese	204	42	21%

Source: Young Lives, Main Survey Rounds 2, 3 and 4

However, one of the main concerns was the number of common items or anchor items dropped between Round 4 and the previous rounds. Table 2 shows that the percentage of anchor items dropped was less than 10%. These results indicate that we have enough anchor items to ensure an adequate equating across rounds and cohorts. Finally, those items that have a good item fit but have DIF were split and considered as a different item.[6]

Table 2. *Number of anchor items dropped by language*

Language	Total anchor items	Anchor items dropped	%
Amharic	55	0	0%
Tigrinya	55	4	7%
Oromifa	55	2	4%
Telugu	57	0	0%
Vietnamese	76	1	1%

Source: Young Lives, Main Survey Rounds 2, 3 and 4

5 See Appendix B and Appendix C for details of the ICC curves and item DIF analysis for all the country analyses performed.

6 See Appendix D for details of the items dropped and flagged with DIF.

Once items with poor fit and DIF for all groups were dropped, we ran the three parameter model again in order to get corrected IRT scores for each set of children. Table 3 shows the average mean scores for all the languages by cohort and round. IRT scores, for both cohorts, increase over time.

Table 3. *Mean scores by language for each round and age cohort (standard deviation)*

Language	Older Cohort		Younger Cohort		
	R2	R3	R2	R3	R4
Amharic	2.2 (0.97)	2.7 (1.16)	0.0 (1.00)	1.3 (1.35)	2.1 (1.29)
Oromifa	2.3 (1.12)	2.7 (1.16)	0.0 (1.00)	0.9 (1.01)	2.7 (1.16)
Tigrinya	2.8 (1.01)	3.4 (1.22)	0.0 (1.00)	1.5 (1.08)	2.4 (1.20)
Telugu	2.4 (1.05)	2.6 (0.99)	0.0 (1.00)	0.8 (0.96)	1.9 (0.98)
Vietnamese	3.4 (1.26)	3.6 (1.15)	0.0 (1.00)	1.7 (0.85)	3.0 (0.91)

Source: Young Lives, Main Survey Rounds 2, 3 and 4

Table 4 shows the increment in the IRT scores over time by cohort and language. We found that all the increments are statistically significant for both cohorts and languages; also, in the Younger Cohort, since we have three time points, we could estimate the increments between Rounds 2 and 3, and 3 and 4. Our results show that Amharic, Tigrigna and Vietnamese children have the highest increment between Rounds 2 and 3, while for Oromifa and Telugu children, the highest increment was between Rounds 3 and 4.

Table 4. *Gap analysis for each age cohort*

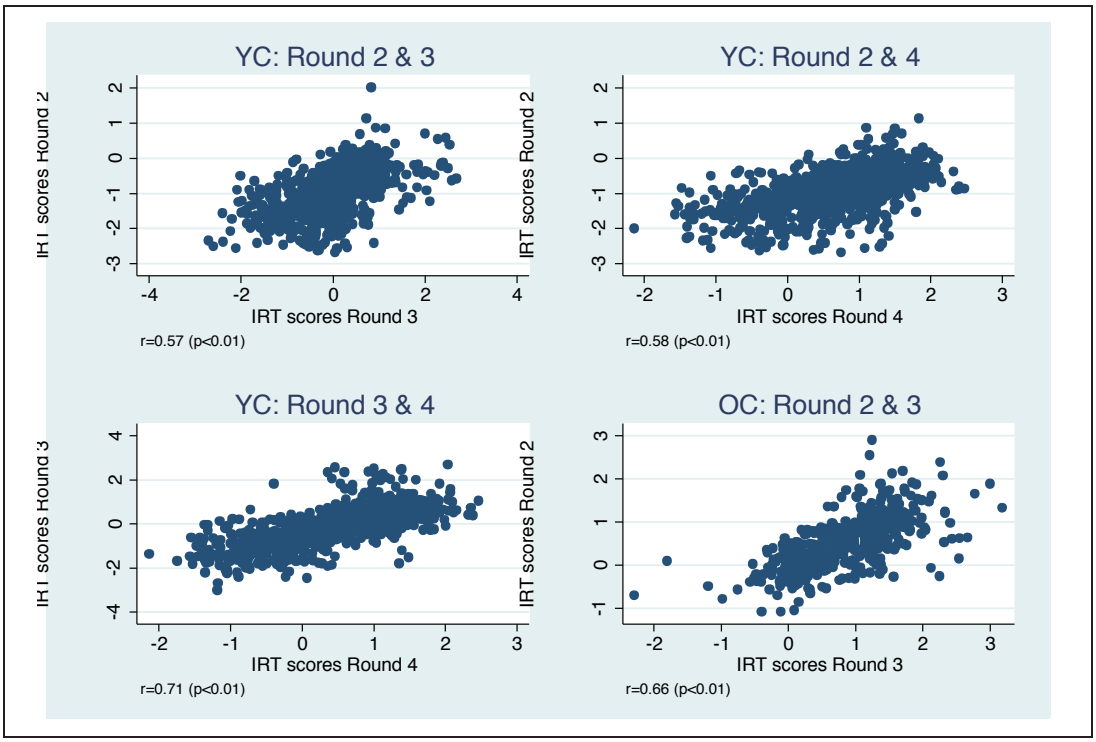
Language	Older Cohort	Younger Cohort	
	R3 - R2	R3 - R2	R4 - R3
Amharic	0.42*	1.26*	0.88*
Oromifa	0.36*	0.89*	1.85*
Tigrinya	0.64*	1.47*	0.97*
Telugu	0.21*	0.77*	1.17*
Vietnamese	0.14*	1.71*	1.26*

Notes: * Mean scores differences between rounds are statistically significant at 5% according to the ttest for dependent or correlated samples.

Source: Young Lives, Main Survey Rounds 2, 3 and 4

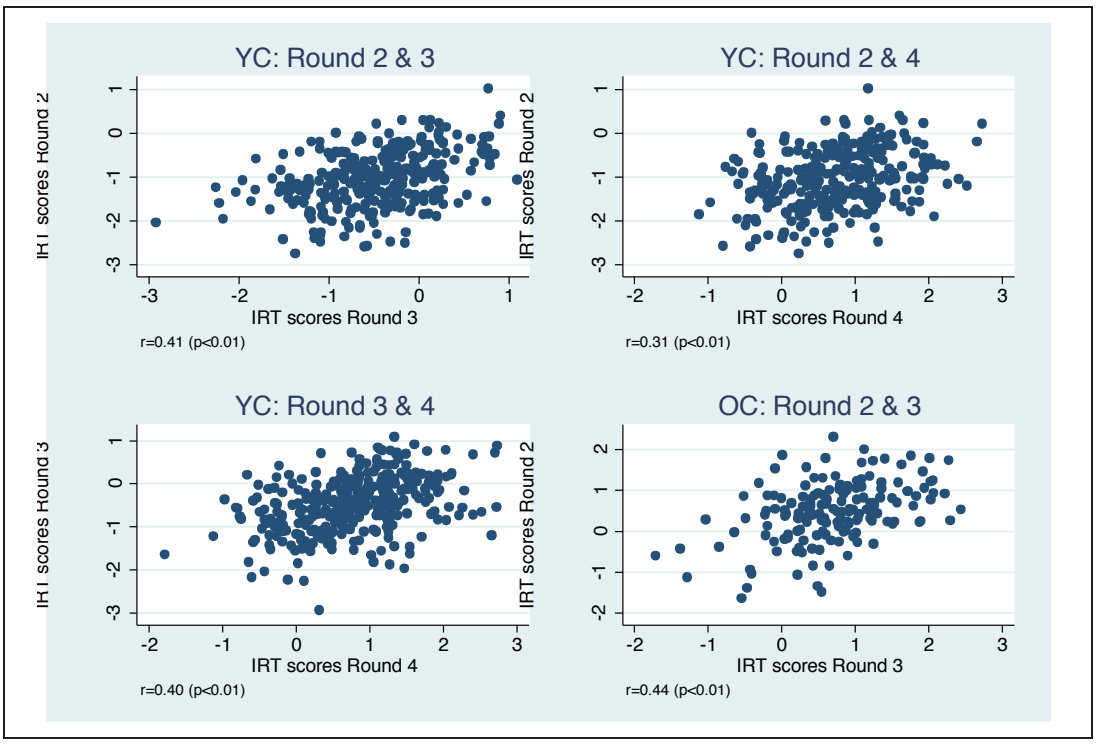
Figures 4 to 8 show the correlation of IRT scores between rounds for each language. Amharic, Telugu and Vietnam have the highest correlations, while Oromifa and Tigrinya show the lowest correlations between rounds for both age cohorts.

Figure 4. *Scatterplots for IRT scores between rounds for Younger and Older Cohort – Amharic*



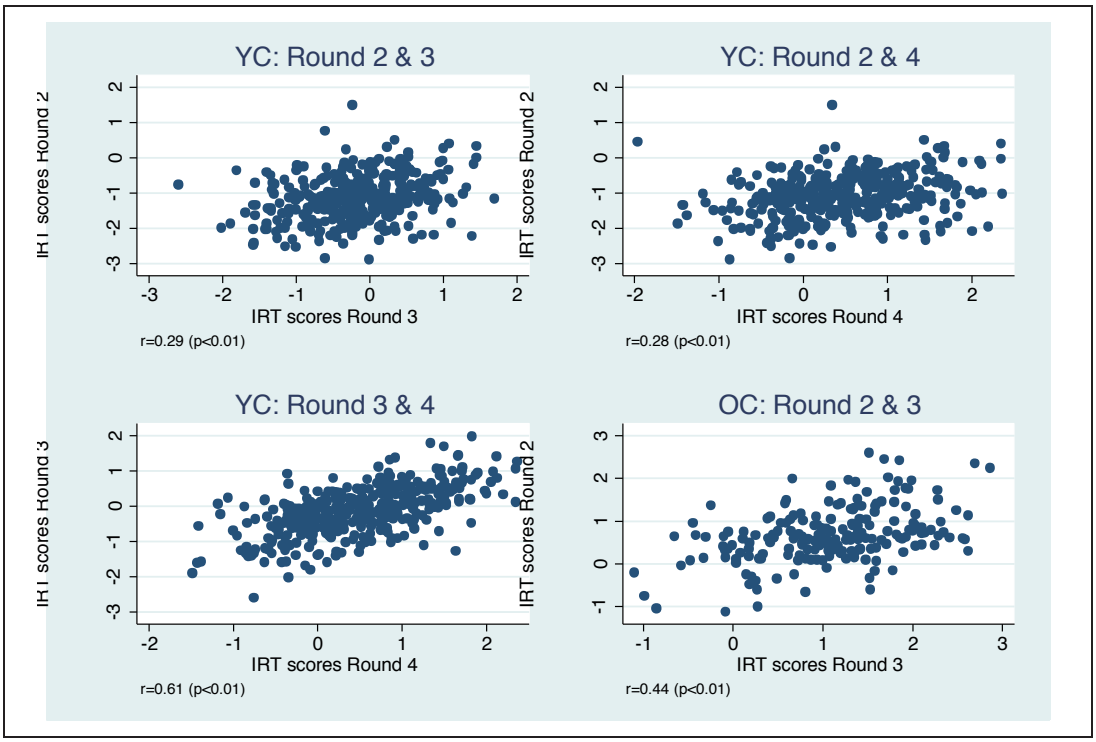
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 5. *Scatterplots for IRT scores between rounds for Younger and Older Cohort – Oromifa*



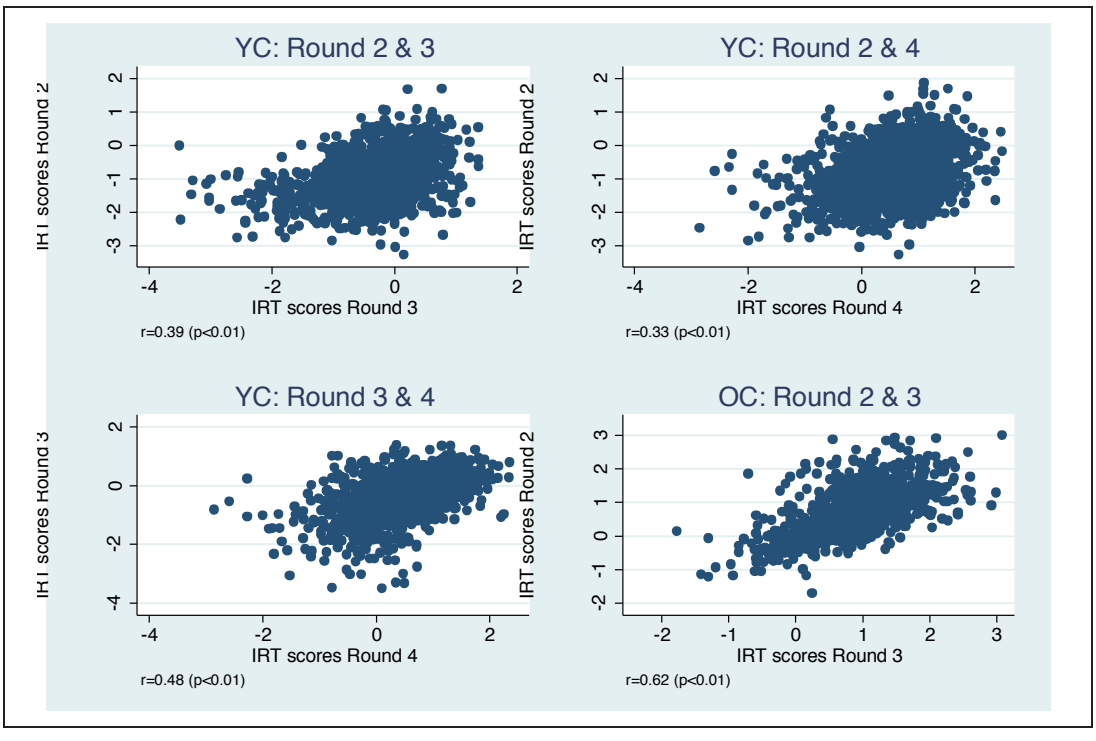
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 6. *Scatterplots for IRT scores between rounds for Younger and Older Cohort – Tigrinya*



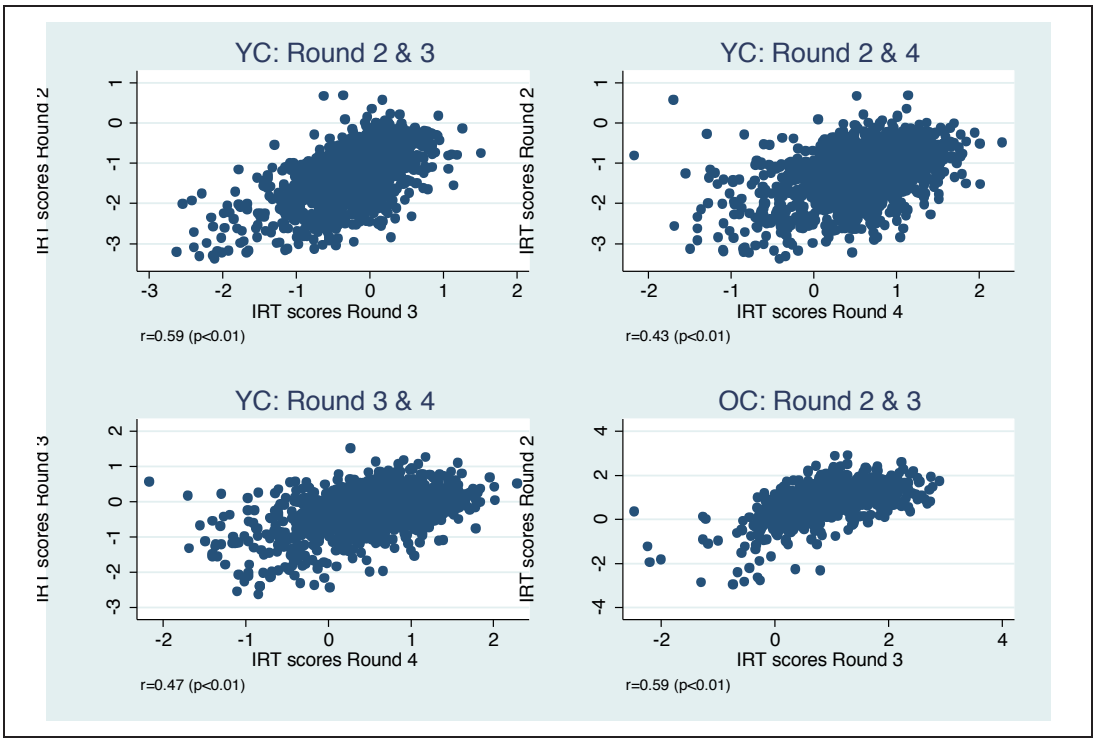
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 7. *Scatterplots for IRT scores between rounds for Younger and Older Cohort – Telugu*



Source: Young Lives, Main Survey Rounds 2, 3 and 4

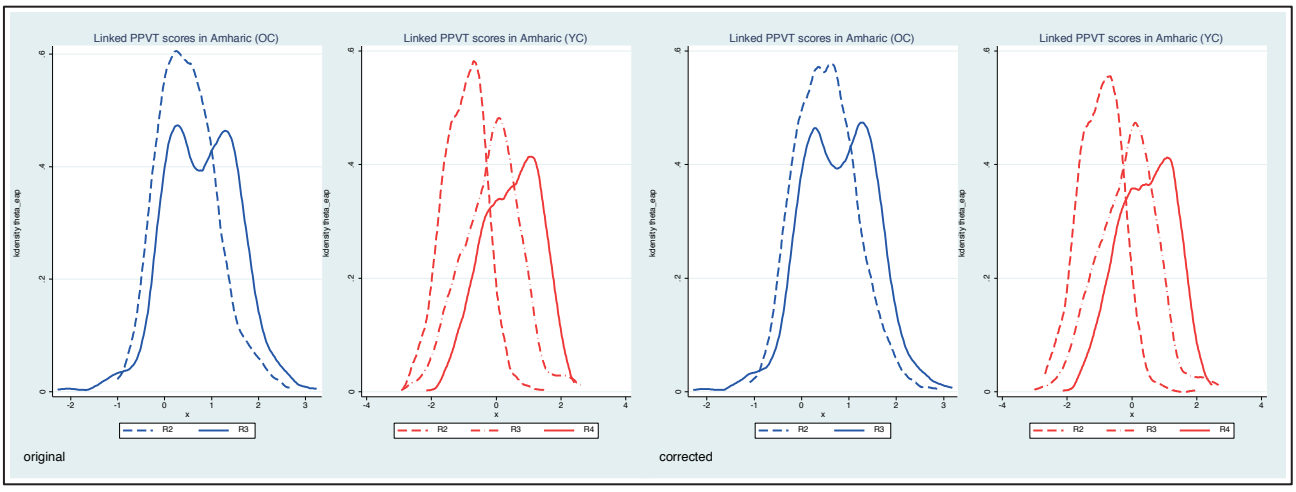
Figure 8. *Scatterplots for IRT scores between rounds for Younger and Older Cohort – Vietnam*



Source: Young Lives, Main Survey Rounds 2, 3 and 4

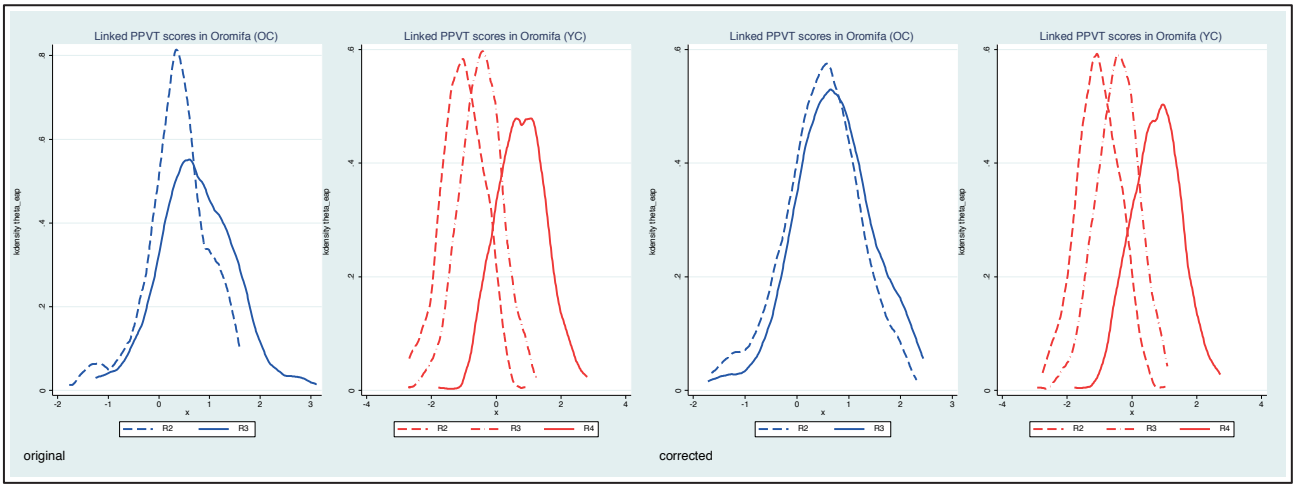
Then, we compared the distribution of the original and corrected scores. Figures 9 to 13 show that average scores for Younger Cohort children increase over time for all the main languages analysed, while the scores for the Older Cohort show some stagnation for Telugu and Vietnamese children; therefore, the average scores are fairly similar across rounds, confirming possible ceiling effects.

Figure 9. *Original and corrected IRT scores for Amharic*



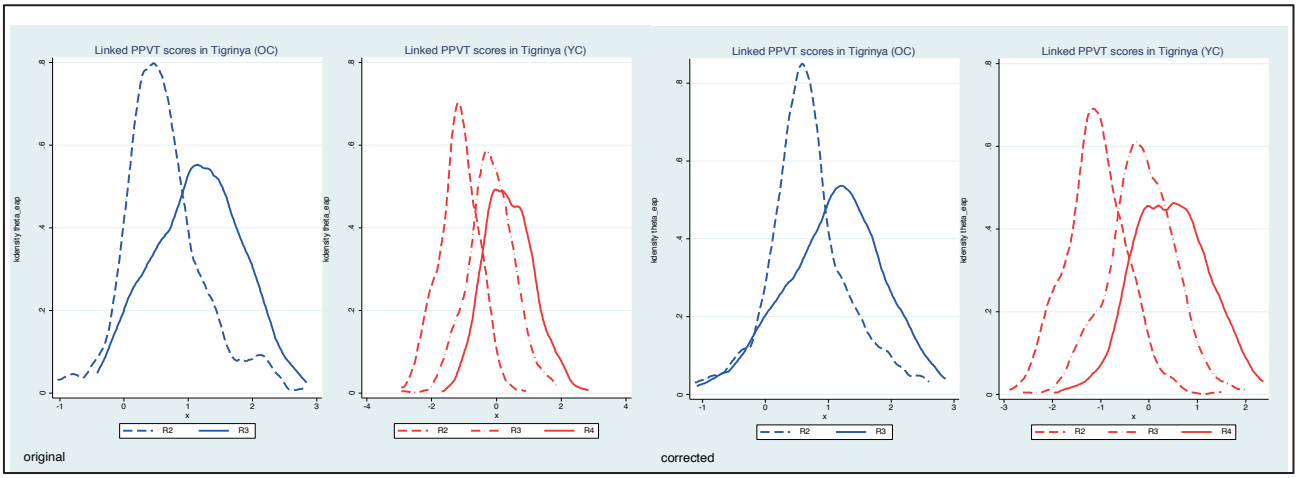
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 10. *Original and corrected IRT scores for Oromifa*



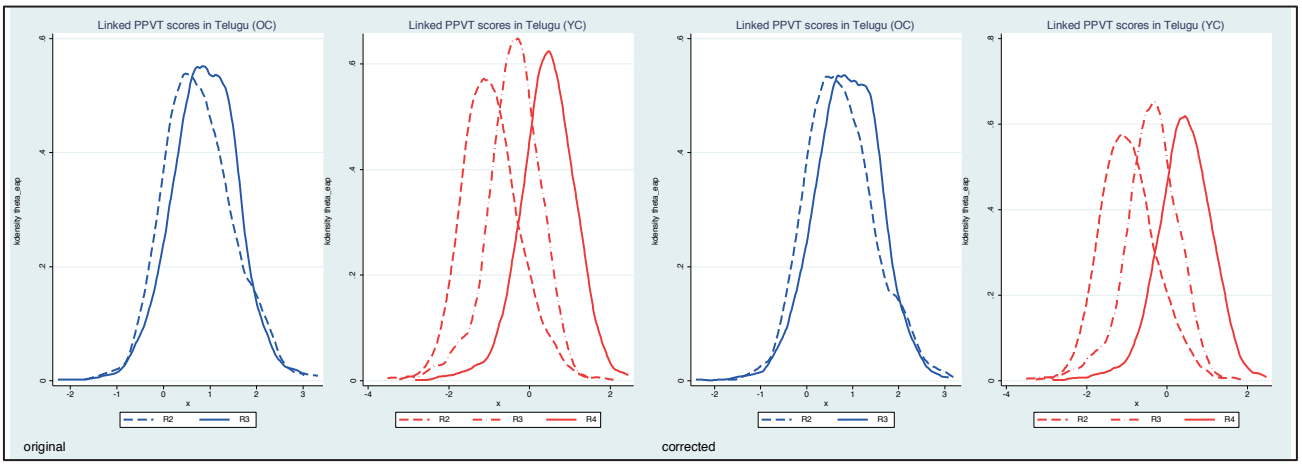
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 11. *Original and corrected IRT scores for Tigrinya*



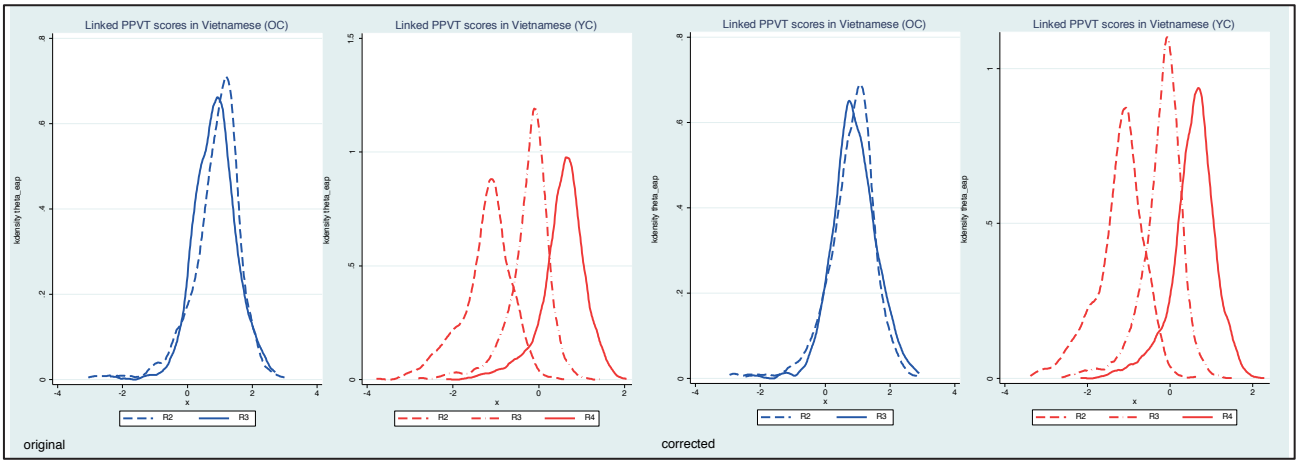
Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 12. *Original and corrected IRT scores for Telugu*



Source: Young Lives, Main Survey Rounds 2, 3 and 4

Figure 13. *Original and corrected IRT scores for Vietnamese*



Source: Young Lives, Main Survey Rounds 2, 3 and 4

Finally, we equated the Round 4 PPVT scores of the siblings with the scores of the young lives children in order to have comparable measures. The analysis showed an adequate anchoring (see Appendix F) since none of the items administered to the siblings in Ethiopia (Amharic, Oromifa, and Tigrinya) and Vietnam showed a poor fit.[7]

5. Final remarks

This technical note gives details of the procedures followed to equate the PPVT scores for the main languages in three of the four Young Lives study countries. The main results are:

- Results confirm that the new approach followed in Round 4 was adequate, as most of the items selected had a good item fit and did not show DIF by groups (cohort or round) for all the main languages in each country.
- For some languages, such as Tigrigna and Oromifa, the number of items deleted by poor fit or DIF across all groups (rounds and cohort) was significant, with almost one third of items dropped from the final scale.
- It was possible to ensure an adequate equating of the PPVT scores for all the main languages across rounds and cohorts. Our results show that PPVT scores for the Younger and Older Cohort increase over time for all the main languages, and these increments are statistically significant.
- Results from the Younger Cohort show a curvilinear (convex) trend in the vocabulary acquisition for Amharic, Tigrigna, and Vietnamese children since the highest increment was between Rounds 2 and 3; while an exponential growth was observed for Oromifa and Telugu children as the scores increment is higher between Rounds 3 and 4.
- Vocabulary knowledge decreases over time across cohorts for all languages, as PPVT scores for the Older Cohort in Round 2 (at 12 years old) are higher than Younger Cohort children in Round 4 (also at 12 years old).

7 Appendix G provides details of the item parameters used for the test equating.

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Appendices

Appendix A. Details of the STATA analysis performed

Appendix A presents details of the steps followed to obtain the PPVT equated scores for Young Lives. The steps were:

Step 1: Appending data. Our first step was to append the PPVT data (child item answers) for each country (Ethiopia, India and Vietnam) from the last three rounds for the Younger Cohort and Rounds 2 and 3 for the Older Cohort. The objective was to increase the sample size for the IRT analysis.

Step 2: Generating datasets by language. Once the data was appended for each country, we used the variable related with the *language test administration* to filter and select cases who took the test in the same language within each country. The languages selected by country were:

Table A1. *Main languages chosen by country*

Ethiopia	India	Vietnam
Amharic	Telugu	Viet
Oromifa		
Tigrinya		

Thus, we had a dataset for each of the languages above. These datasets comprised PPVT information for both children cohorts from Round 2 to 4.

Step 3: Item scoring. With the dataset for each language, we scored the items using a dummy coding, where the item took the value of 1 if the children answered the item correctly, and 0 otherwise. The following is an example for this item scoring using STATA:

Item scoring

```
* Generating answer codes for all items ( 1 to 204 )

gen ans_1=4
gen ans_2=3
gen ans_3=1
…
gen ans_201=4
gen ans_202=2
gen ans_203=3
gen ans_204=2

        mvdecode ppvt1 - ppvt204, mv(77 79 88 99)

        forval i = 1/204        {
                replace ppvt`i' = 0 if ppvt`i'!=ans_`i' & ppvt`i'!=.
                replace ppvt`i' = 1 if ppvt`i'==ans_`i'
        }
```

The answer keys for the 204 items can be obtained from the child questionnaires available online.

Step 4: IRT pool analysis. Once we scored all the items, we ran the IRT pool analysis for each language using the openirt ado file. This IRT analysis was used to check for item fit and item bias by round and age cohort. The following is an example for each analysis performed in this step.

IRT analysis for Vietnam

STATA code

```
openirt, id(id) save_item_parameters("viet_items_ppvt.dta") save_trait_parameters("viet_traits_ppvt.dta")
item_prefix("ppvt") model("3PL") samplesize(500) burnin(500)
```

viet_items_ppvt.dta : this dataset will comprise the item difficulty, discrimination and guessing parameters.
viet_traits_ppvt.dta : this dataset will comprise the child ability measures

Item fit analysis (ICC graphs) per item for Vietnam

STATA code

```
use "$output\ppvt_full_viet.dta", clear
drop ans*
merge 1:1 id using "$output\viet_traits_ppvt_p.dta"

        drop _merge
        xtile perc_thet=theta_pv1,nq(10)
        sort perc
        by perc: egen mean_theta=mean(theta_pv1)

forval i=1/204{
        by perc: egen mean_ppvt`i'=mean(ppvt`i')
}

keep perc mean*

forval i=1/204{
ren mean_ppvt`i' id`i'
}

duplicates drop perc, force
reshape long id,i(perc) j(item)
ren id prop
ren ite id

merge m:1 id using "$output\viet_items_ppvt_p.dta"
drop _merge

cd "$graphs\"
forval i=1/204 {
local j=((`i' - 1)*10+ 1)
twoway (scatter prop mean_theta if id==`i', sort)(function c_pv1[`j'] + (1-c_pv1[`j'])/(1+exp(-1.7*a_pv1[`j']*(x-
b_pv1[`j']))) if id==`i', range(-4 4)), ///
        xtitle("Theta") ytitle("P(X=1|Theta)") title("Item `i'") legend(off)
graph save tmp`i', replace
}
```

ppvt_full_viet.dta : It is the pool dataset for vietnam

Item DIF analysis (ICC graphs by group per item) for Vietnam

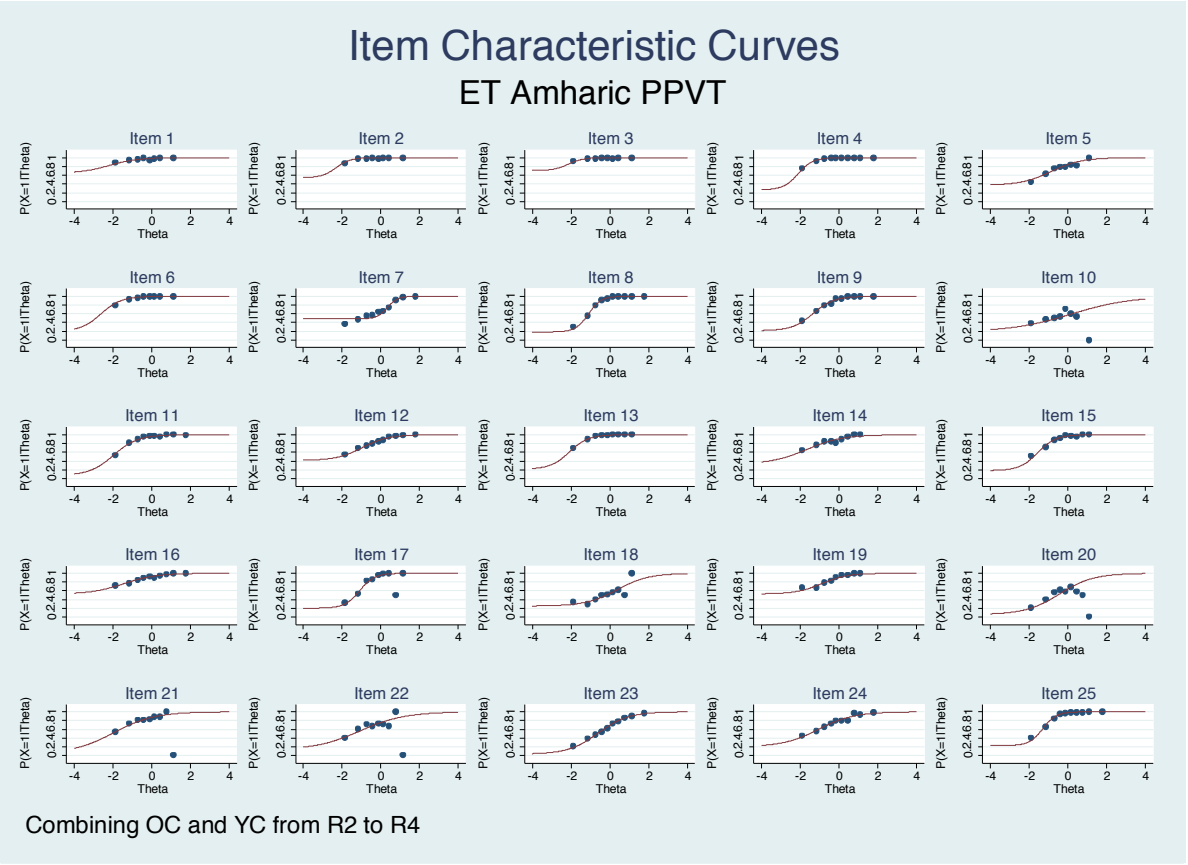
STATA code

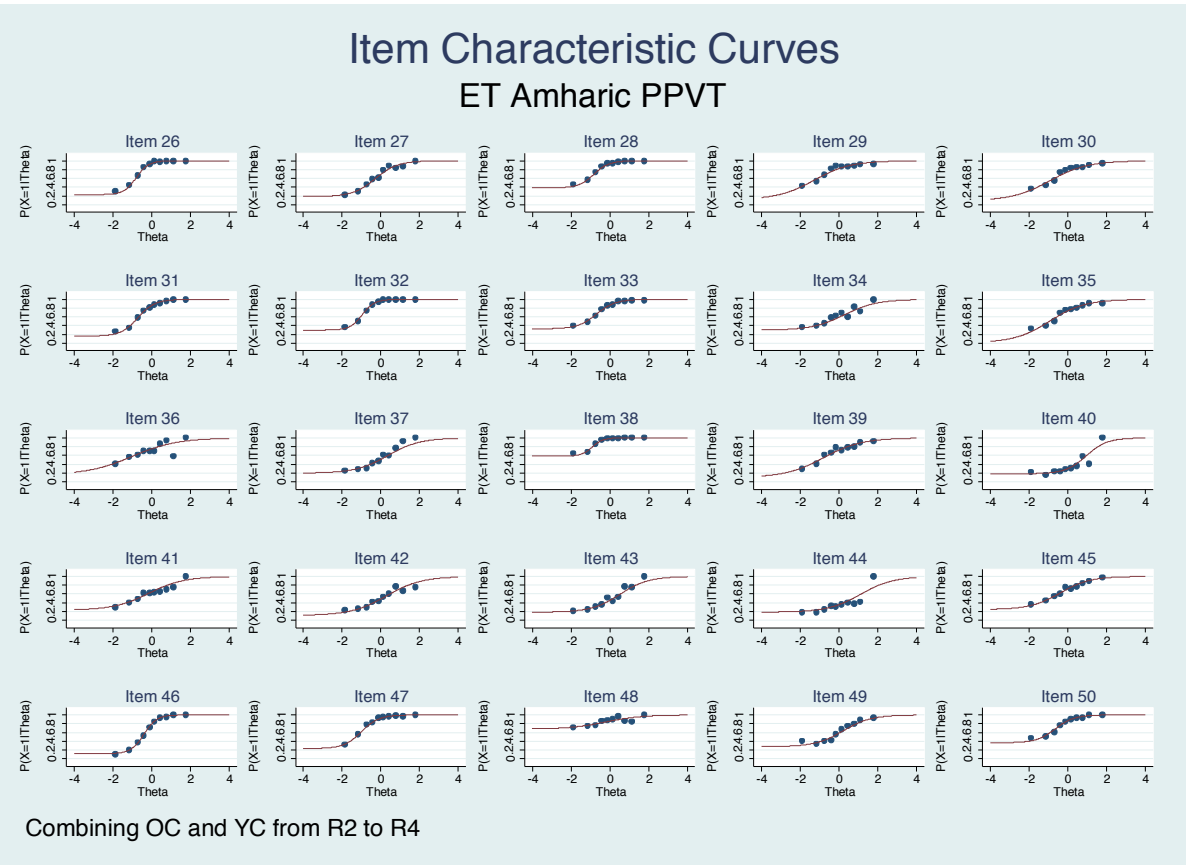
```
use "$output\ppvt_full_viet.dta", clear
drop ans*
merge 1:1 id using "$output\viet_traits_ppvt.dta", nogen

            xtile perc_thet=theta_pv1,nq(10)
            sort perc
            by perc: egen mean_theta=mean(theta_pv1)

forval i=1/204{
            by perc: egen mean_ppvt`i'=mean(ppvt`i')
}

levels of group, local(group)

forval i=1/204{
foreach n of local group{
by perc: egen mean_item`i'_`n' = mean(ppvt`i') if group==`n'
}
}

keep perc mean* group

forval i=1/204{
ren mean_ppvt`i' id`i'
}

duplicates drop perc group, force
egen group_perc=group(group perc)
reshape long id mean_item,i(group_perc) j(item )
ren id prop
ren ite id

merge m:1 id using "$output\viet_items_ppvt.dta", nogen
sort id group perc_thet

/* group:
    1 R2OC
    2 R3OC
    3 R2YC
    4 R3YC
    5 R4YC
*/

forval i=1/204 {
local j=((`i' - 1)*48 + 1)
twoway (scatter mean_item`i'_1 mean_theta if id==`i' & group==1, sort msymbol(plus) mcolor(red))/*
*/(scatter mean_item`i'_2 mean_theta if id==`i' & group==2, sort msymbol(triangle) mcolor(blue))/*
*/(scatter mean_item`i'_3 mean_theta if id==`i' & group==3, sort msymbol(circle) mcolor(black))/*
*/(scatter mean_item`i'_4 mean_theta if id==`i' & group==4, sort msymbol(lgx) mcolor(dknavy))/*
*/(scatter mean_item`i'_5 mean_theta if id==`i' & group==5, sort msymbol(square) mcolor(green))/*
*/(function c_pv1[`j'] + (1-c_pv1[`j'])/(1+exp(-1.7*a_pv1[`j']*(x-b_pv1[`j']))) if id==`i', range(-4 4)), ///
            xtitle("Theta") ytitle("P(X=1|Theta)") title("Item `i'") legend(off)
graph save tmp`i', replace
}
```

Step 5: *Item dropping and splitting*. Items with poor item fit (ICC) were dropped from the dataset, as well as those items that showed a different ICC for all groups under analysis. For items that showed a different ICC for one or two groups, a new item was generated (splitting) for each group with different behaviour, and children´s answers for that group were deleted from the original item.

Step 6: *IRT pool analysis corrected*. Once all the items were corrected using the first IRT analysis and we kept the items with good fit and without DIF in each dataset; we reran the IRT analysis in order to get the corrected IRT scores. The codes used for this new analysis are similar to those followed in Step 3.

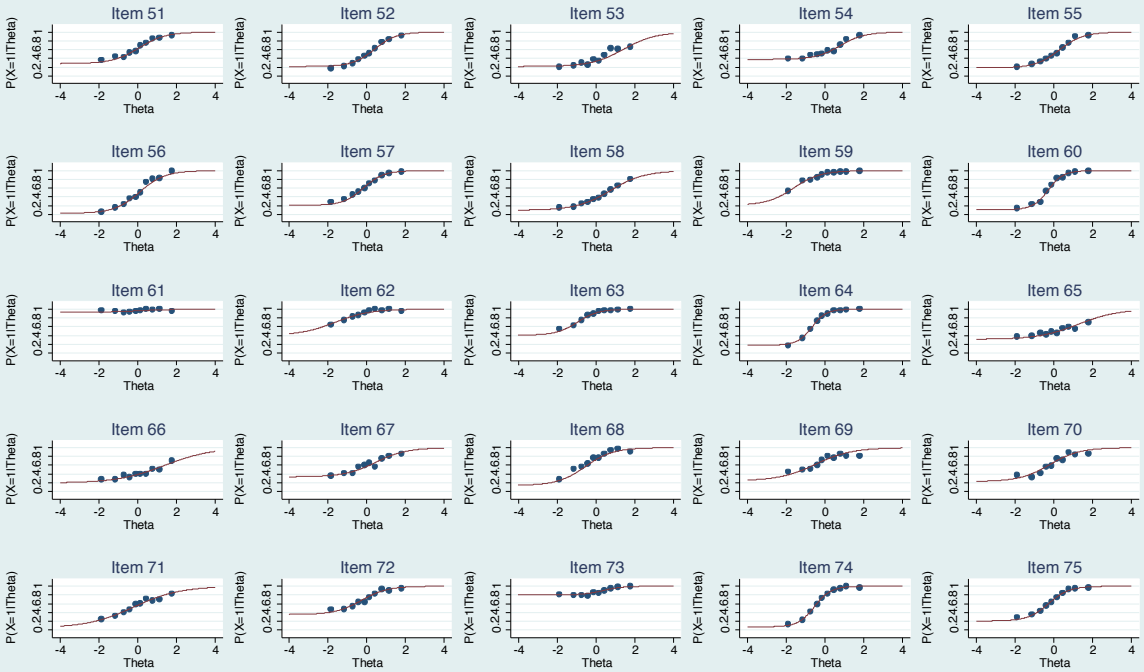
Appendix B. ICC for each item by country and main language





Item Characteristic Curves

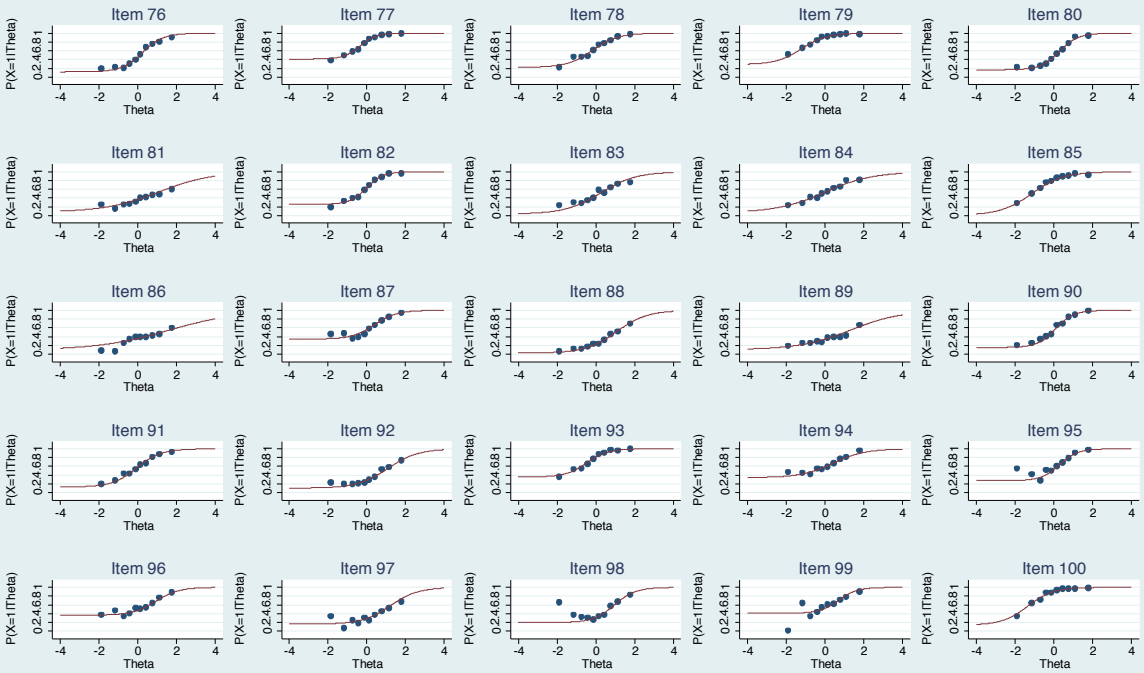
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

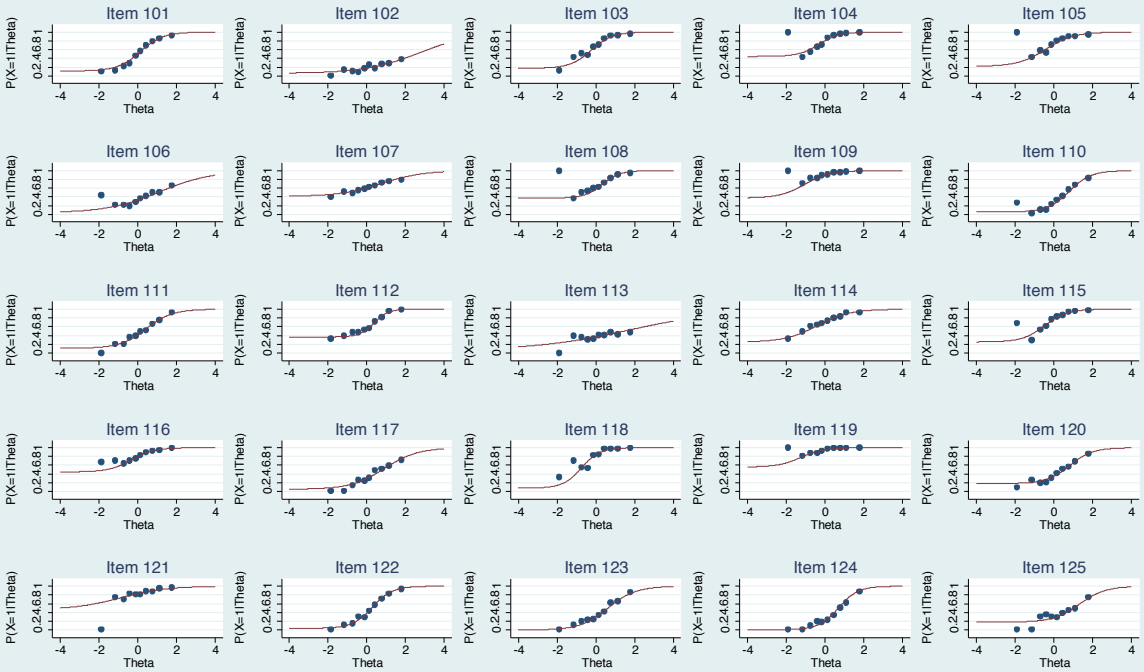
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

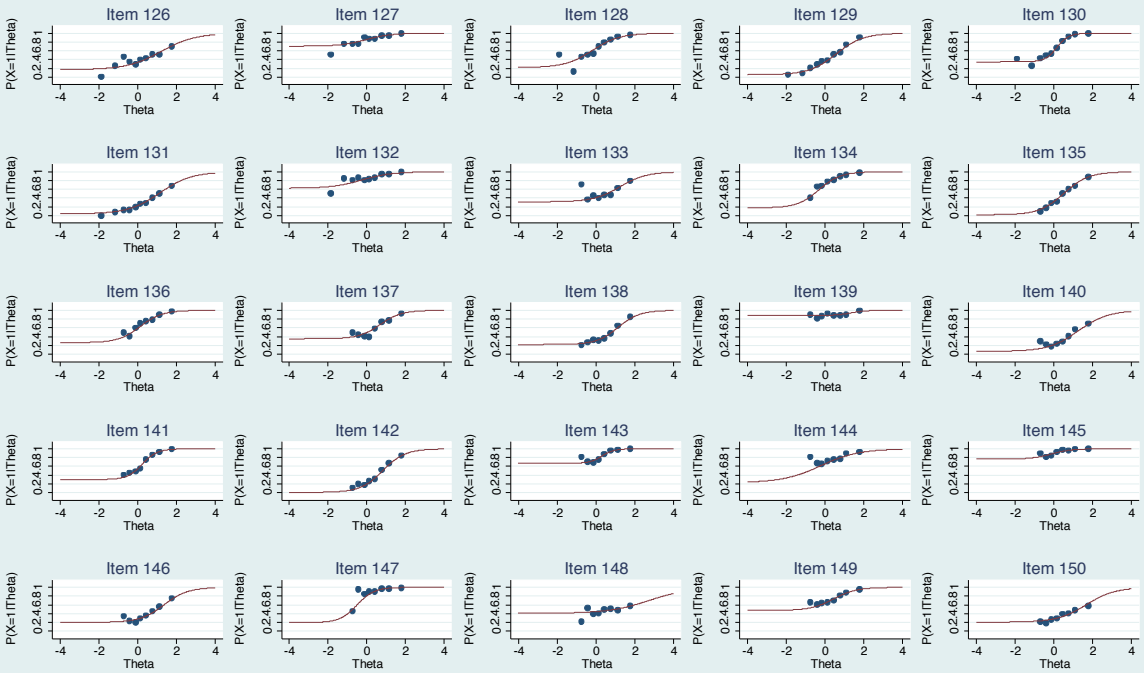
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

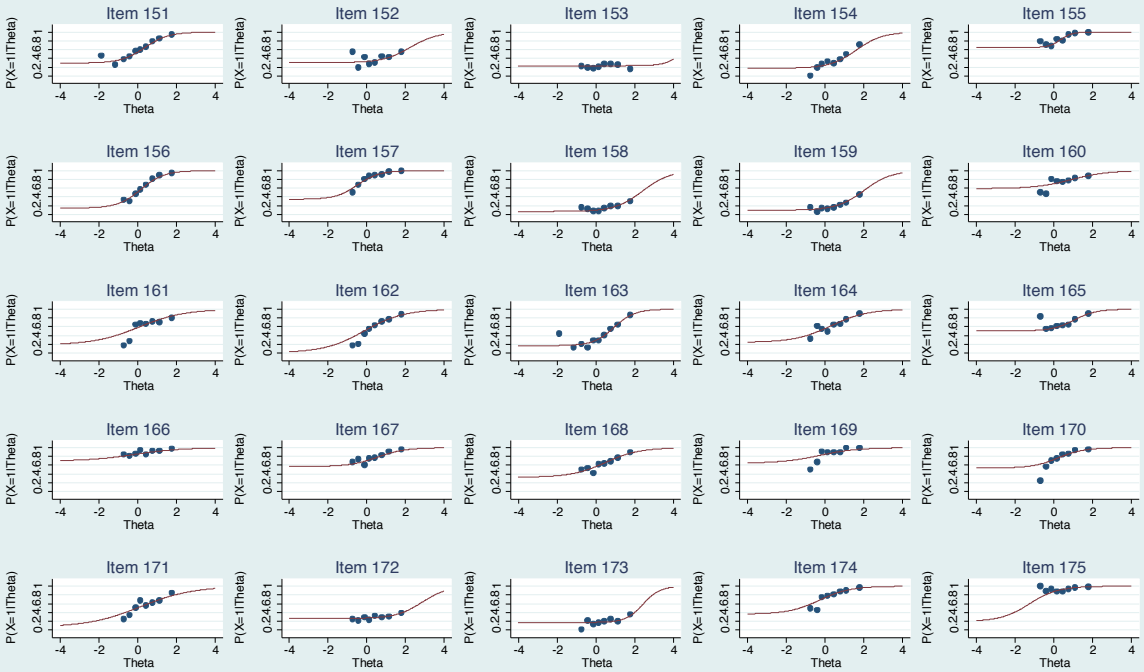
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

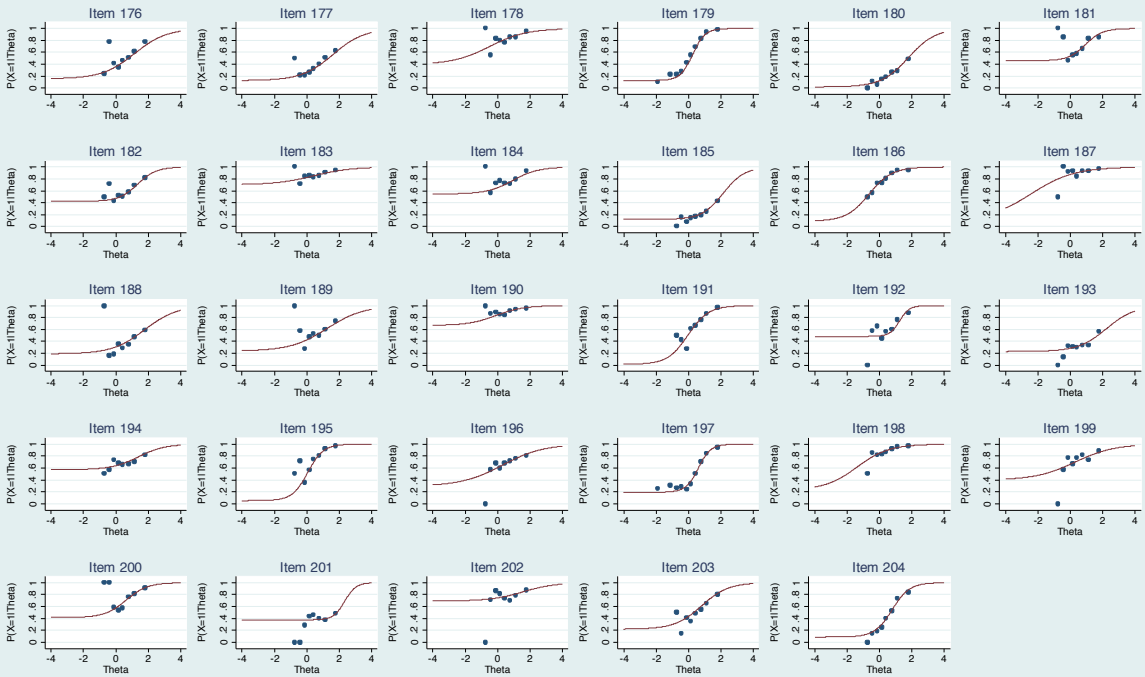
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

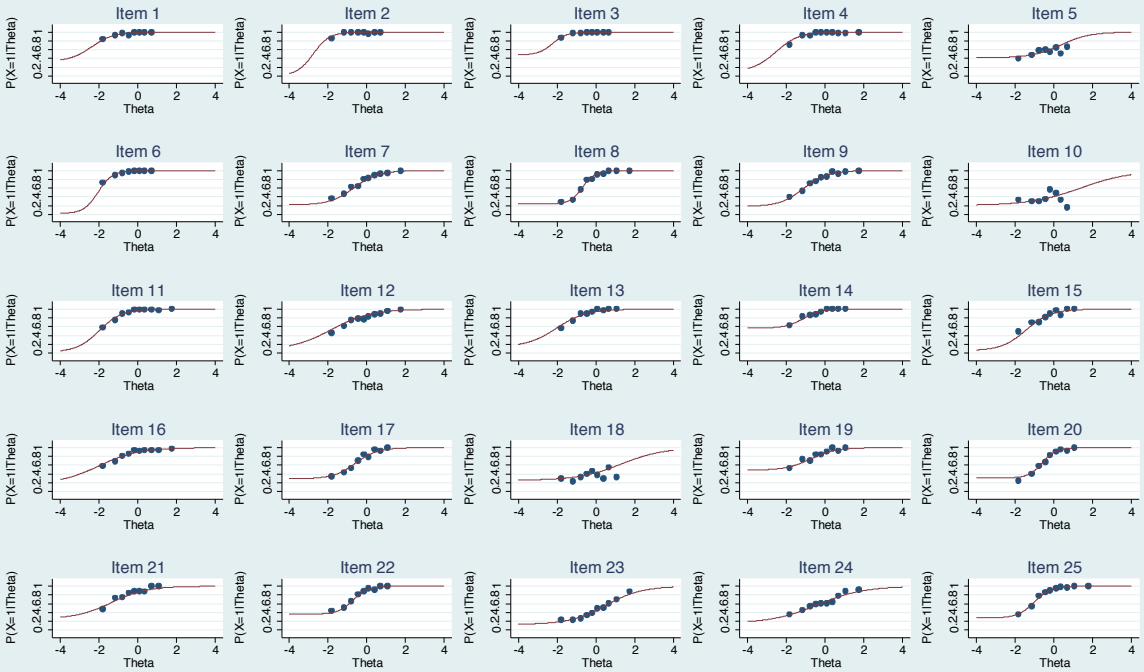
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

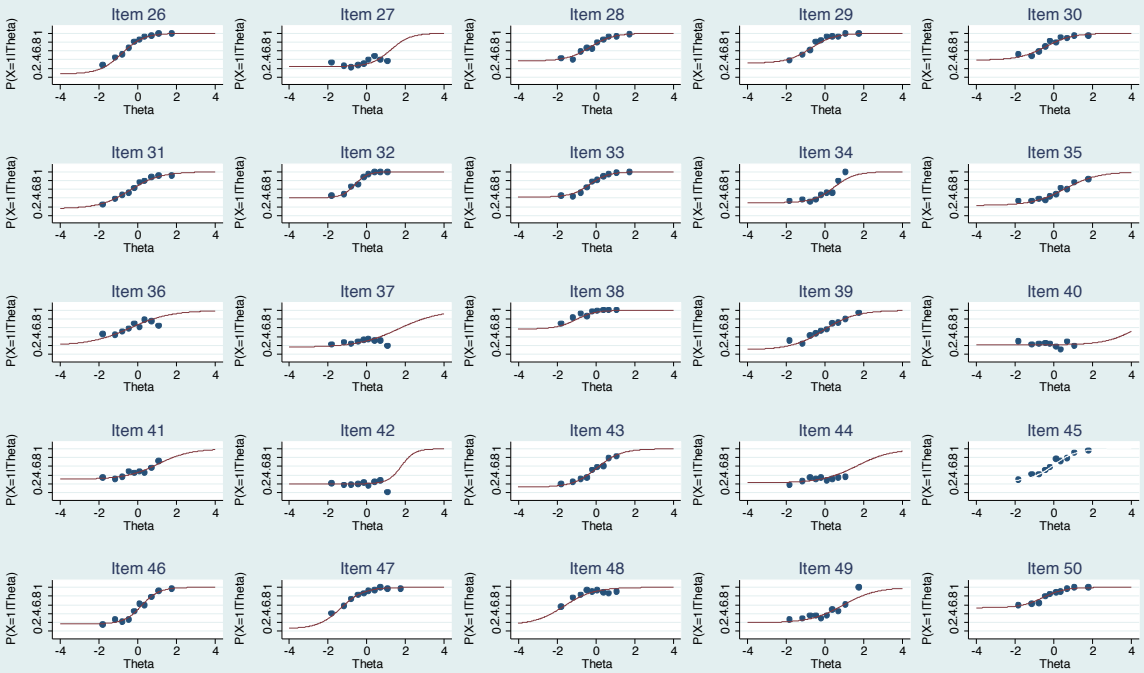
ET Oromifa PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

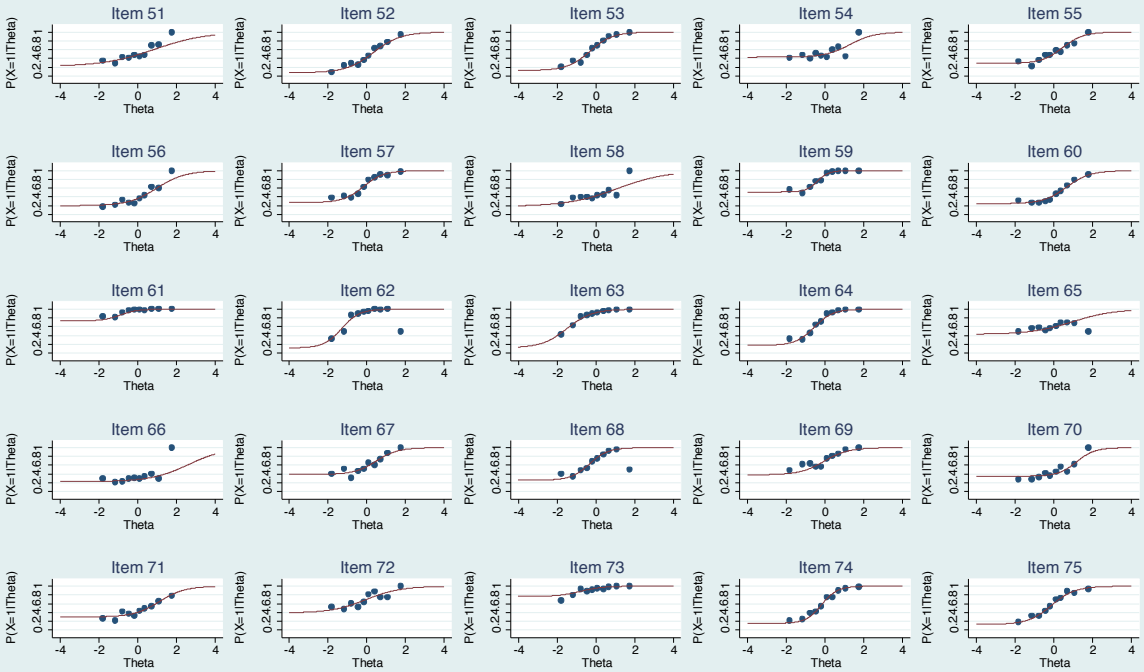
ET Oromifa PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

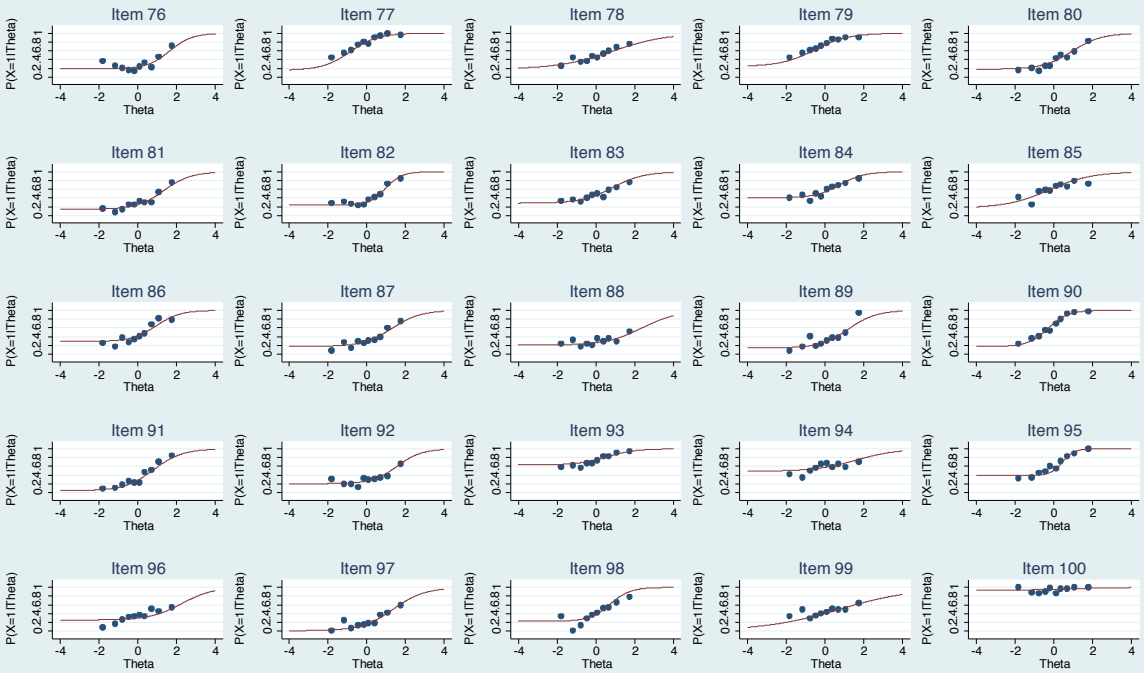
ET Oromifa PPVT



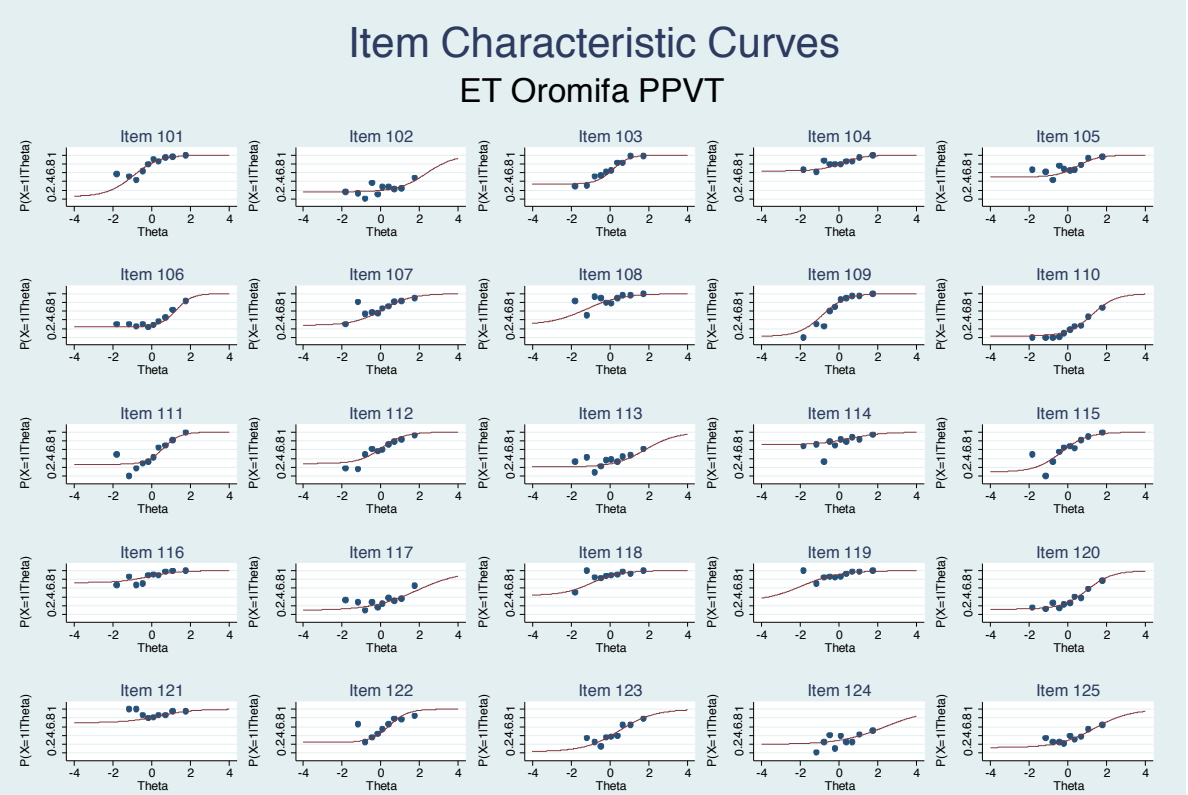
Combining OC and YC from R2 to R4

Item Characteristic Curves

ET Oromifa PPVT



Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Oromifa PPVT
Item 101
Item 102
Item 103
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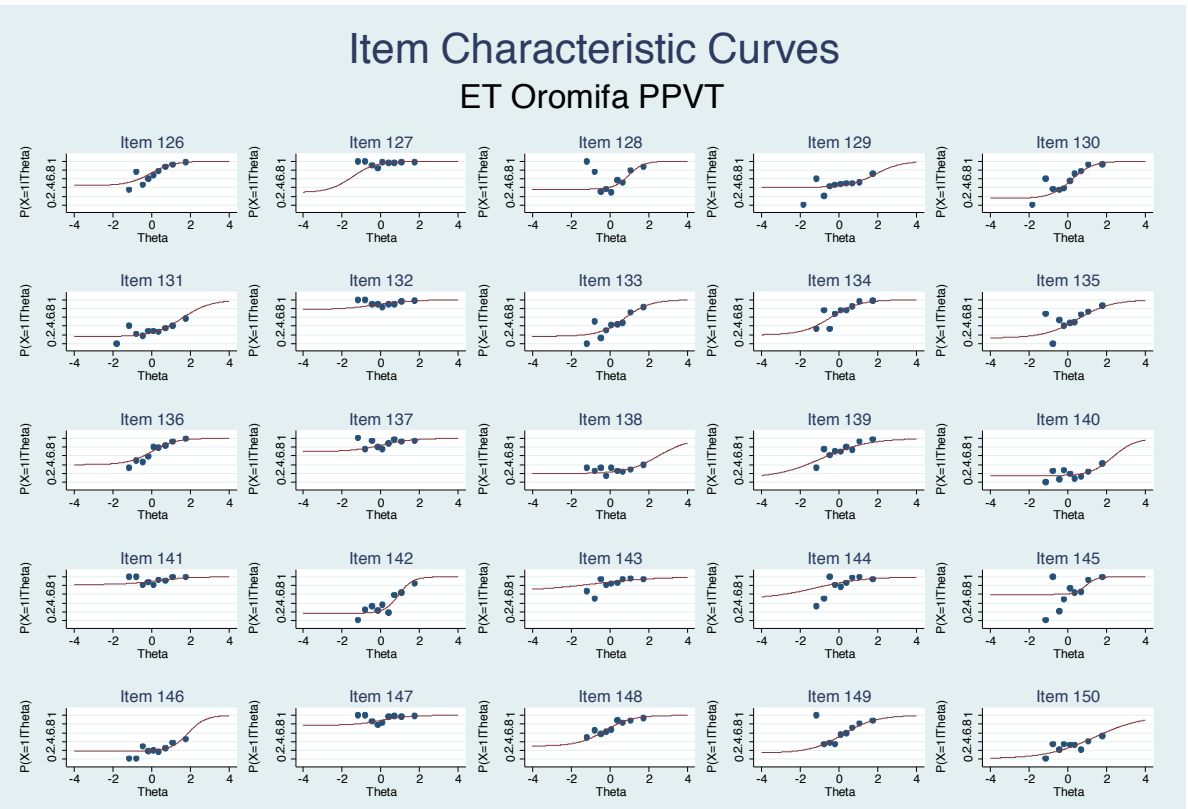
Item 123
Item 124
Item 125
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Oromifa PPVT
Item 126
Item 127
Item 128
Item 129
Item 130
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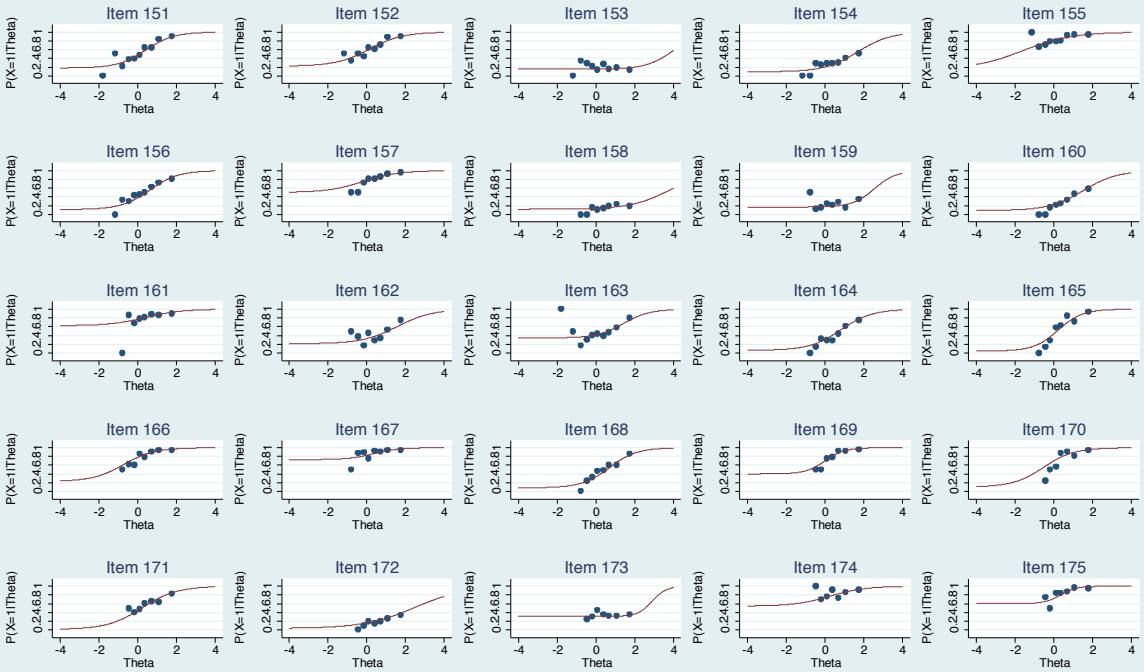
Item 149
Item 150
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4

Item Characteristic Curves

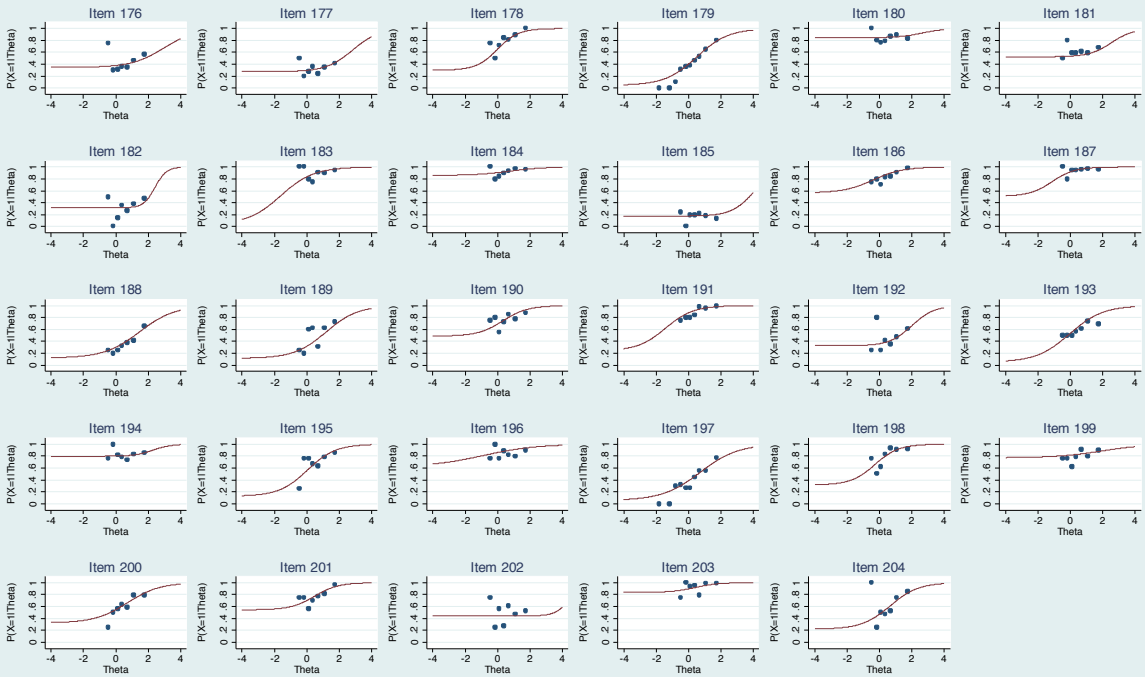
ET Oromifa PPVT



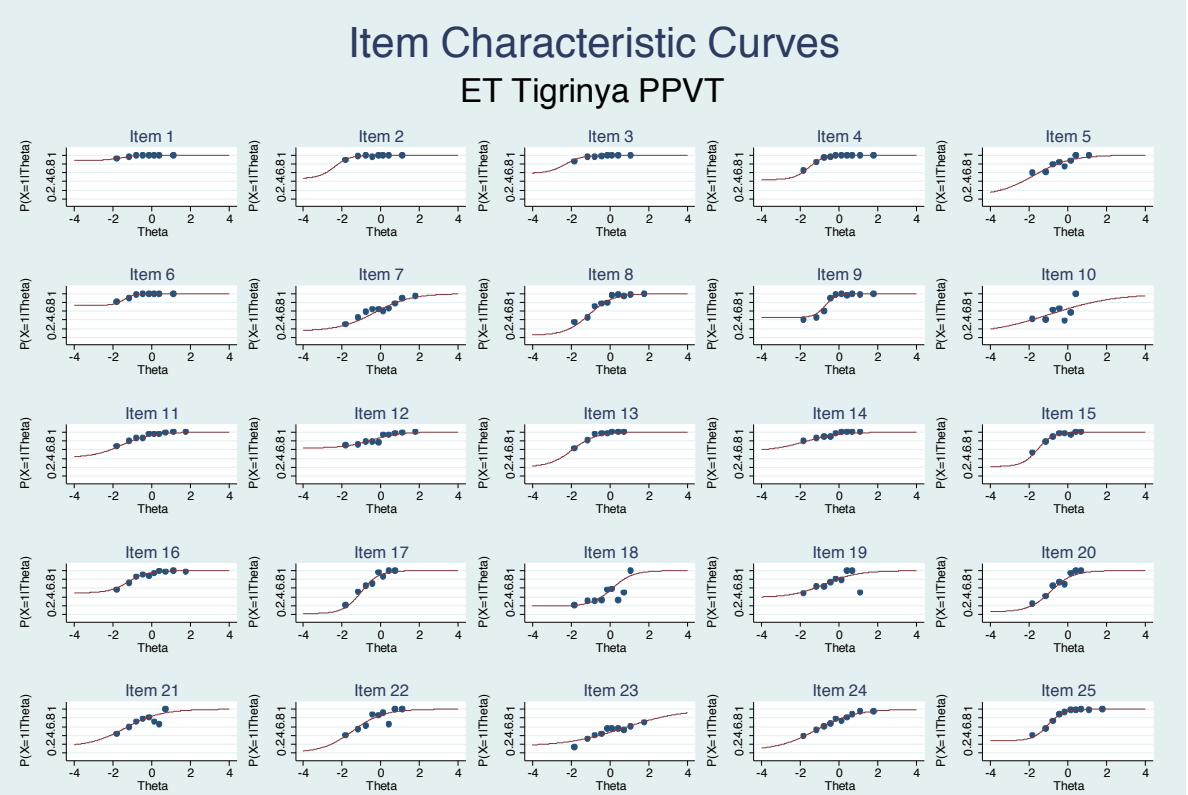
Combining OC and YC from R2 to R4

Item Characteristic Curves

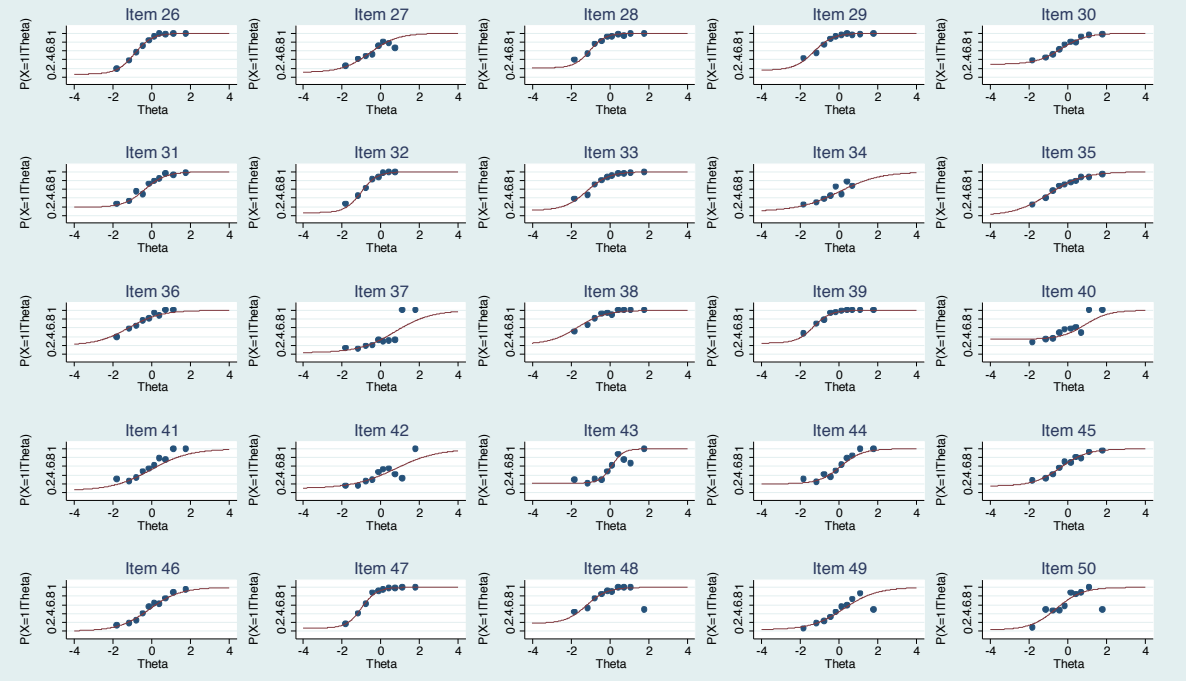
ET Oromifa PPVT



Combining OC and YC from R2 to R4



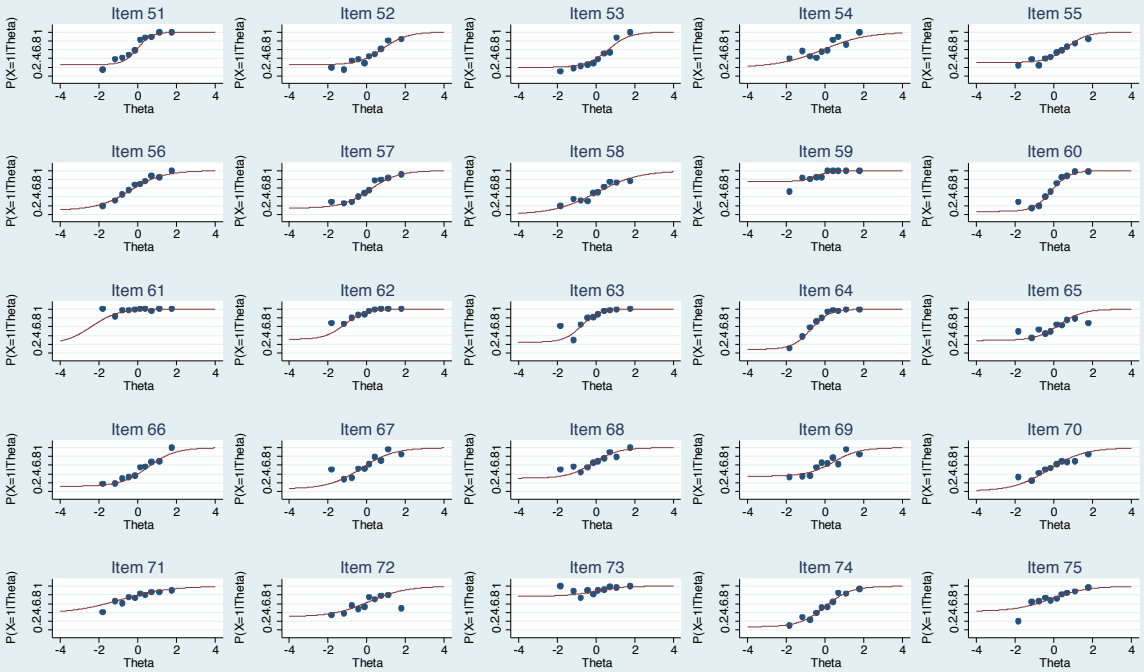
Combining OC and YC from R2 to R4



Combining OC and YC from R2 to R4

Item Characteristic Curves

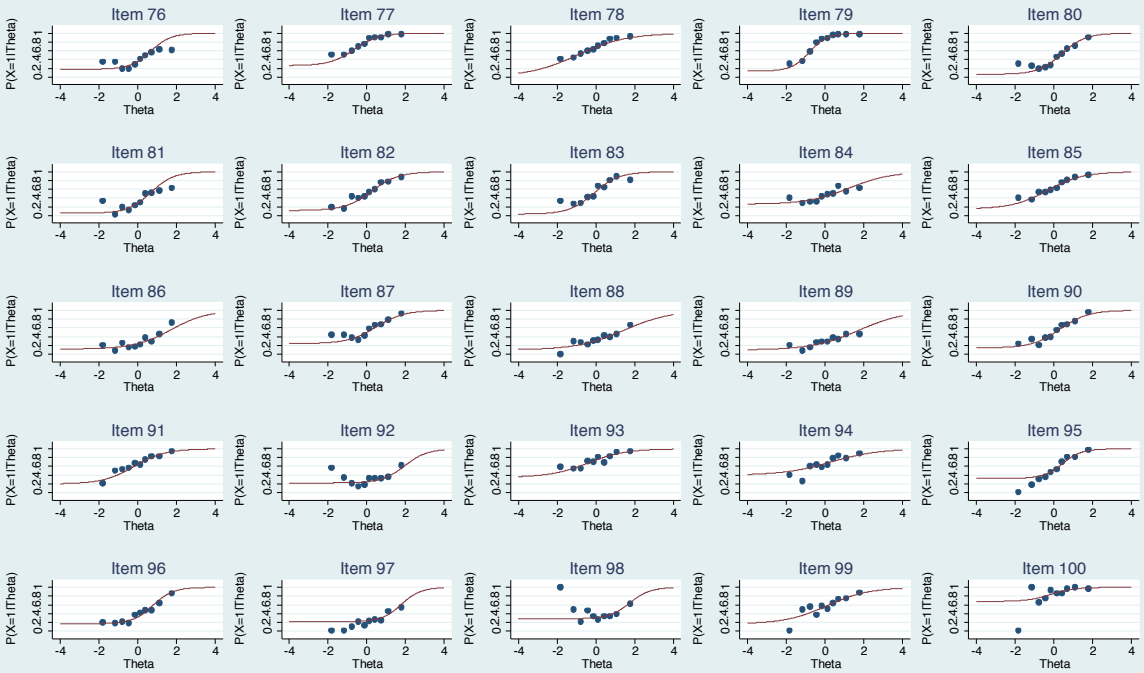
ET Tigrinya PPVT



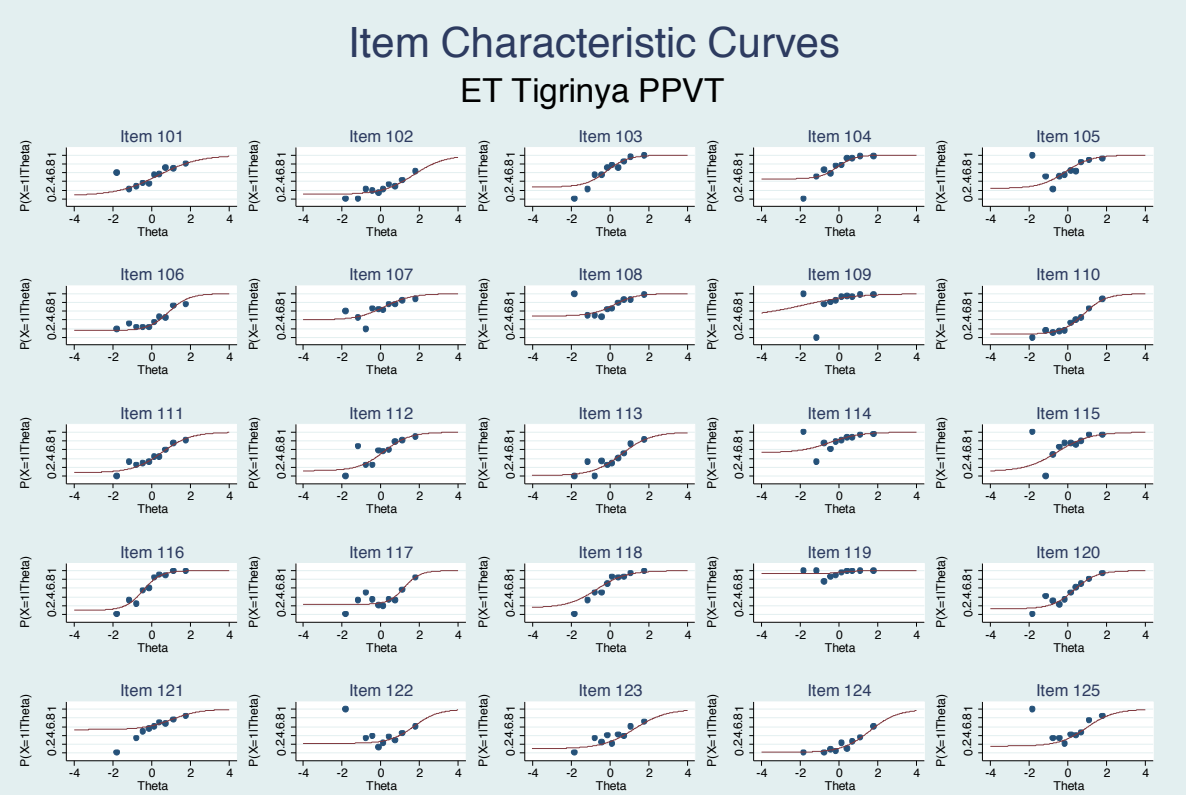
Combining OC and YC from R2 to R4

Item Characteristic Curves

ET Tigrinya PPVT



Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Tigrinya PPVT
Item 101
Item 102
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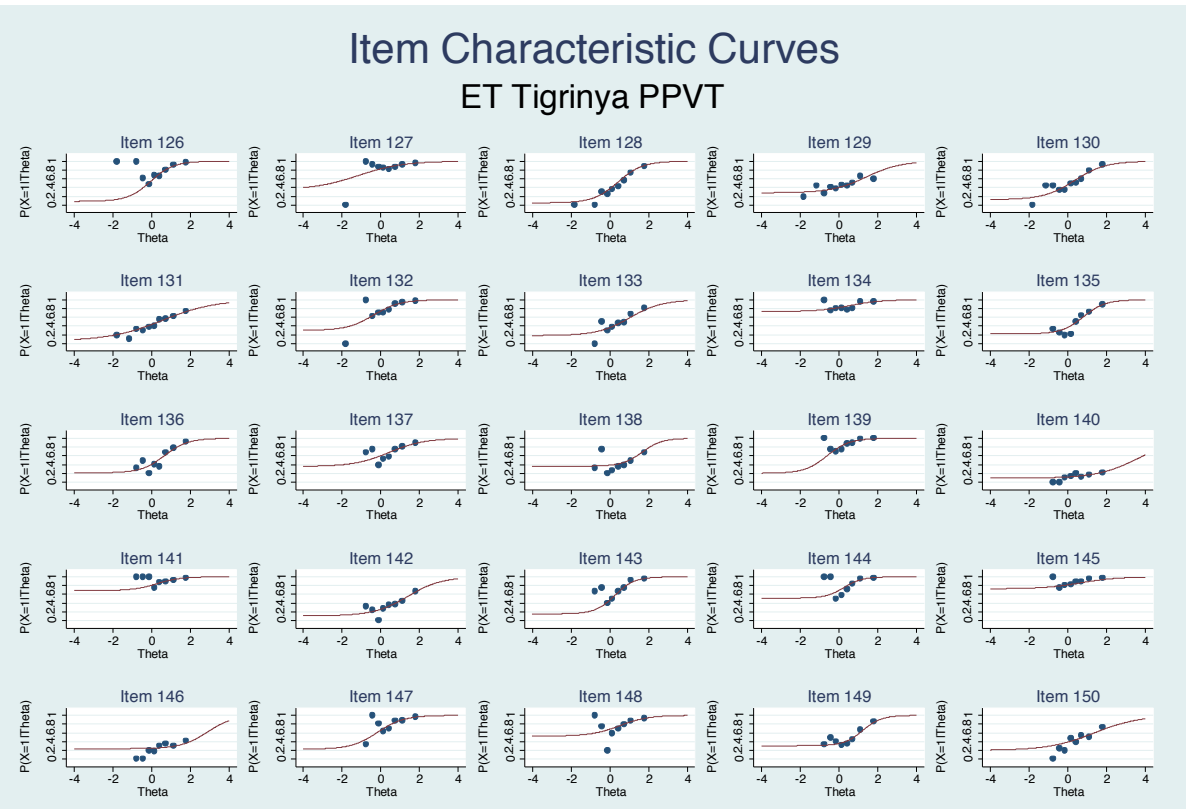
Item 123
Item 124
Item 125
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Tigrinya PPVT
Item 126
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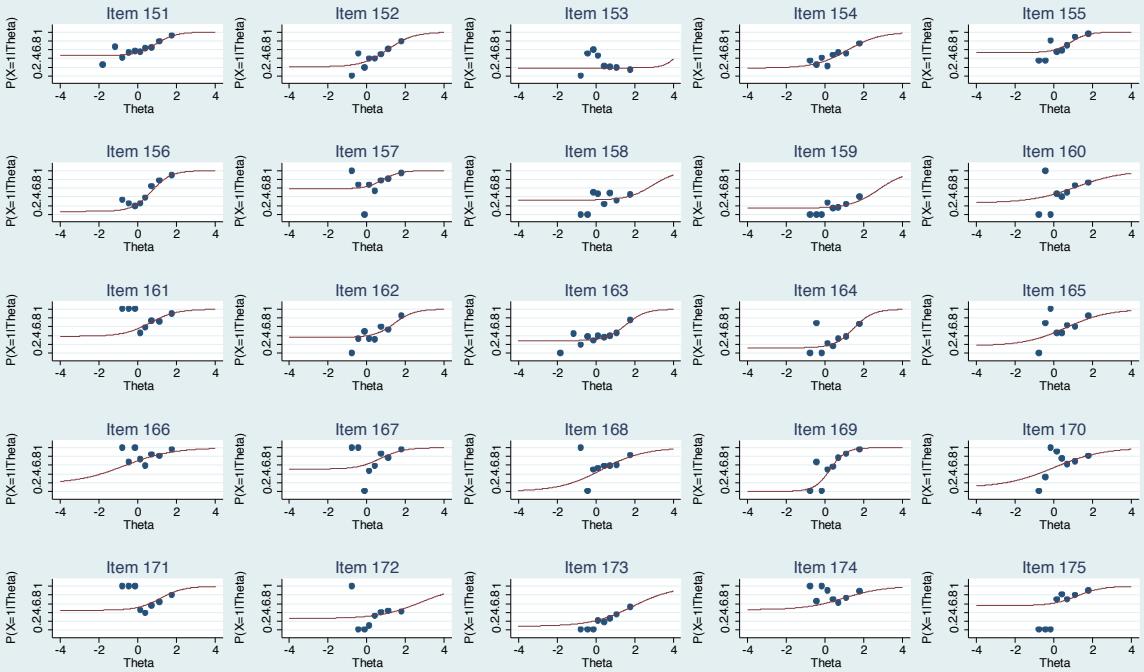
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4

Item Characteristic Curves

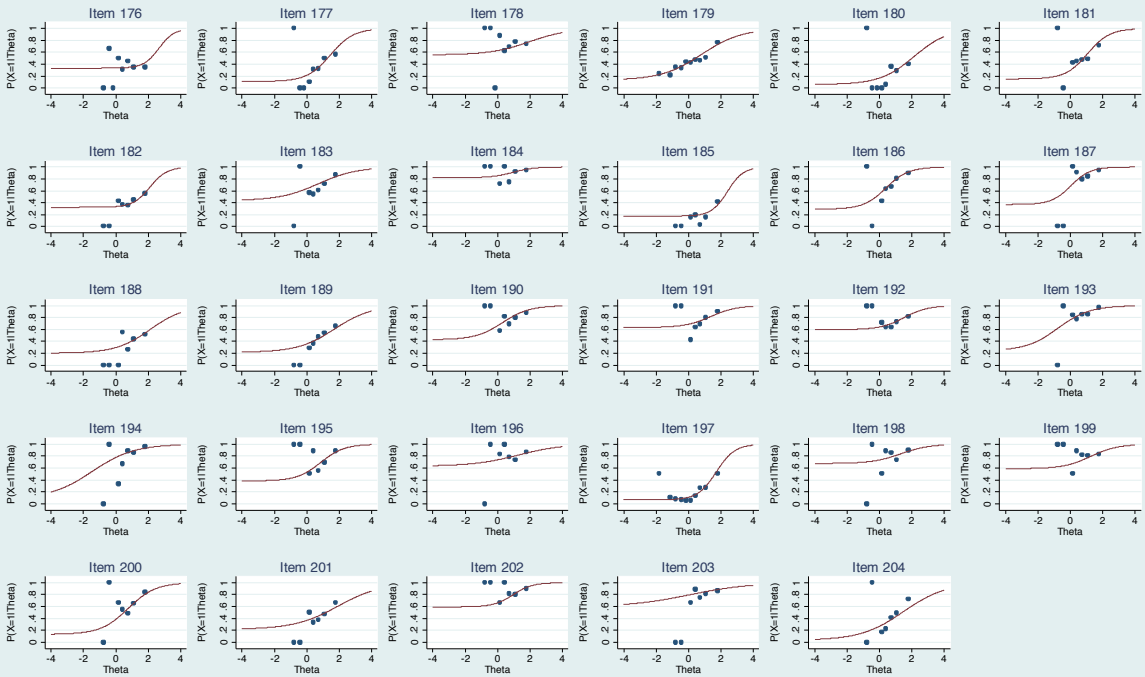
ET Tigrinya PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

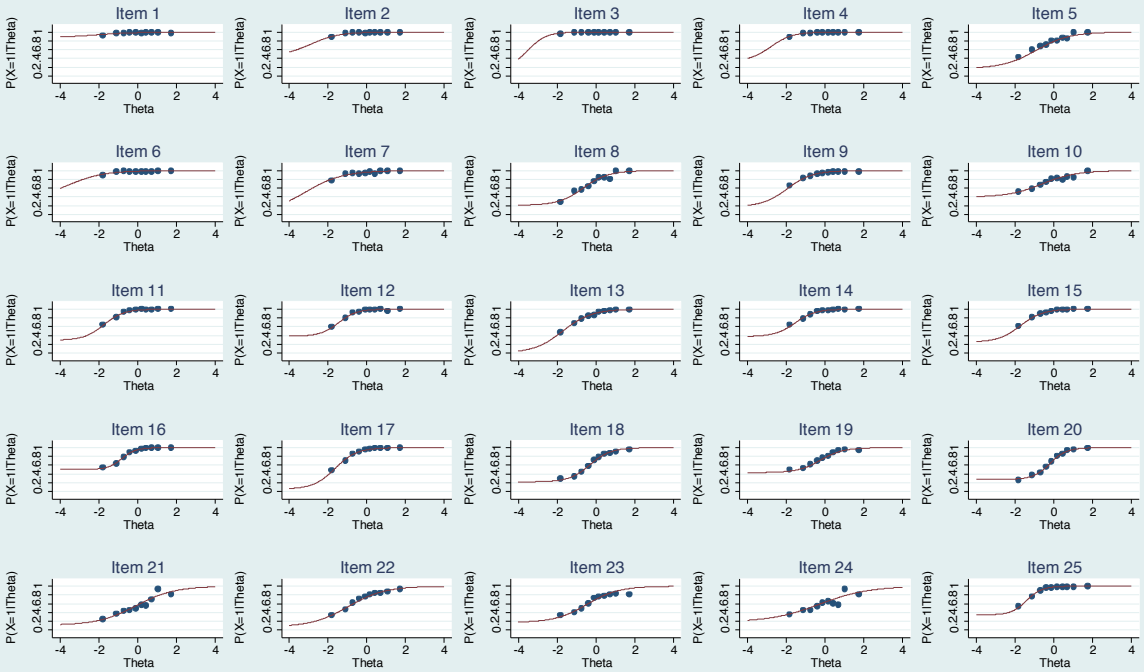
ET Tigrinya PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

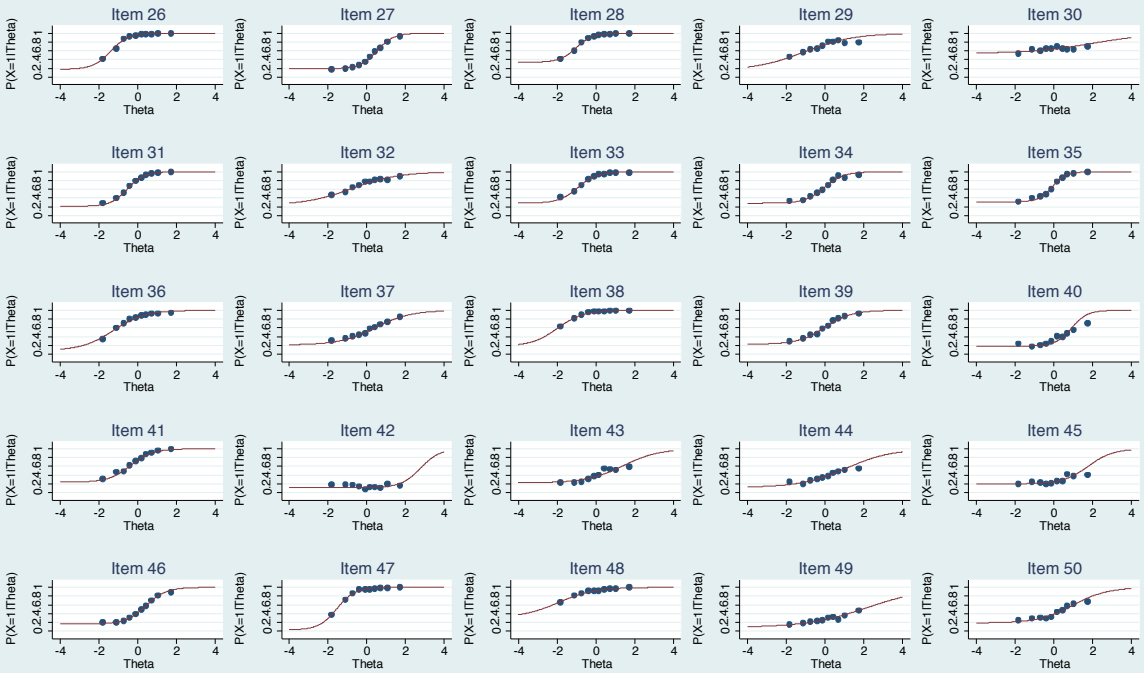
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

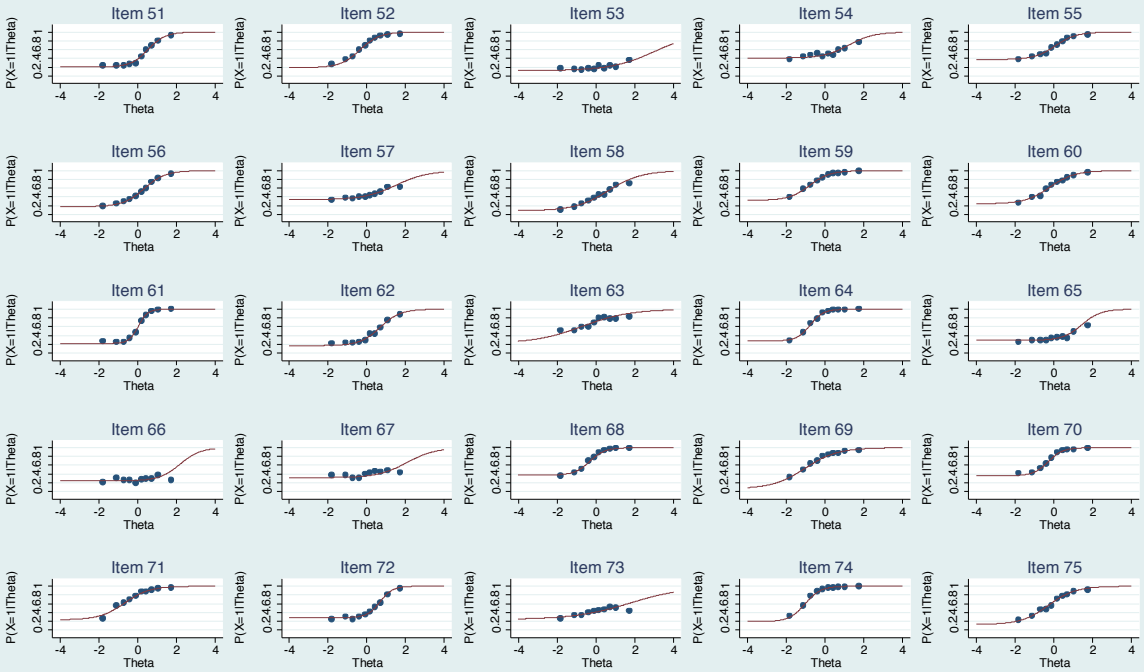
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

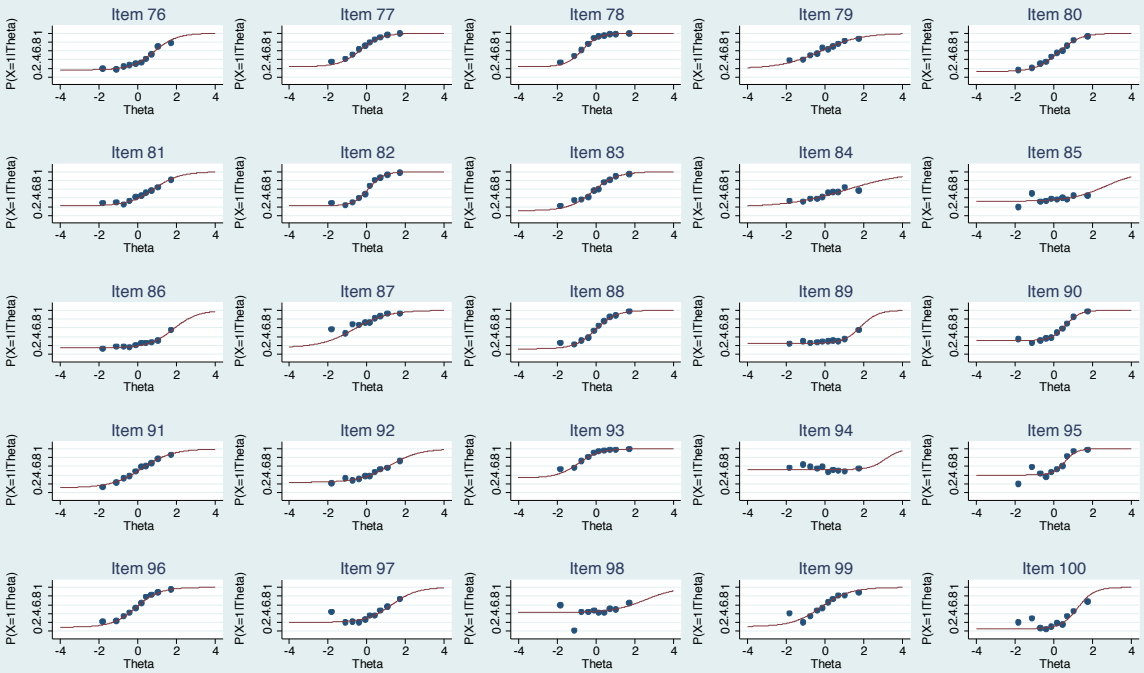
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

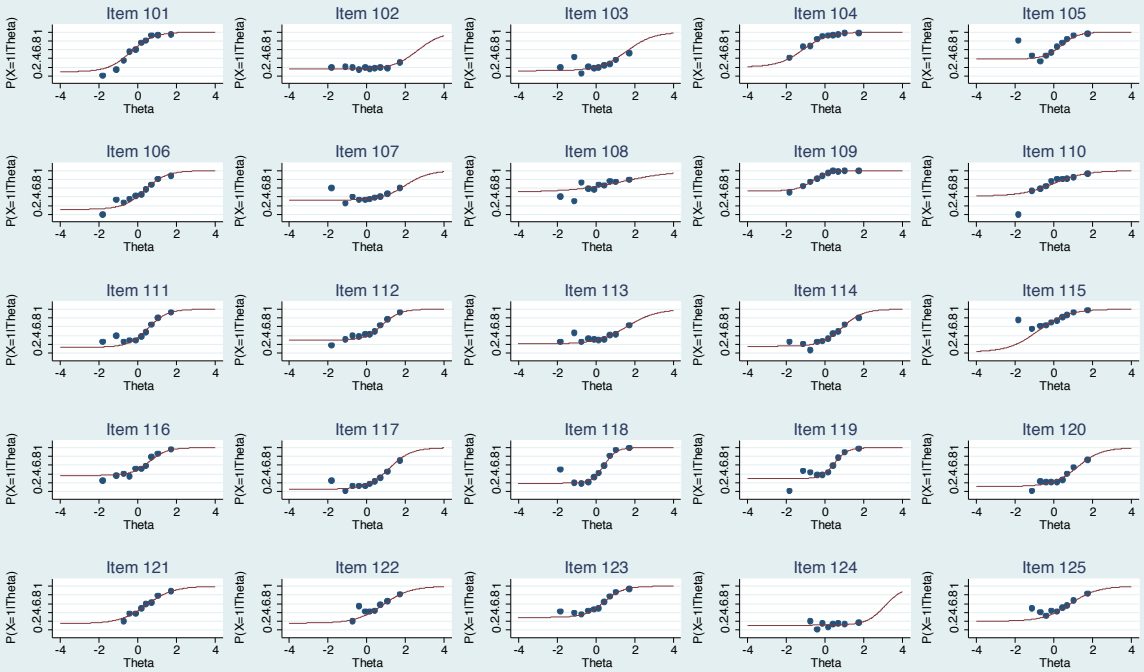
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

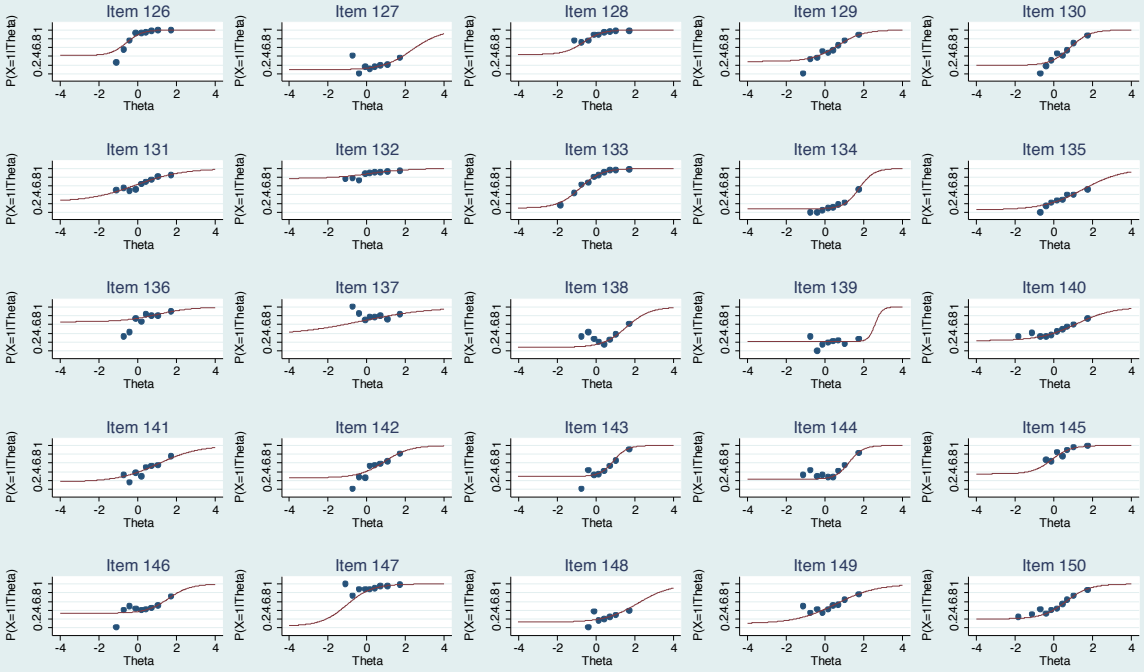
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

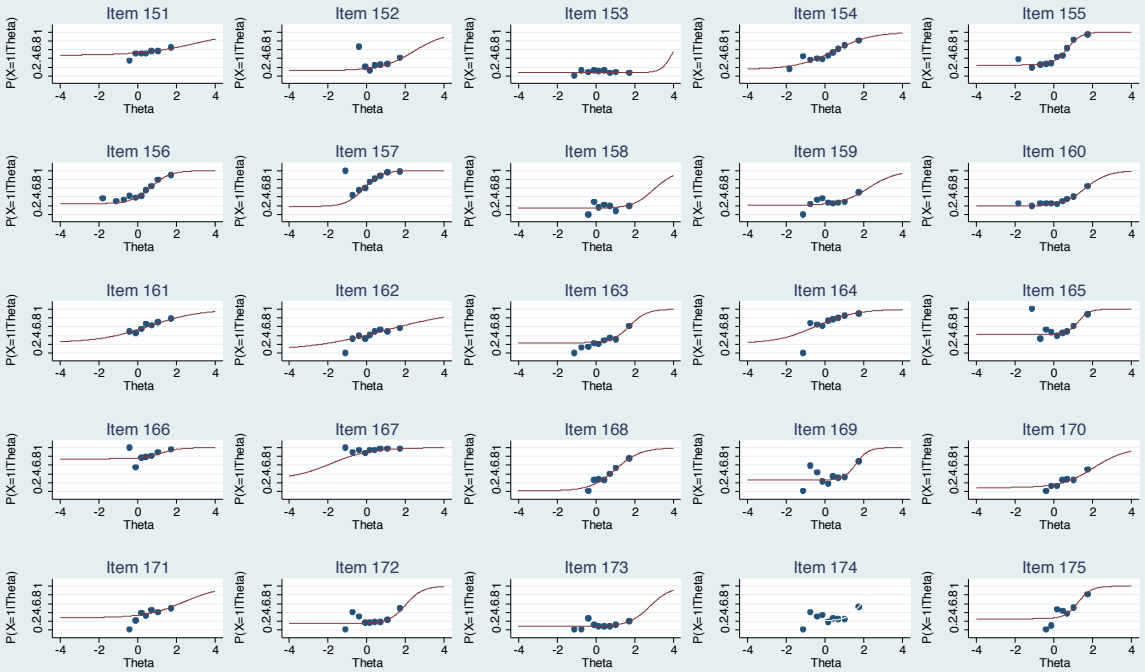
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

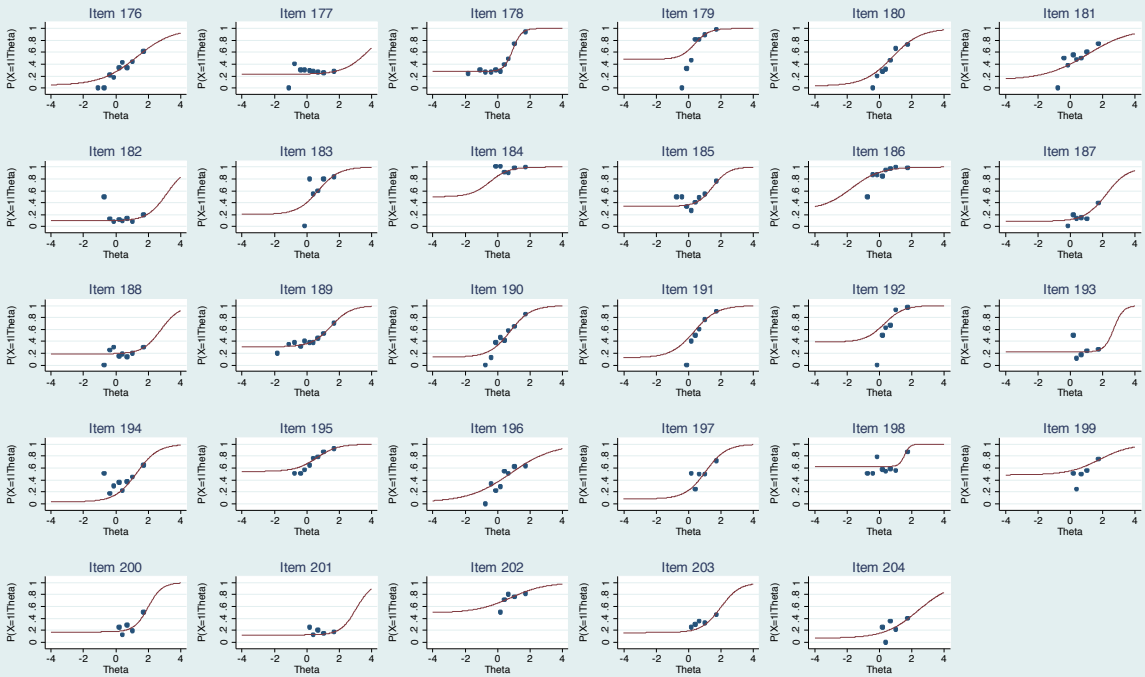
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

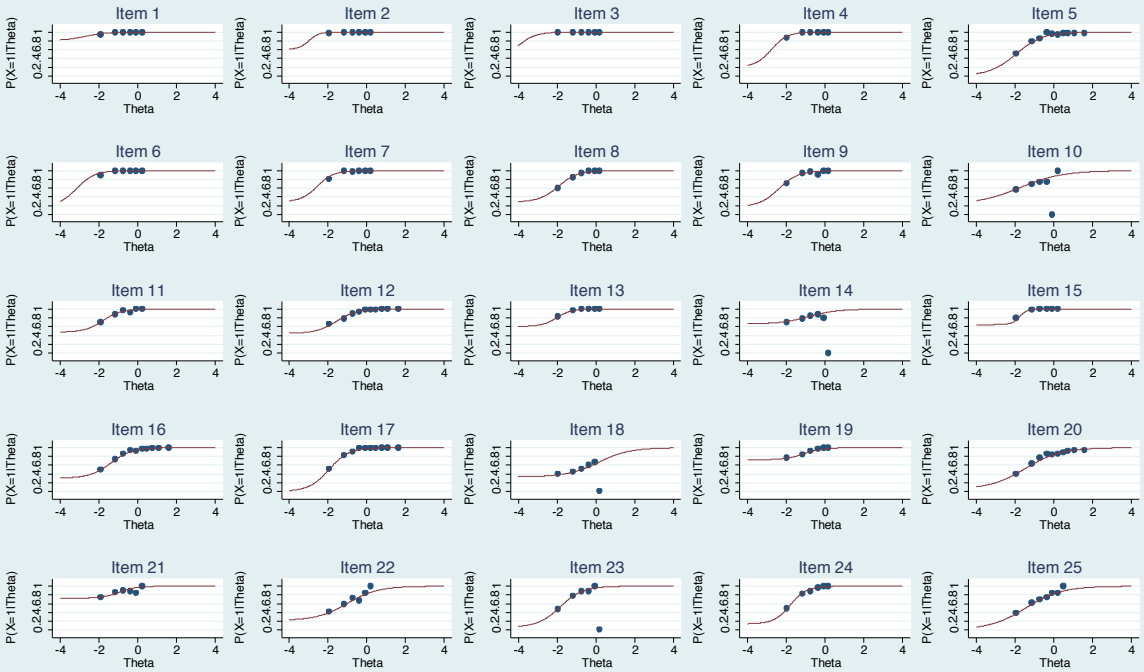
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

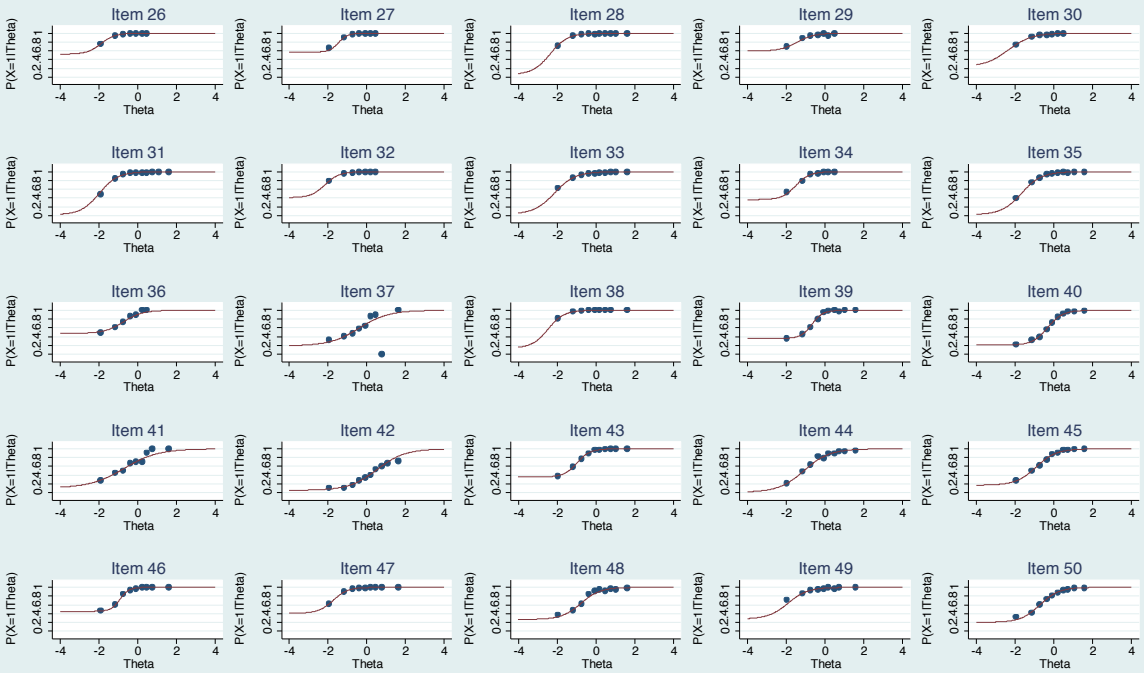
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

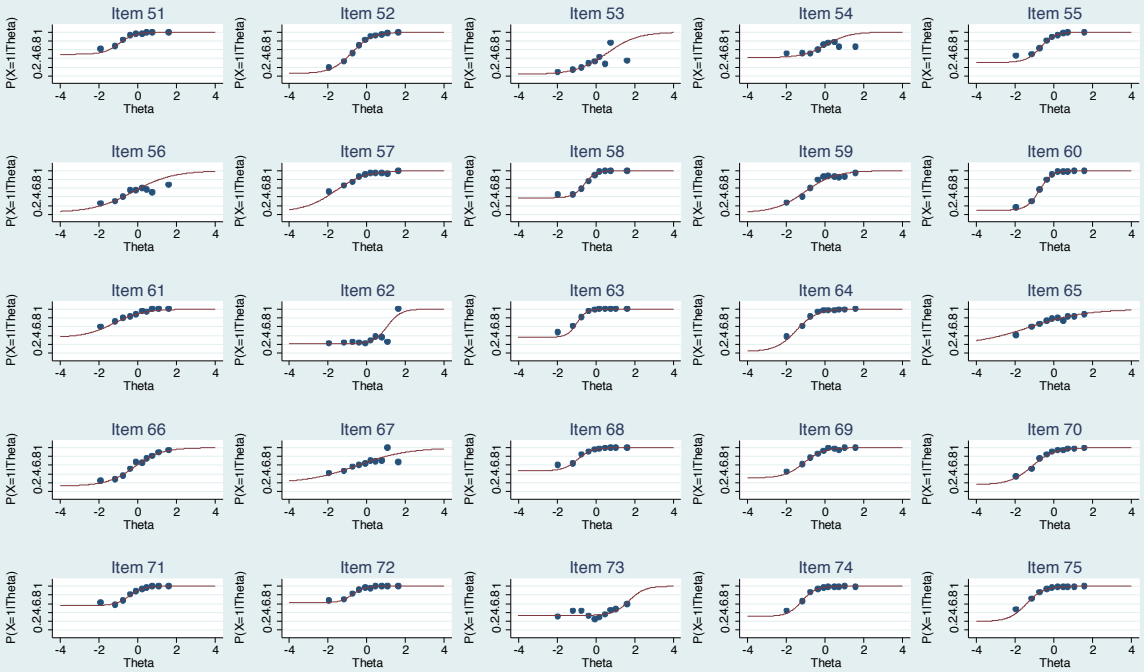
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

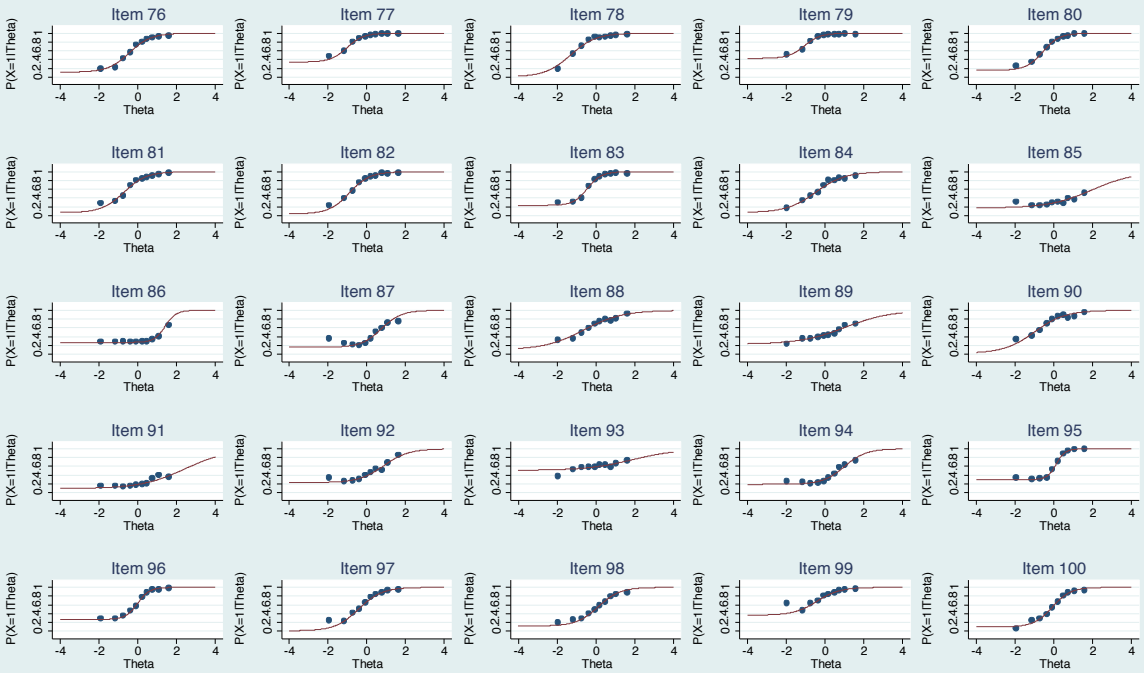
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

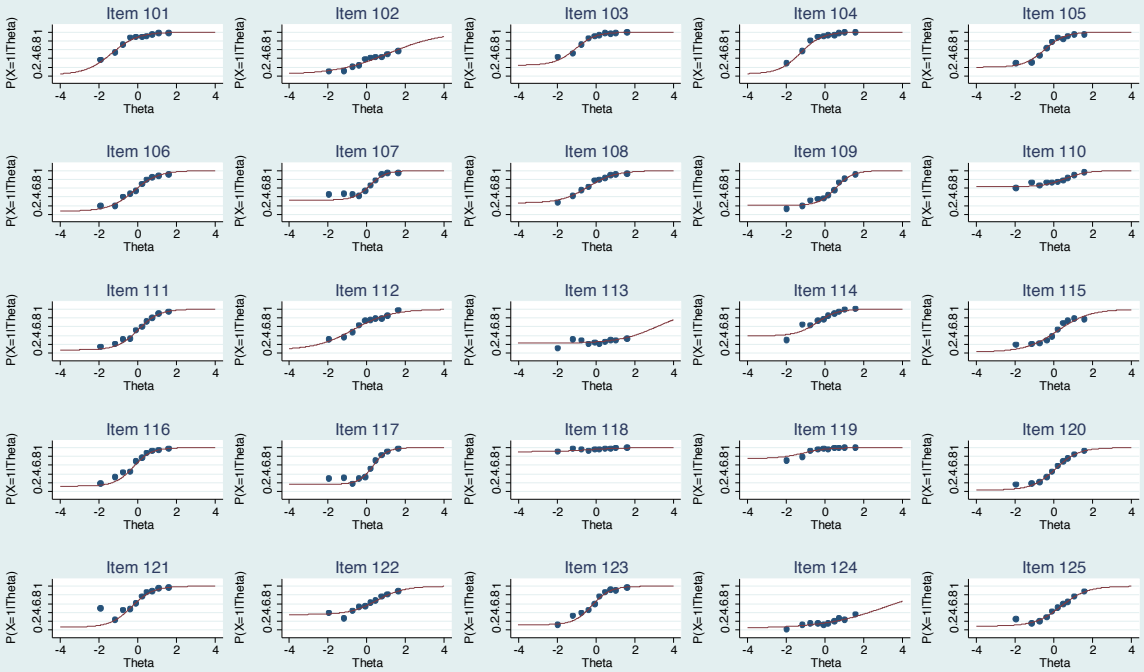
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

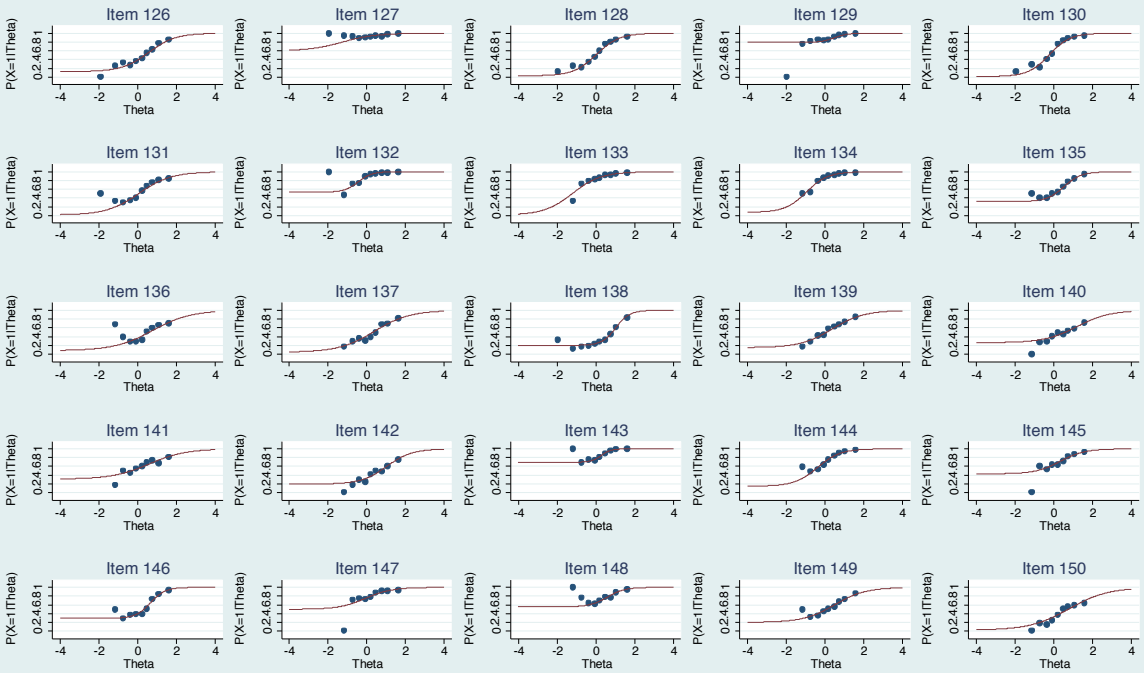
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

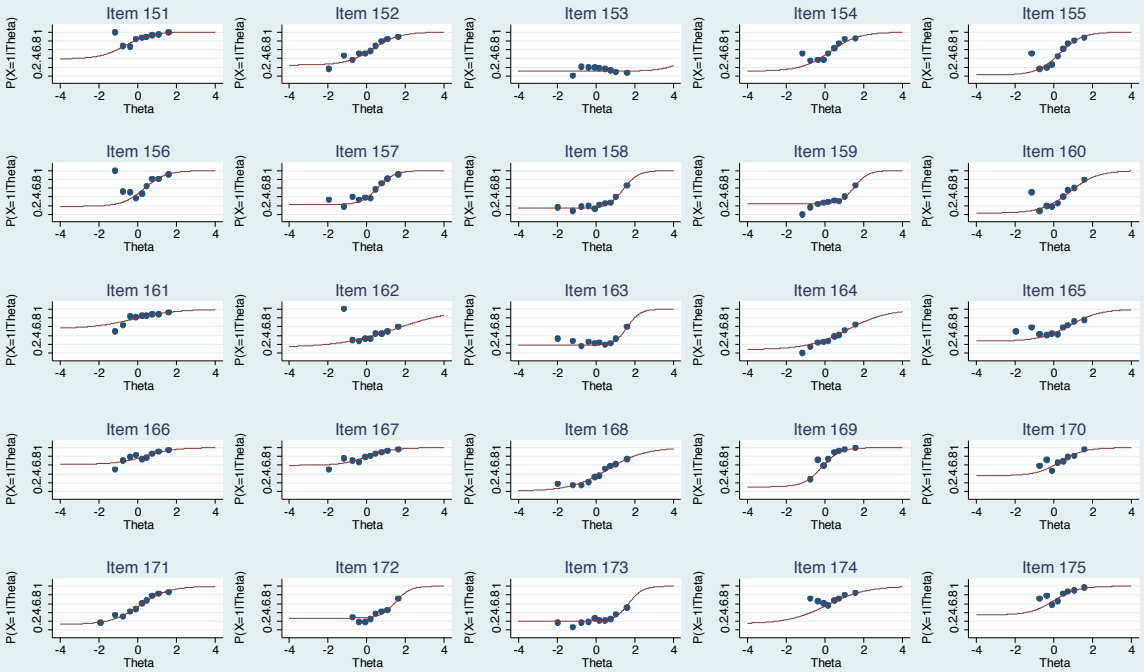
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

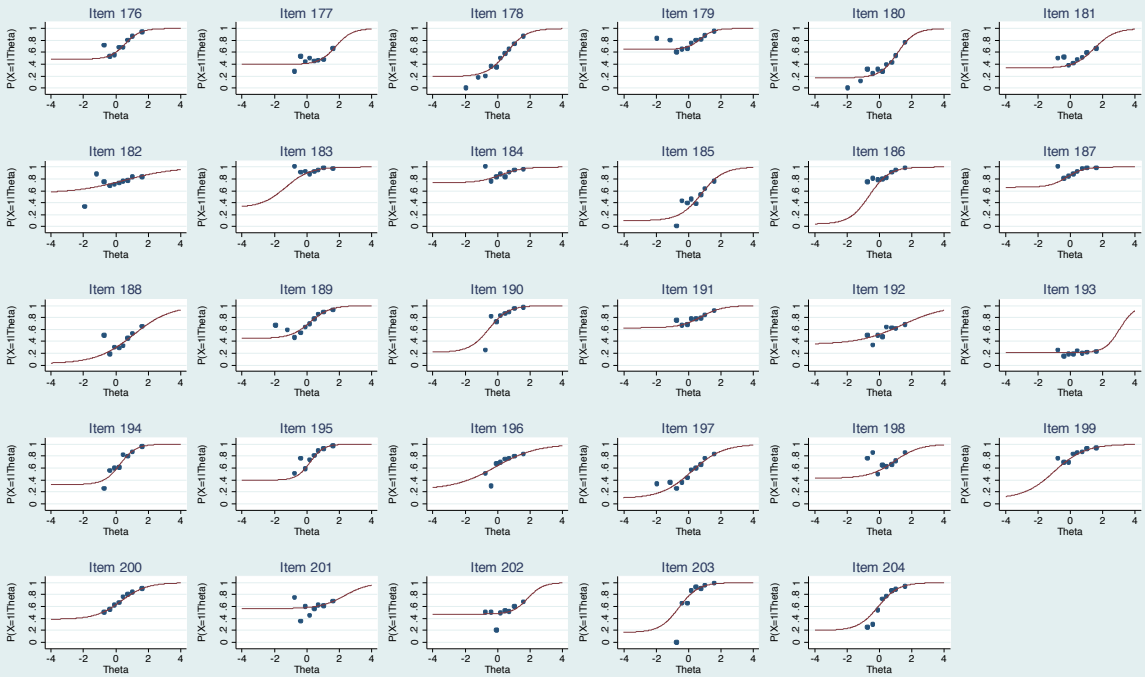
Vietnam PPVT



Combining OC and YC from R2 to R4

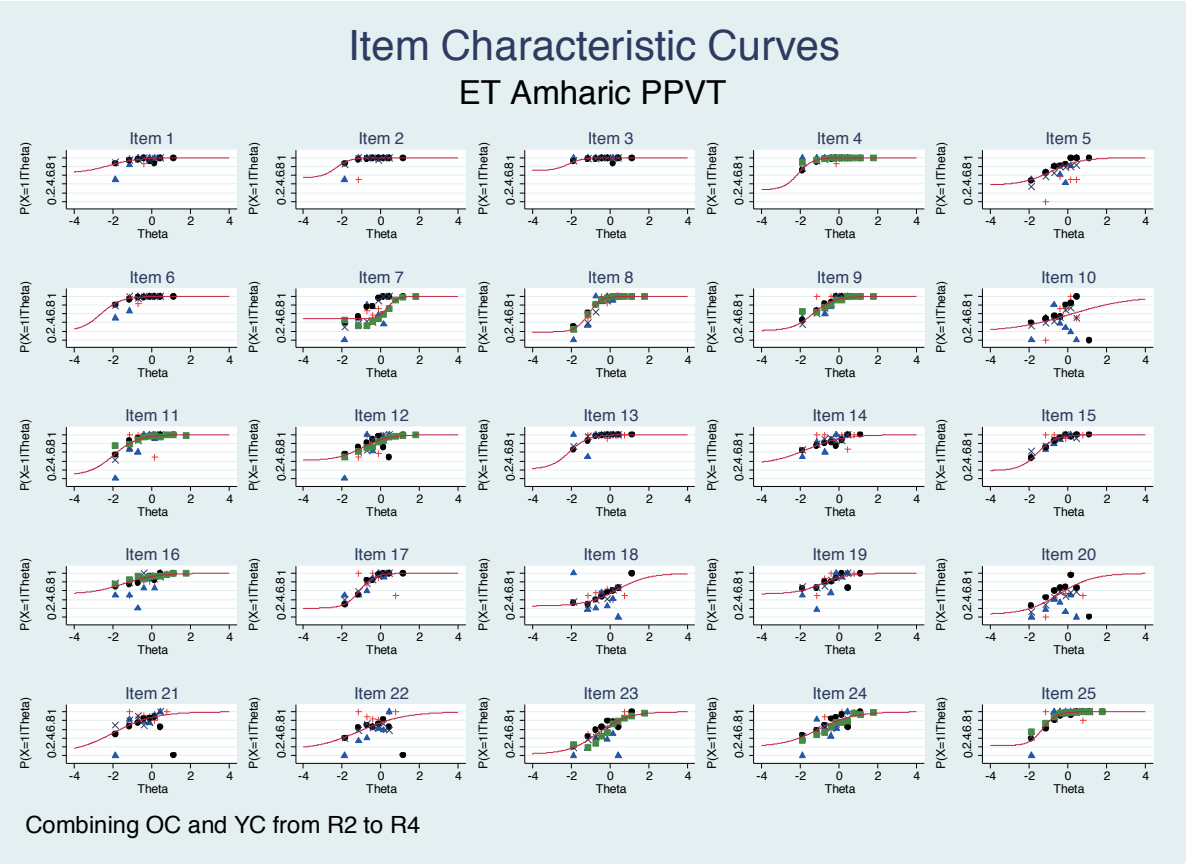
Item Characteristic Curves

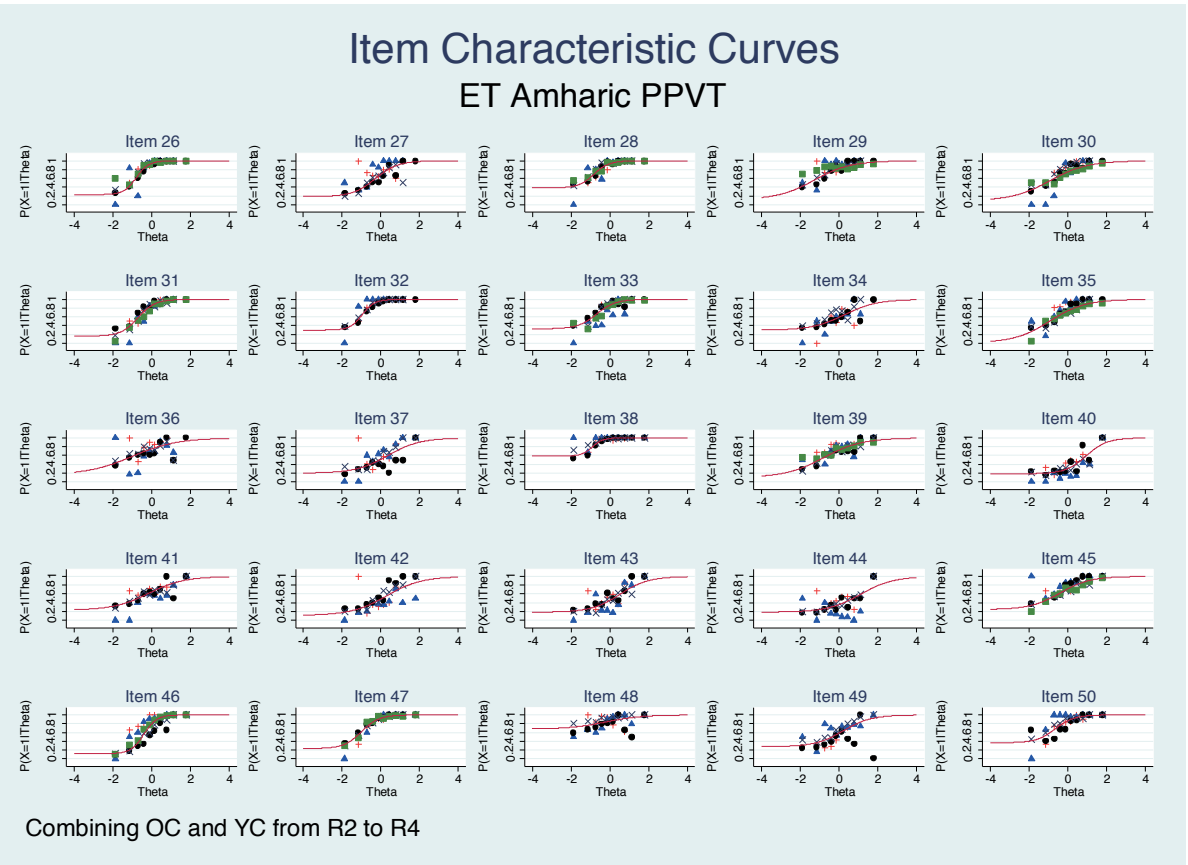
Vietnam PPVT



Combining OC and YC from R2 to R4

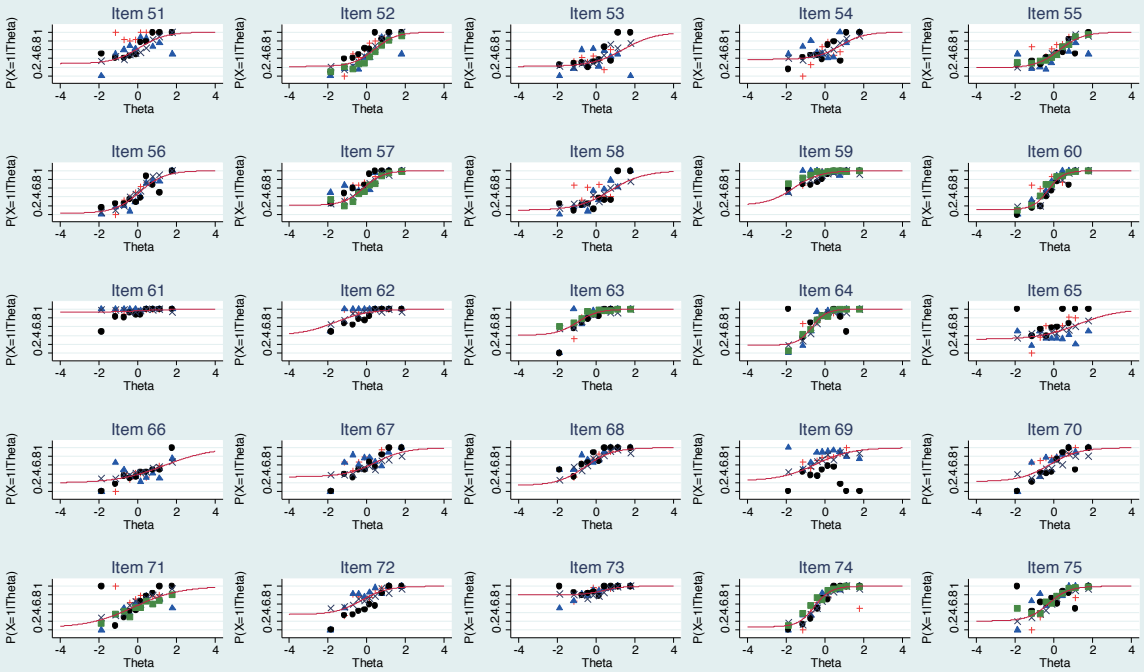
Appendix C. DIF analysis for each item by country and main language





Item Characteristic Curves

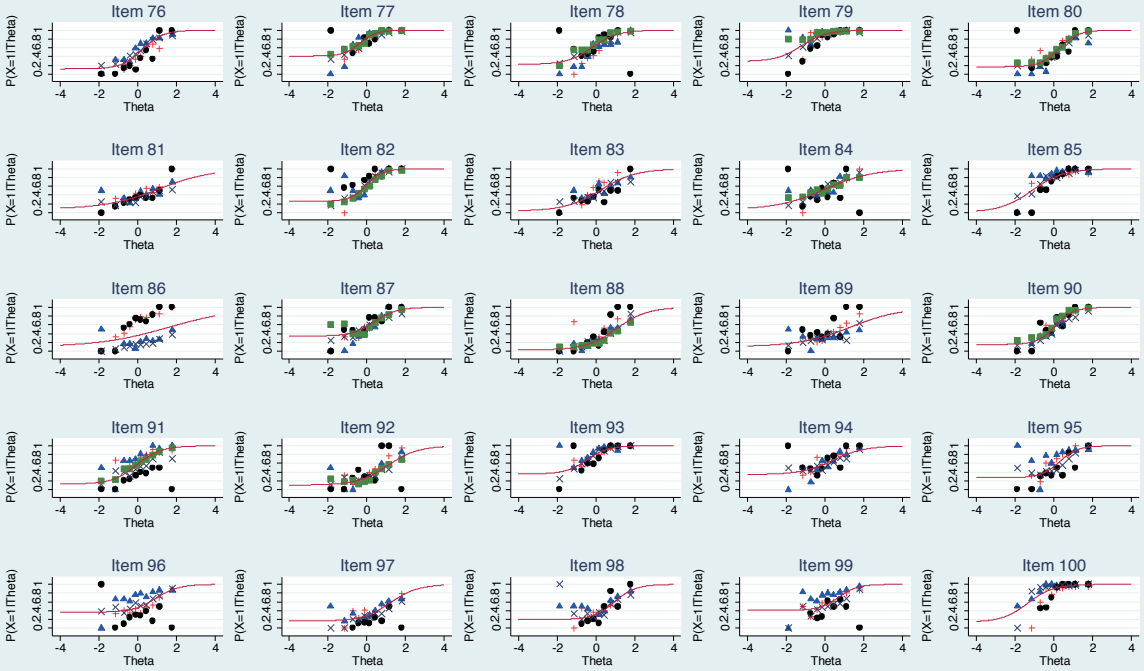
ET Amharic PPVT



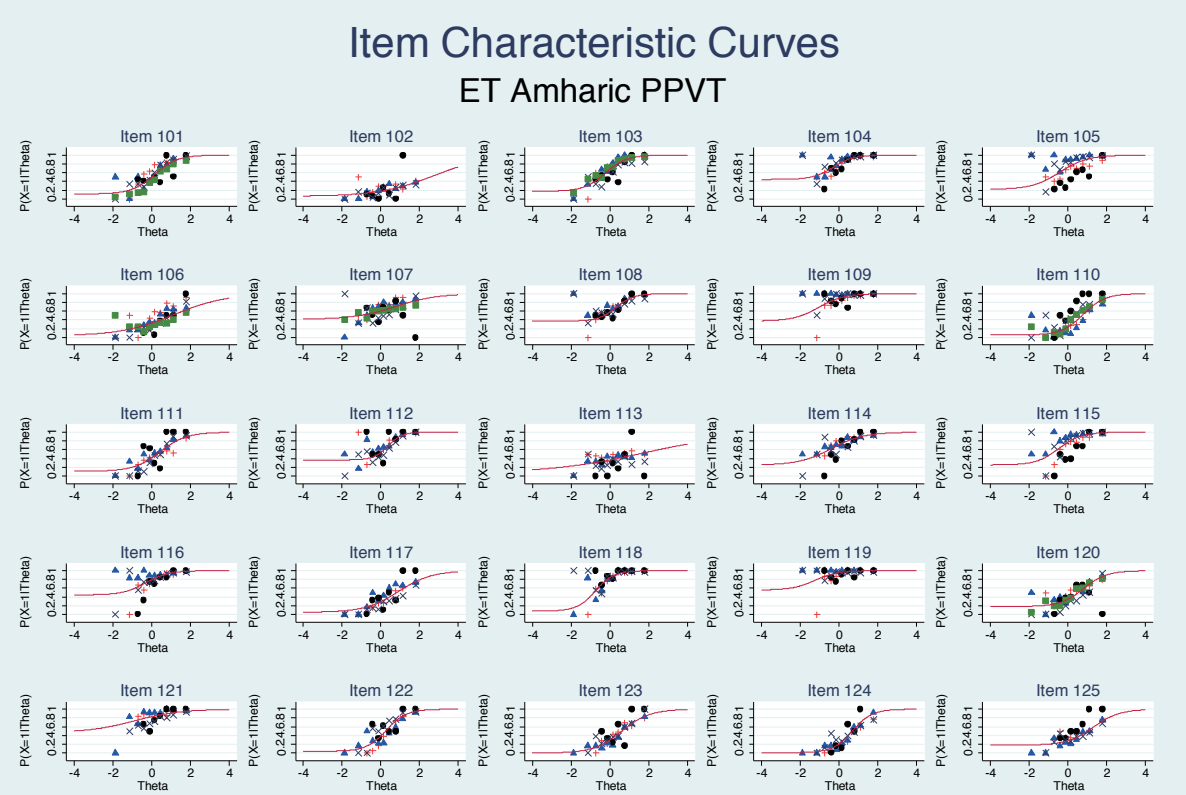
Combining OC and YC from R2 to R4

Item Characteristic Curves

ET Amharic PPVT



Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Amharic PPVT
Item 101
Item 102
Item 103
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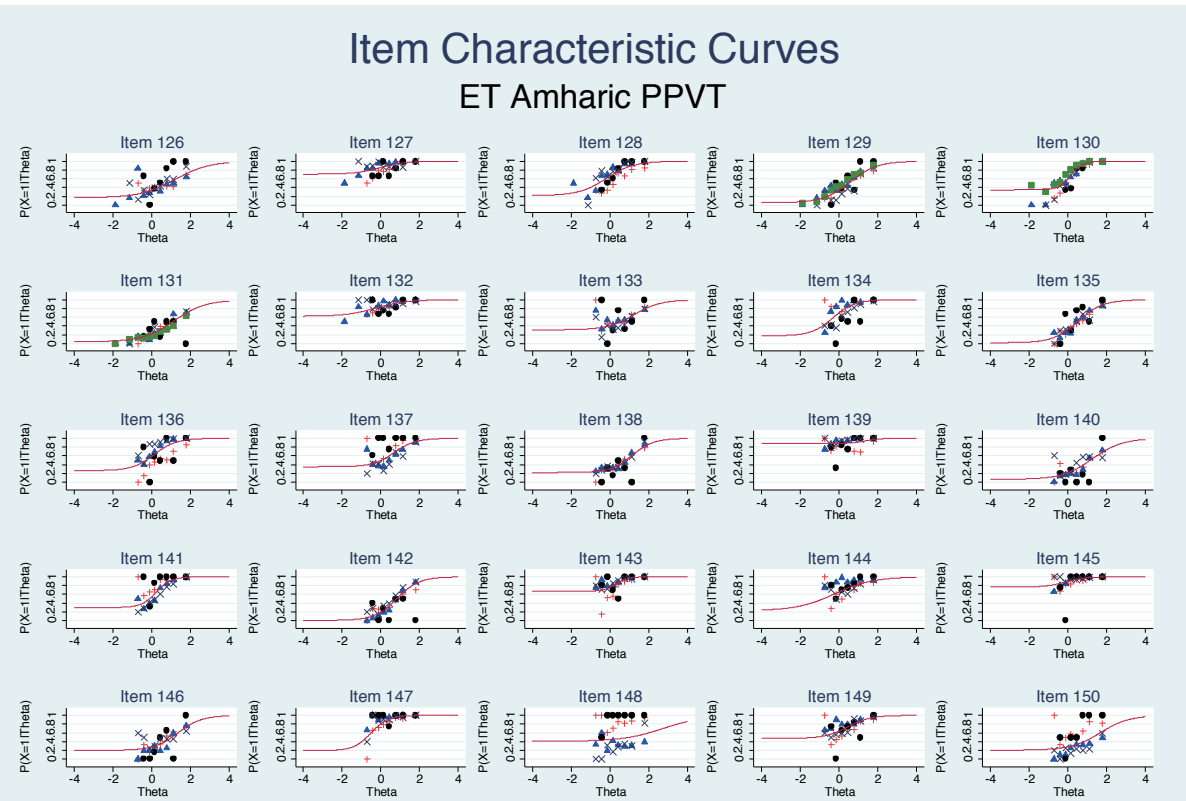
Item 123
Item 124
Item 125
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Amharic PPVT
Item 126
Item 127
Item 128
Item 129
Item 130
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Item 137
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Item 143
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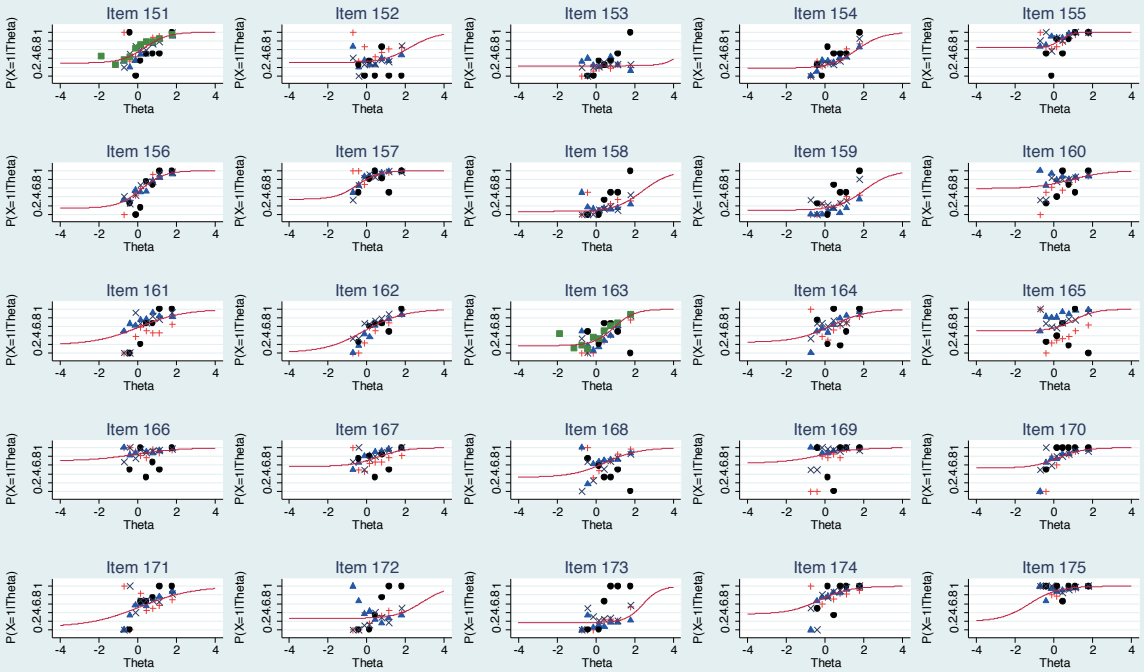
Item 145
Item 146
Item 147
Item 148
Item 149
Item 150
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4

Item Characteristic Curves

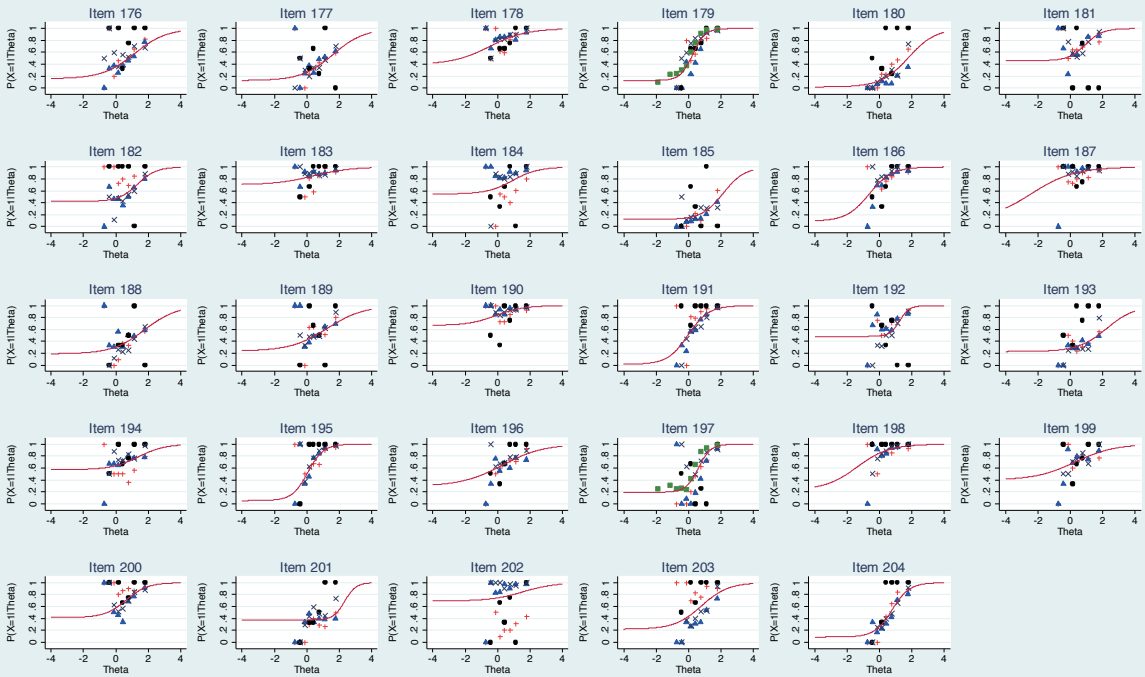
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

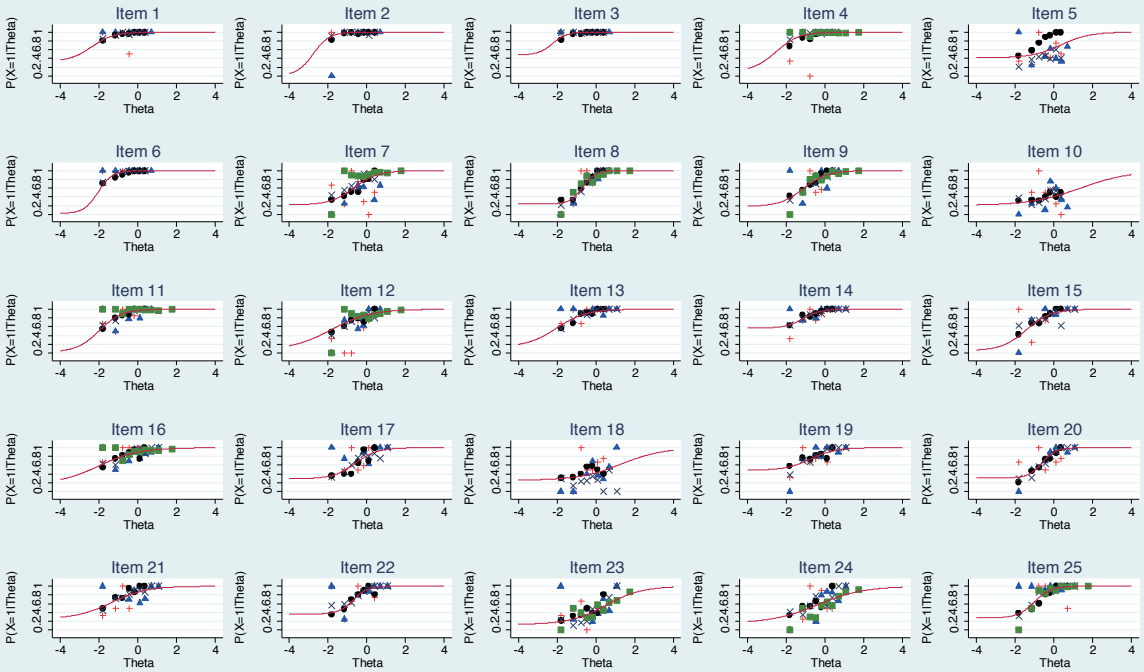
ET Amharic PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

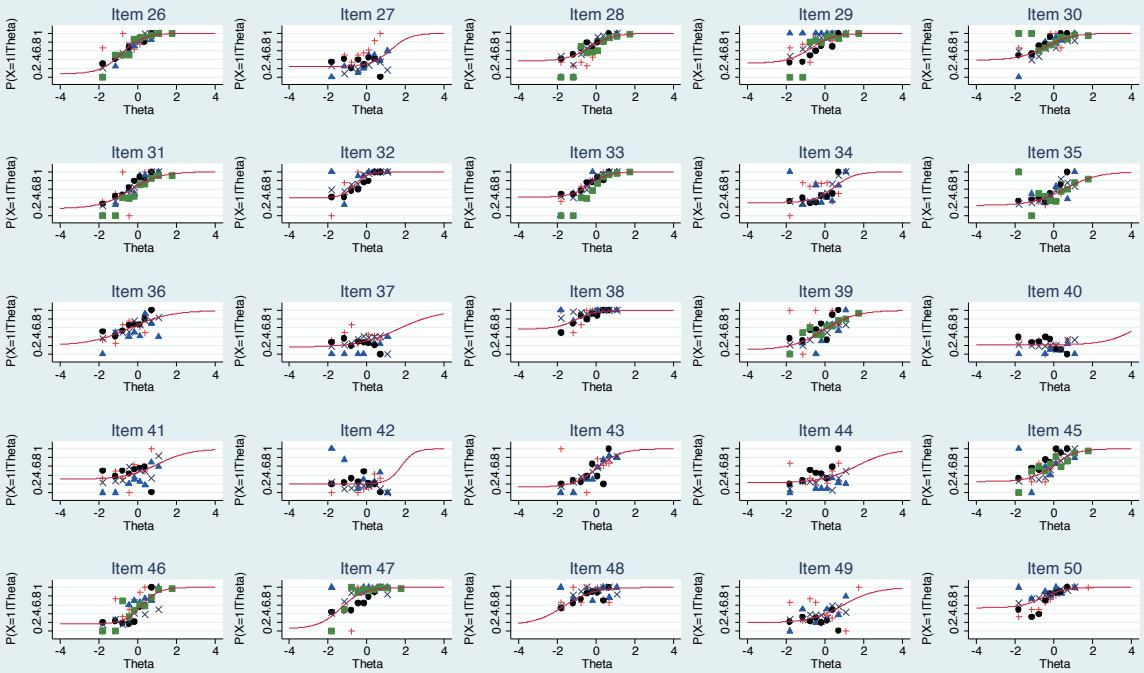
ET Oromifa PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

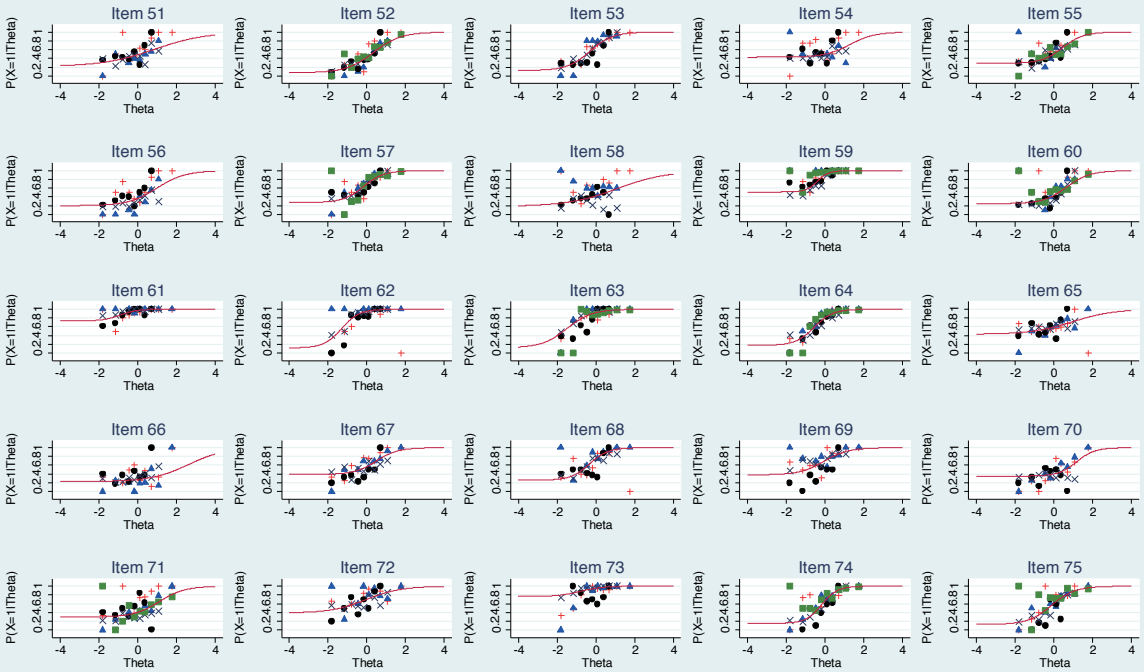
ET Oromifa PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

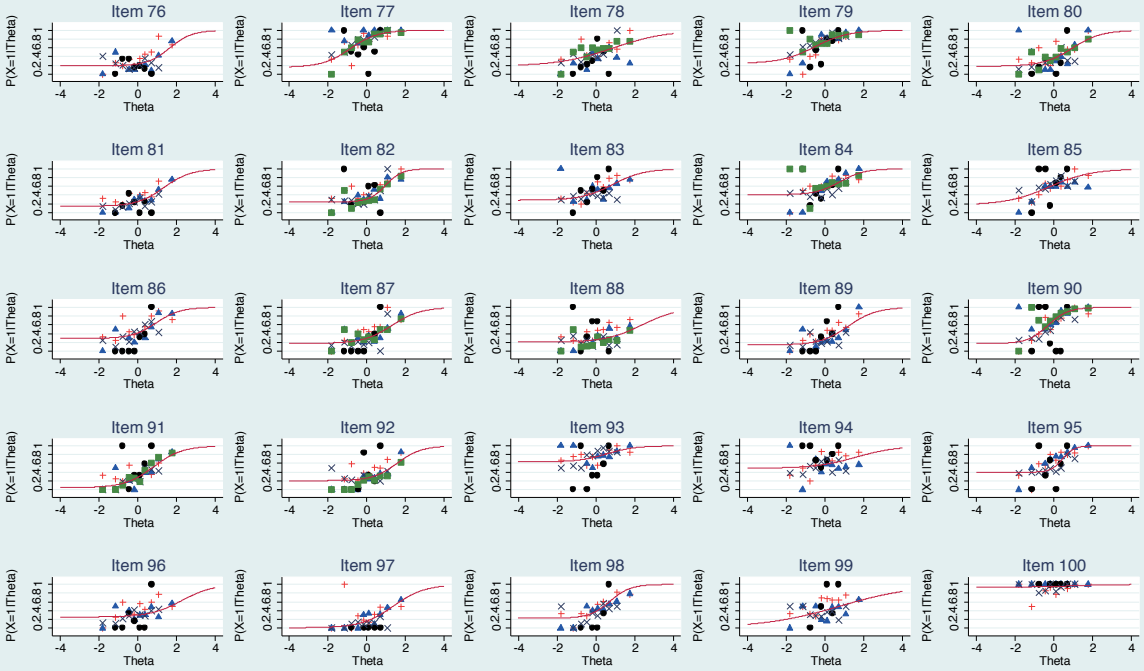
ET Oromifa PPVT



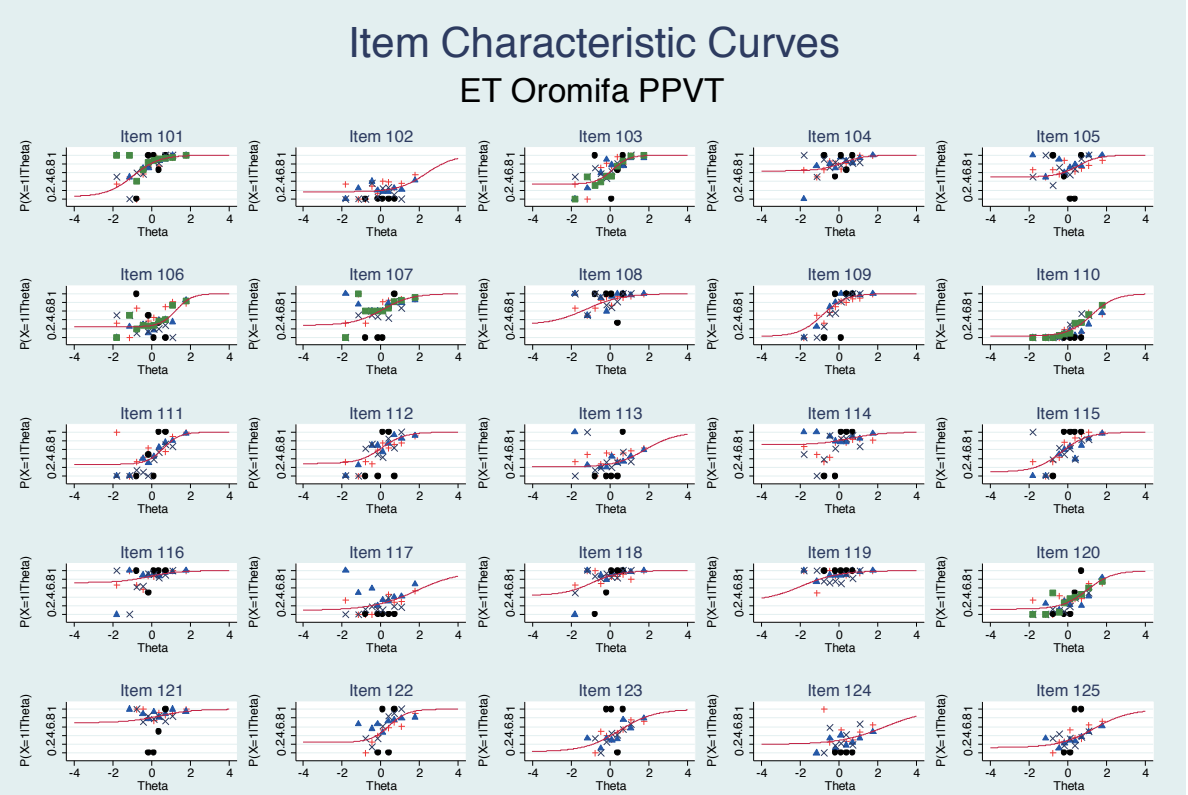
Combining OC and YC from R2 to R4

Item Characteristic Curves

ET Oromifa PPVT



Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Oromifa PPVT
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Item 102
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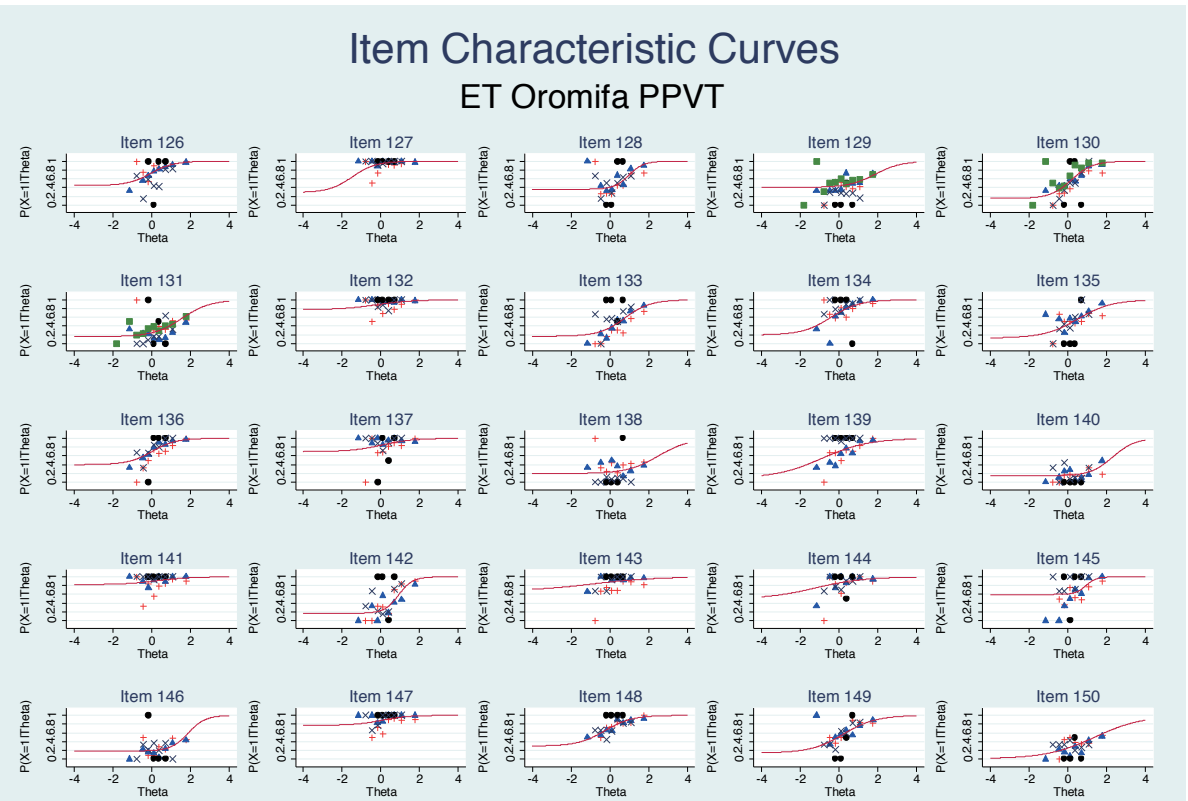
Item 125
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Oromifa PPVT
Item 126
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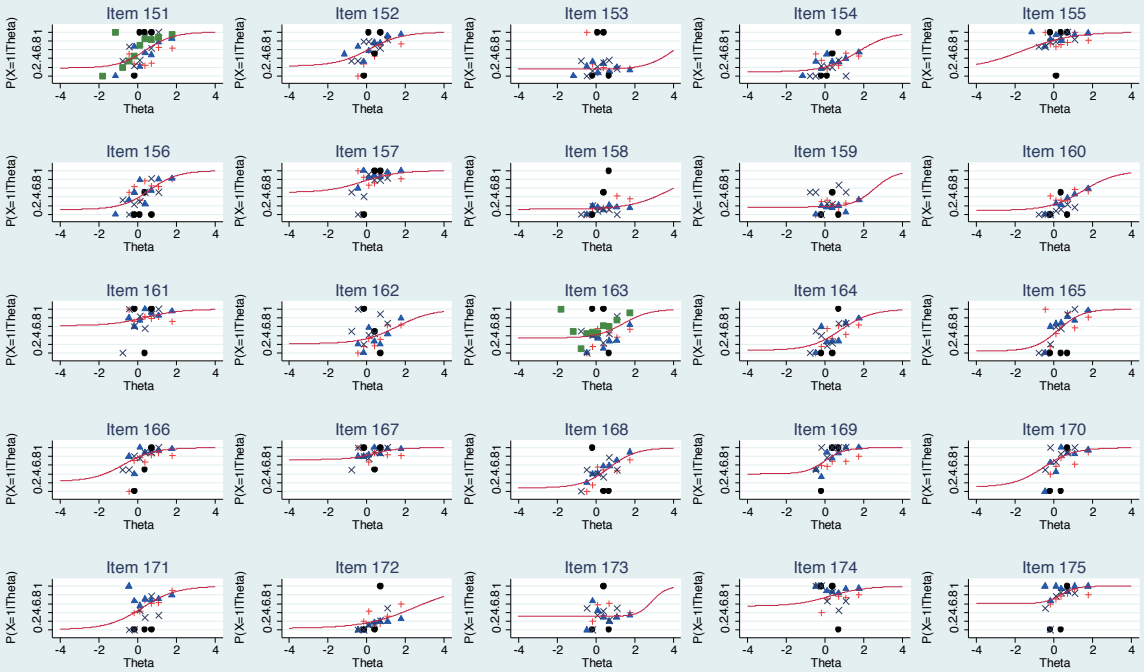
Item 150
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4

Item Characteristic Curves

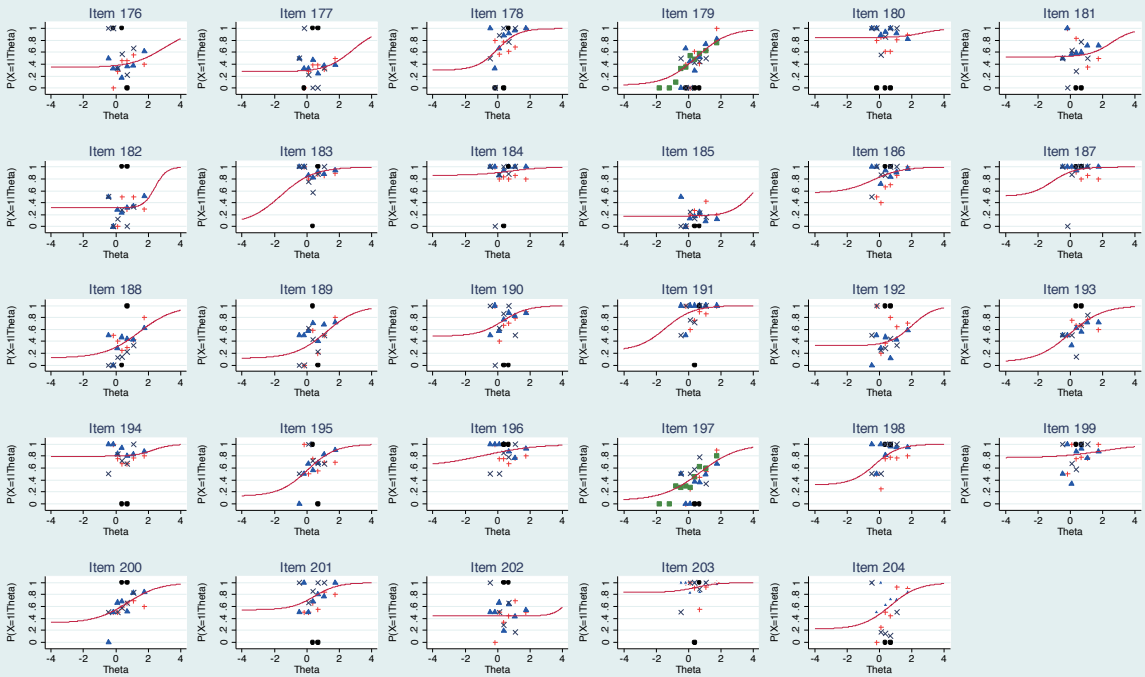
ET Oromifa PPVT



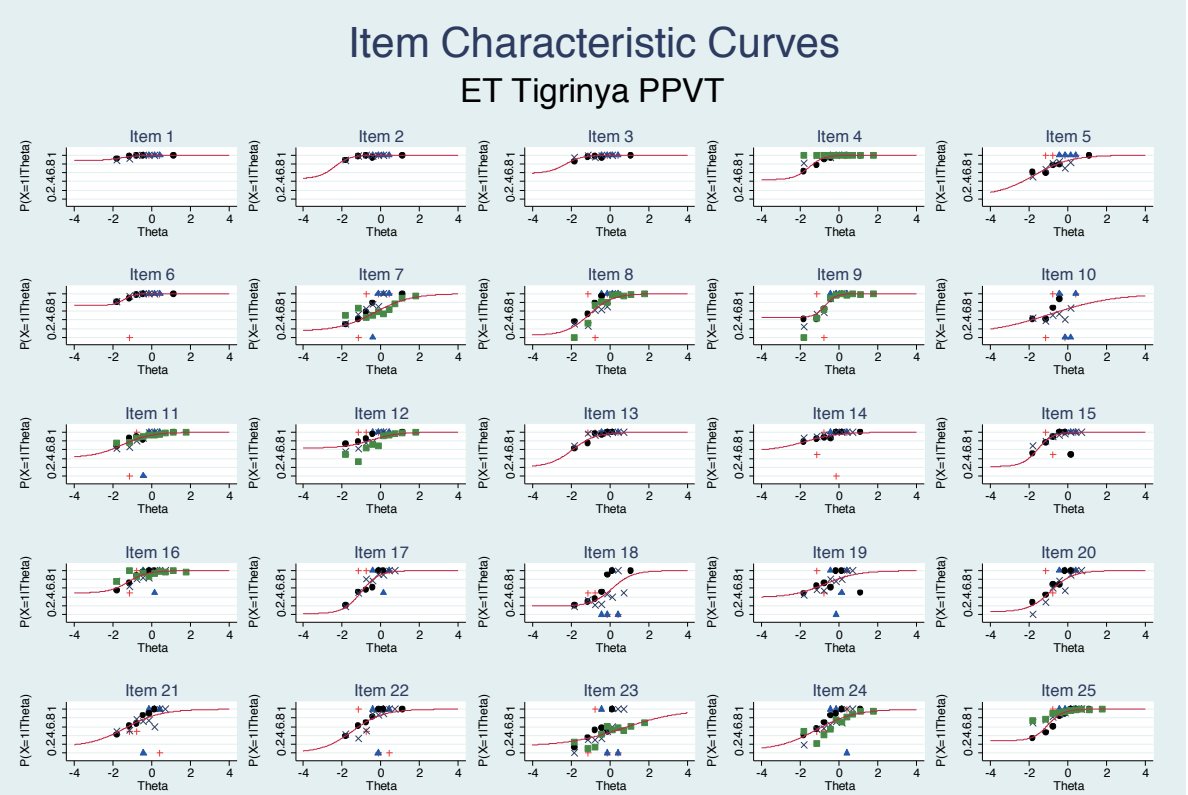
Combining OC and YC from R2 to R4

Item Characteristic Curves

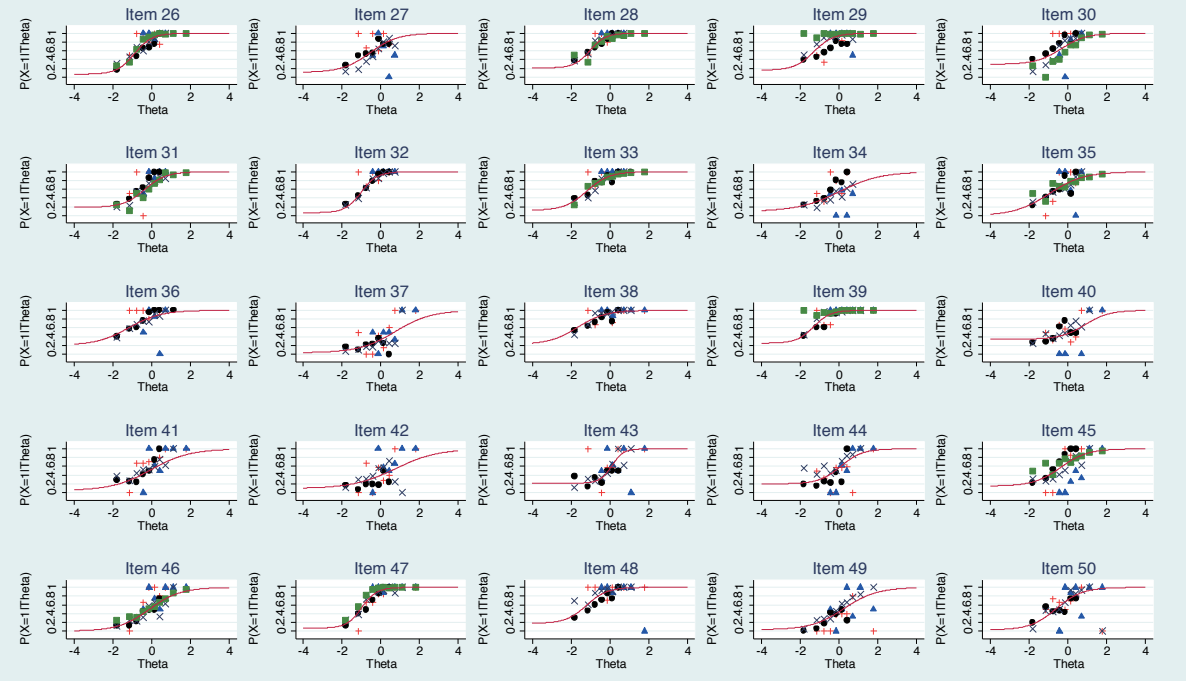
ET Oromifa PPVT



Combining OC and YC from R2 to R4



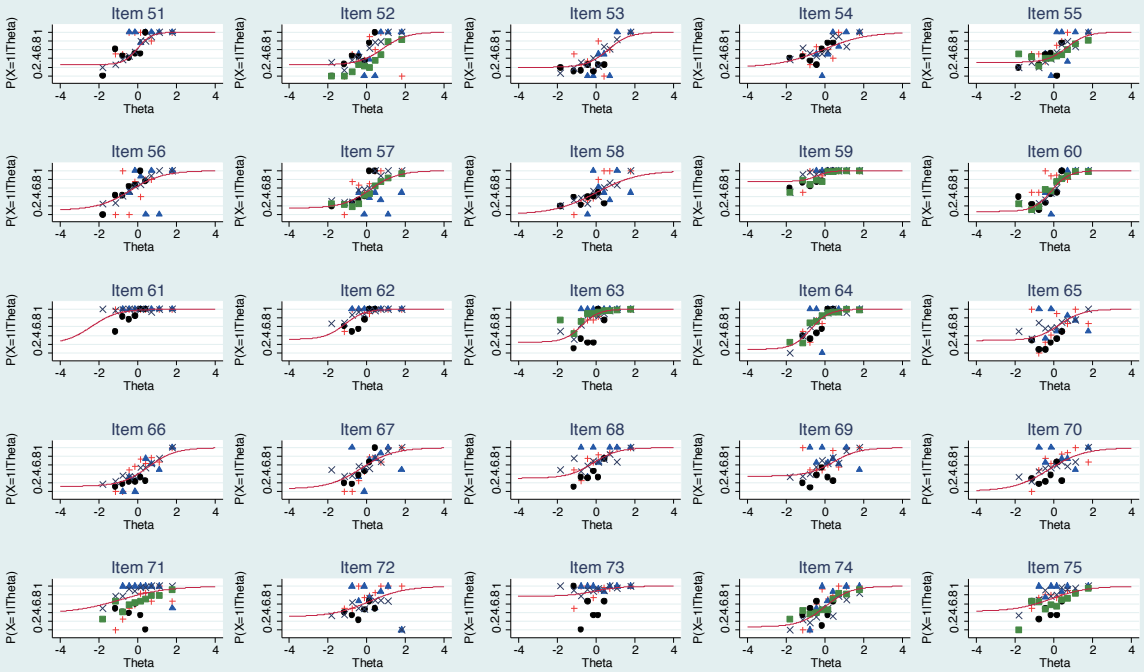
Combining OC and YC from R2 to R4



Combining OC and YC from R2 to R4

Item Characteristic Curves

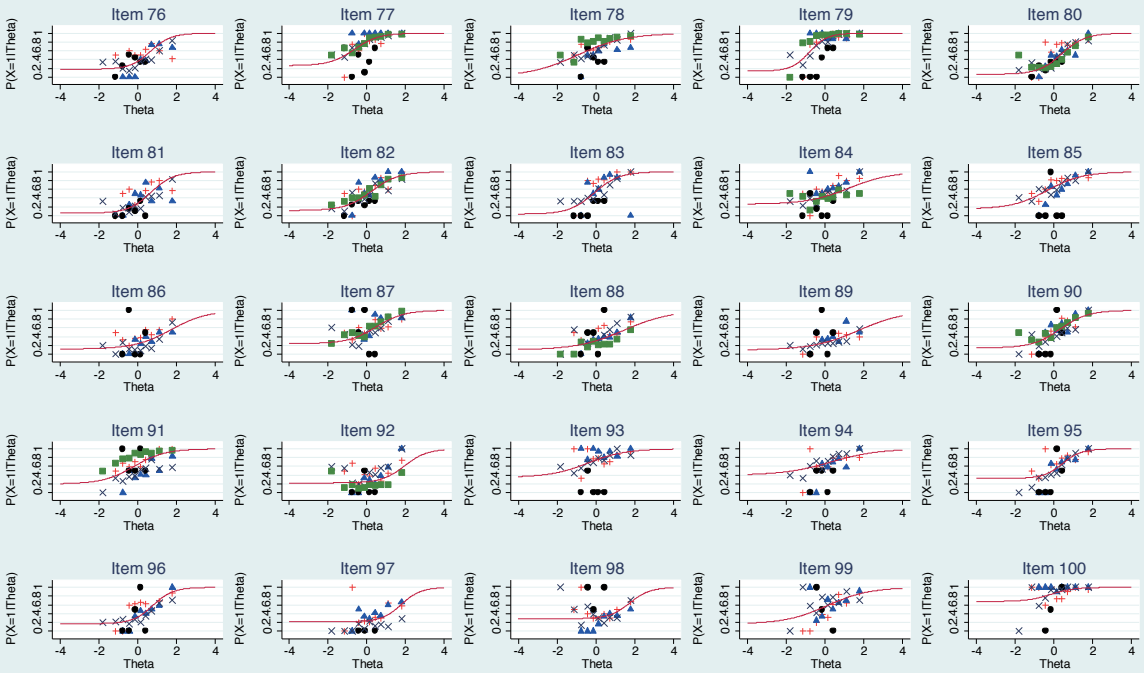
ET Tigrinya PPVT



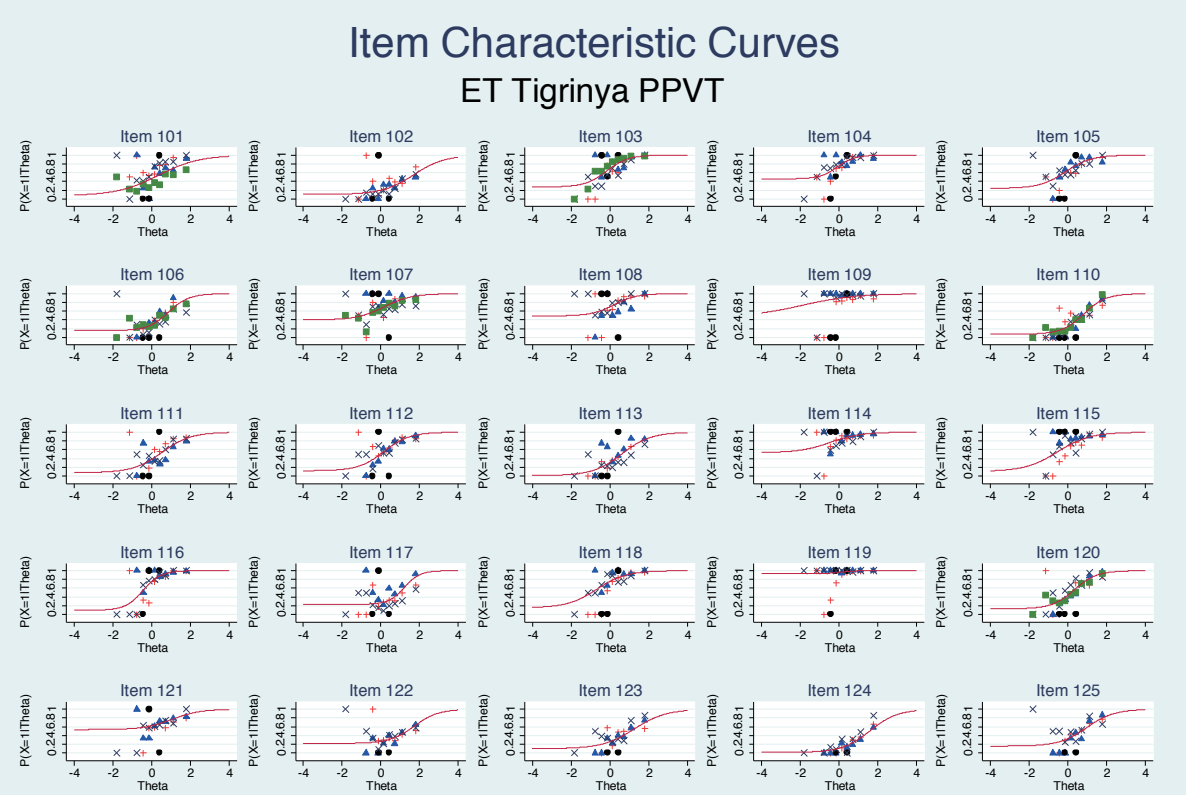
Combining OC and YC from R2 to R4

Item Characteristic Curves

ET Tigrinya PPVT



Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Tigrinya PPVT
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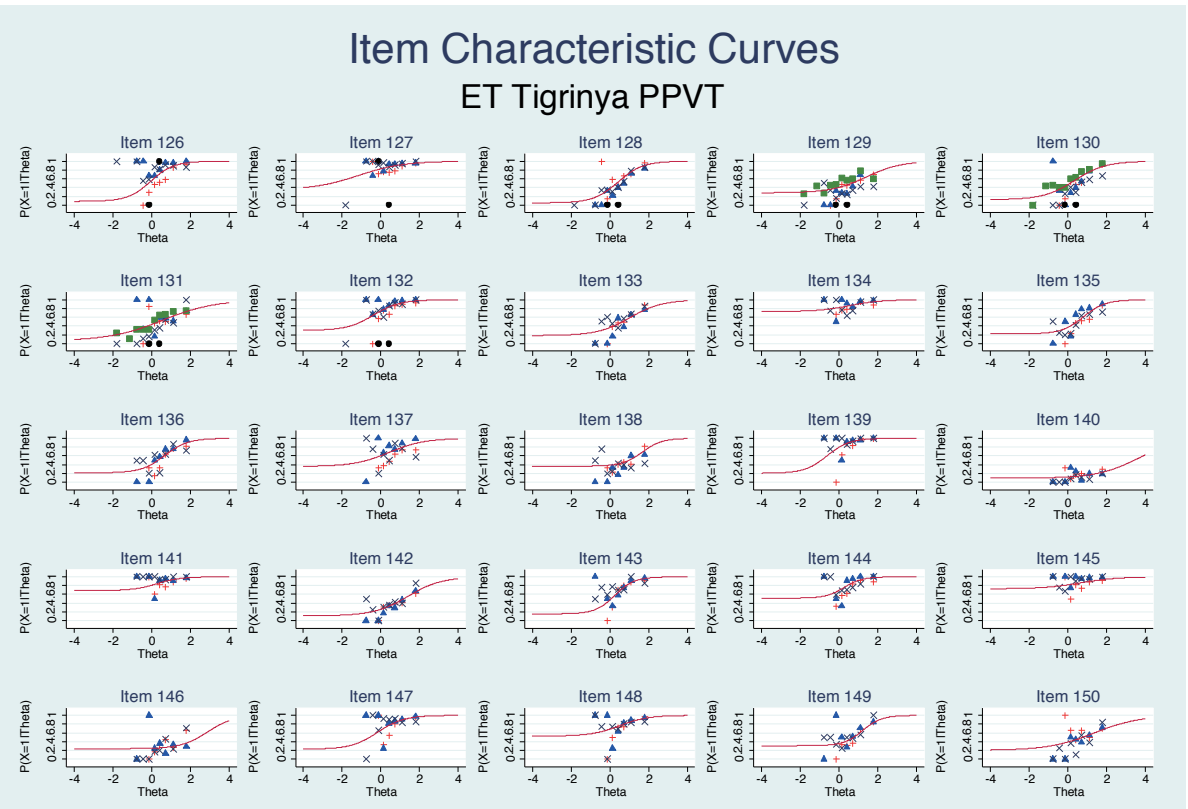
Item 125
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4


Item Characteristic Curves
ET Tigrinya PPVT
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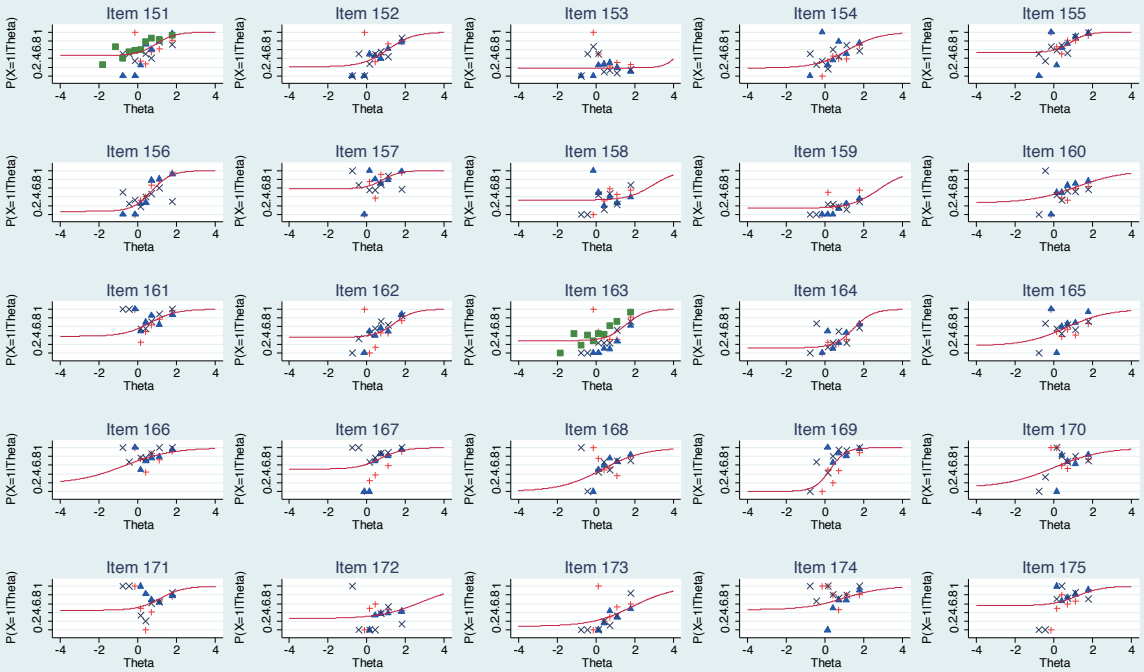
P(X=1|Theta)
Theta
Combining OC and YC from R2 to R4

Item Characteristic Curves

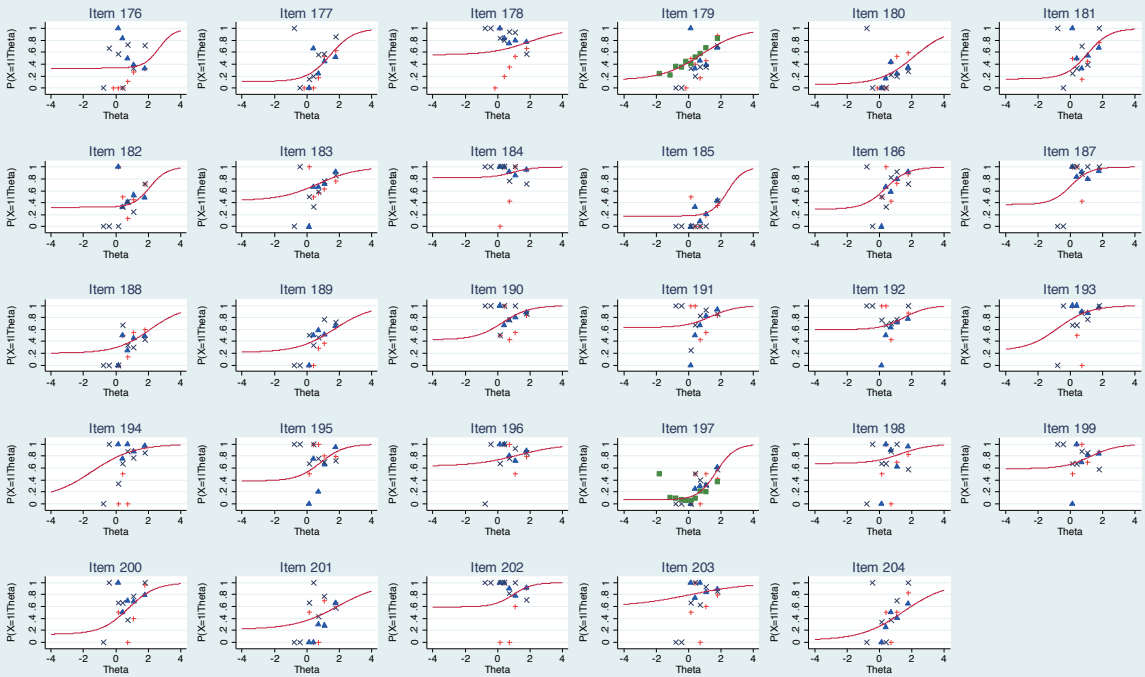
ET Tigrinya PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

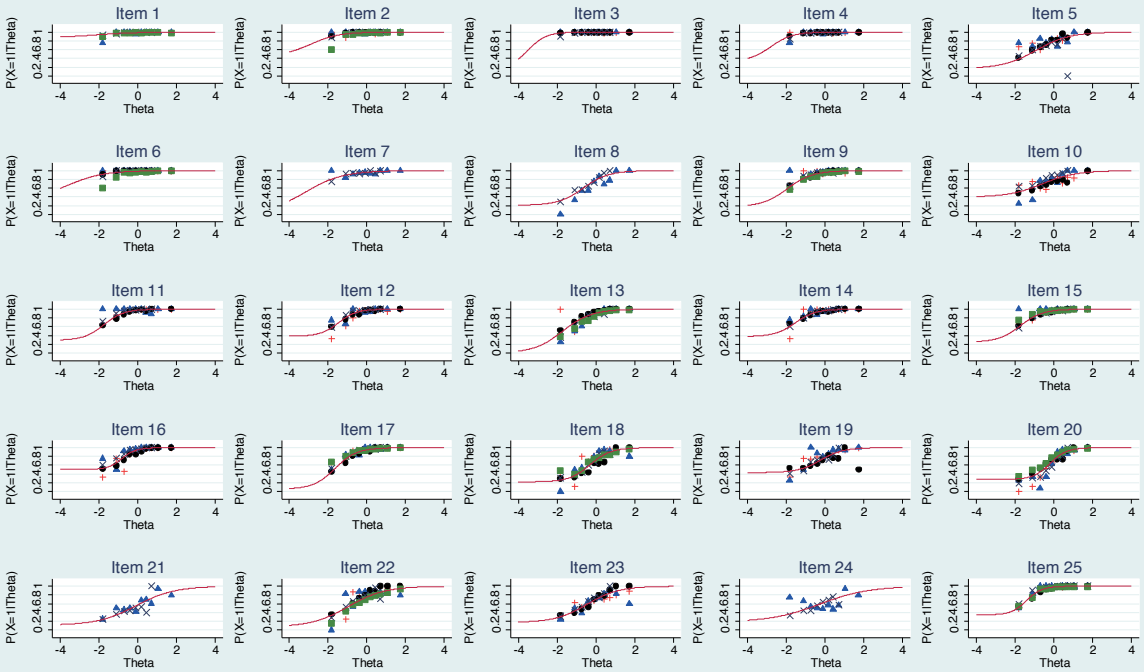
ET Tigrinya PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

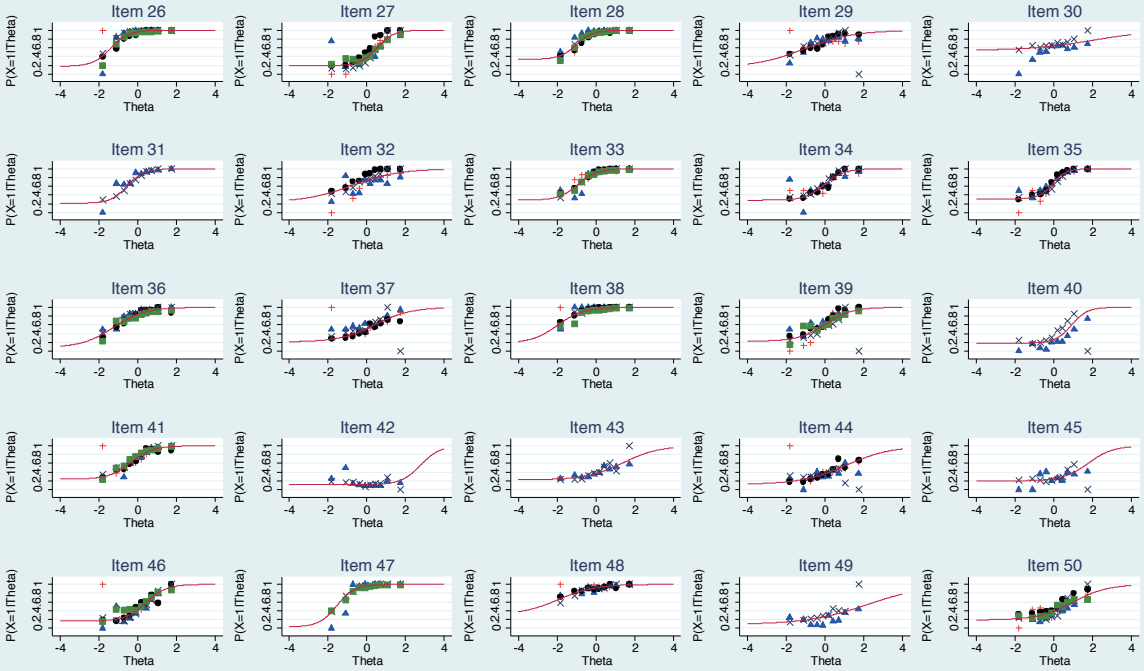
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

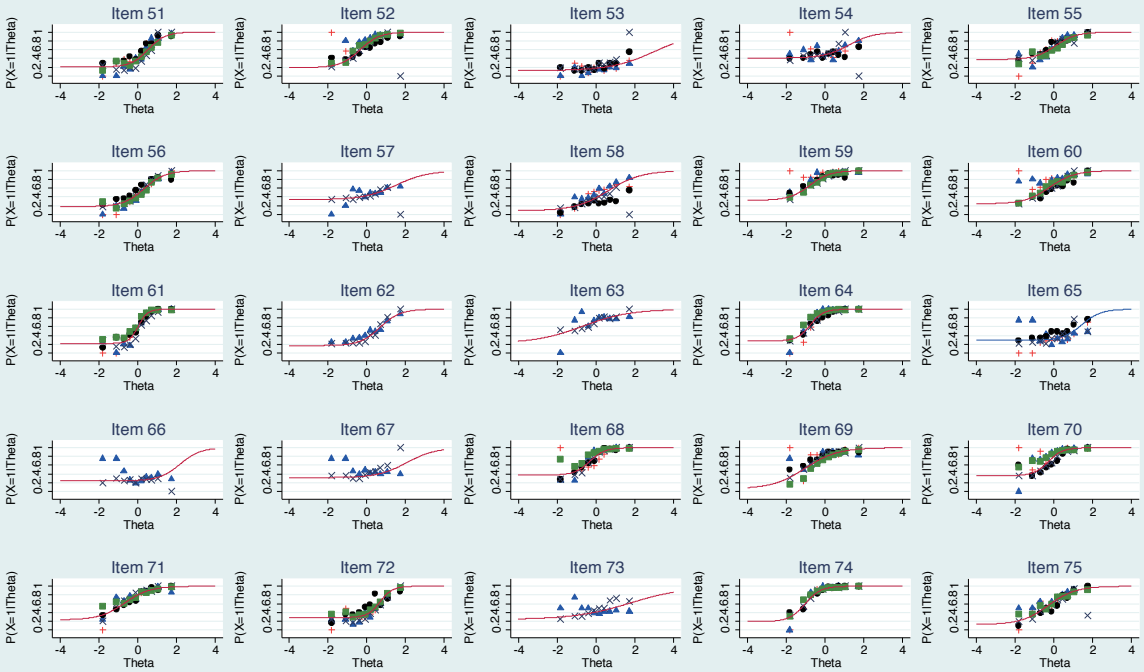
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

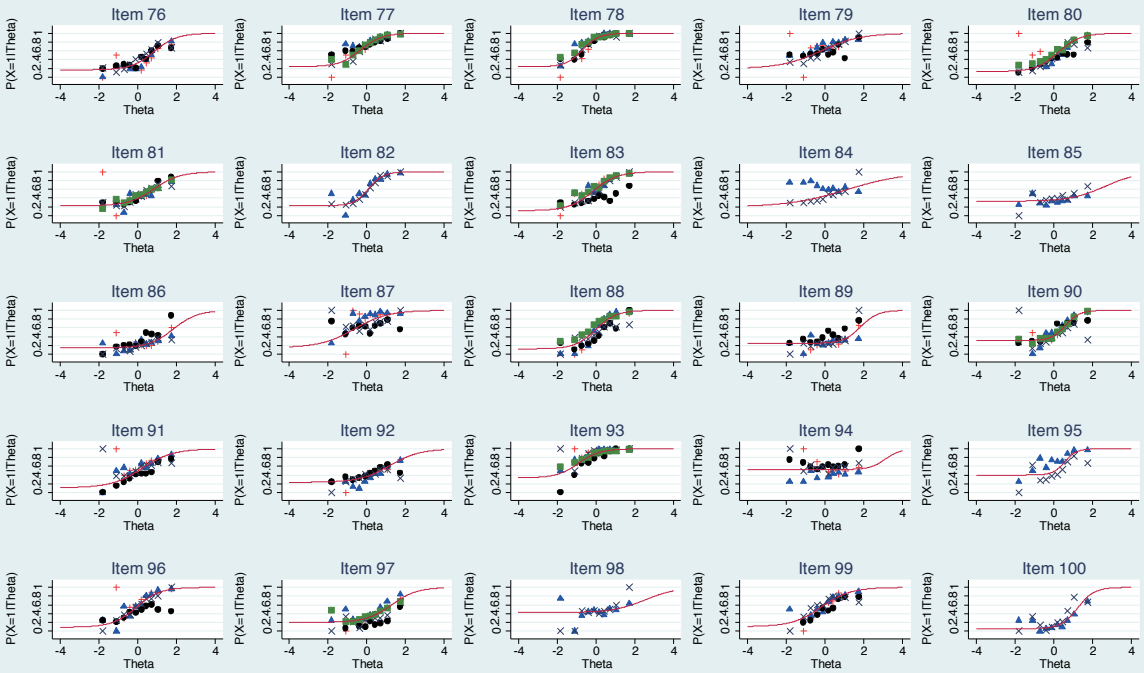
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

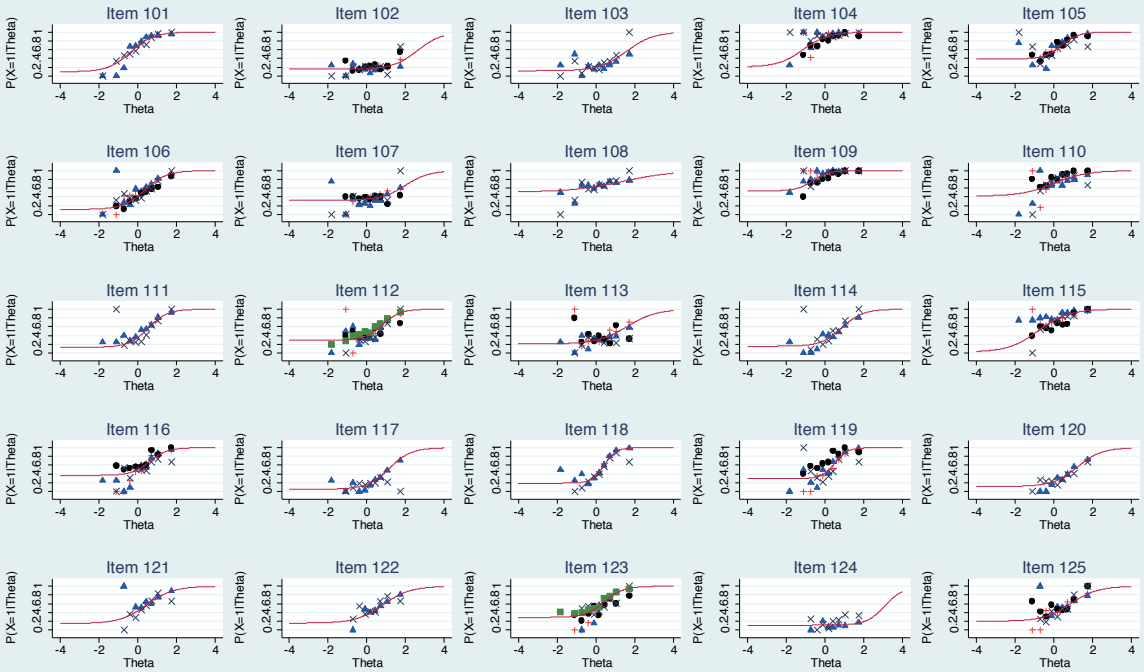
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

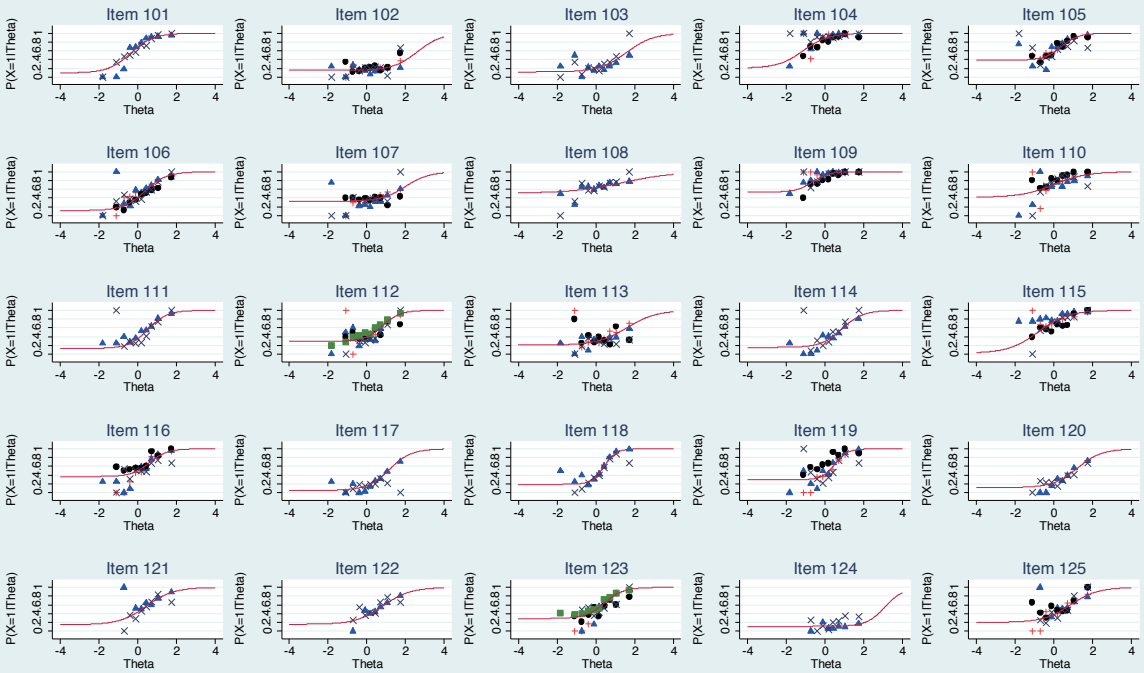
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

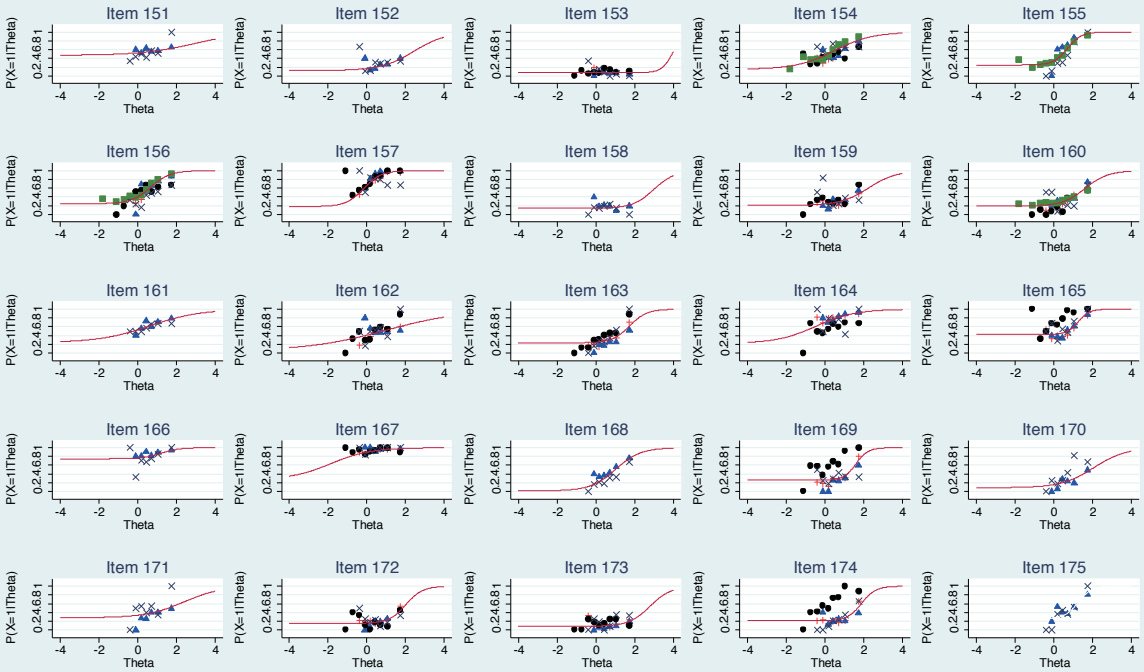
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

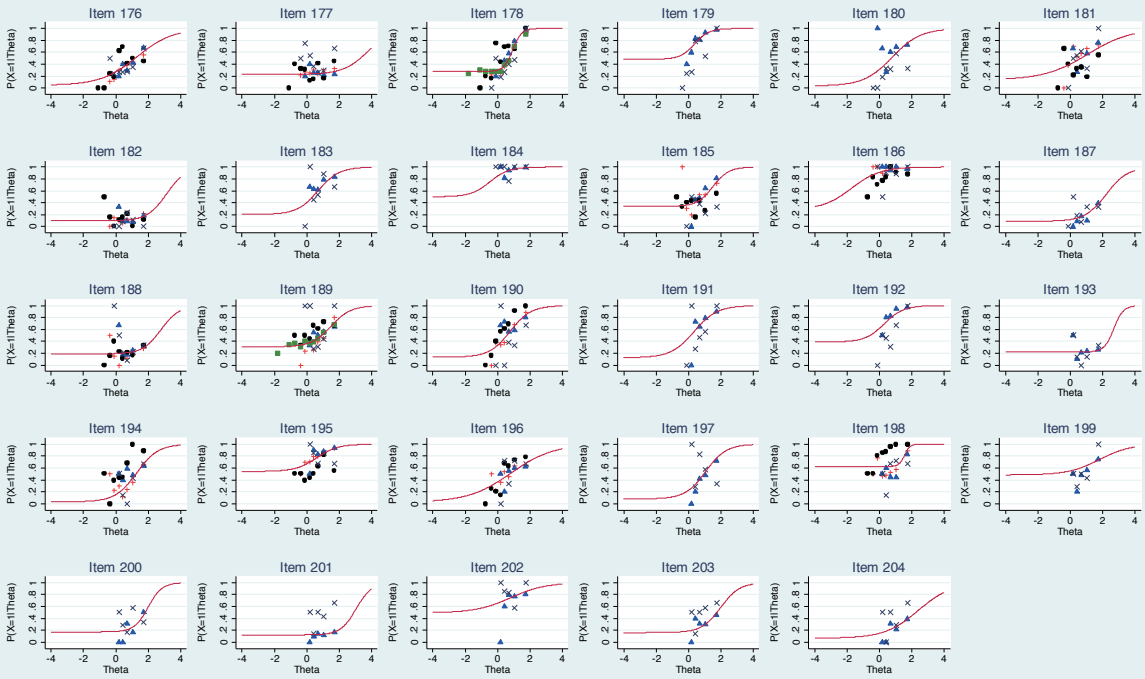
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

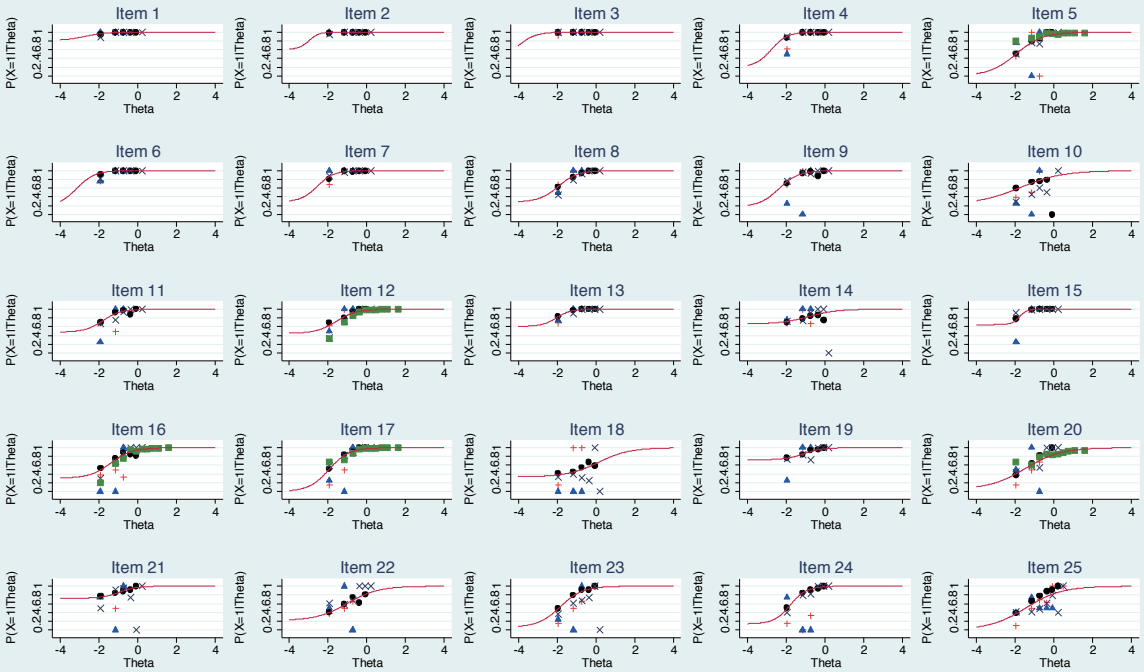
India PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

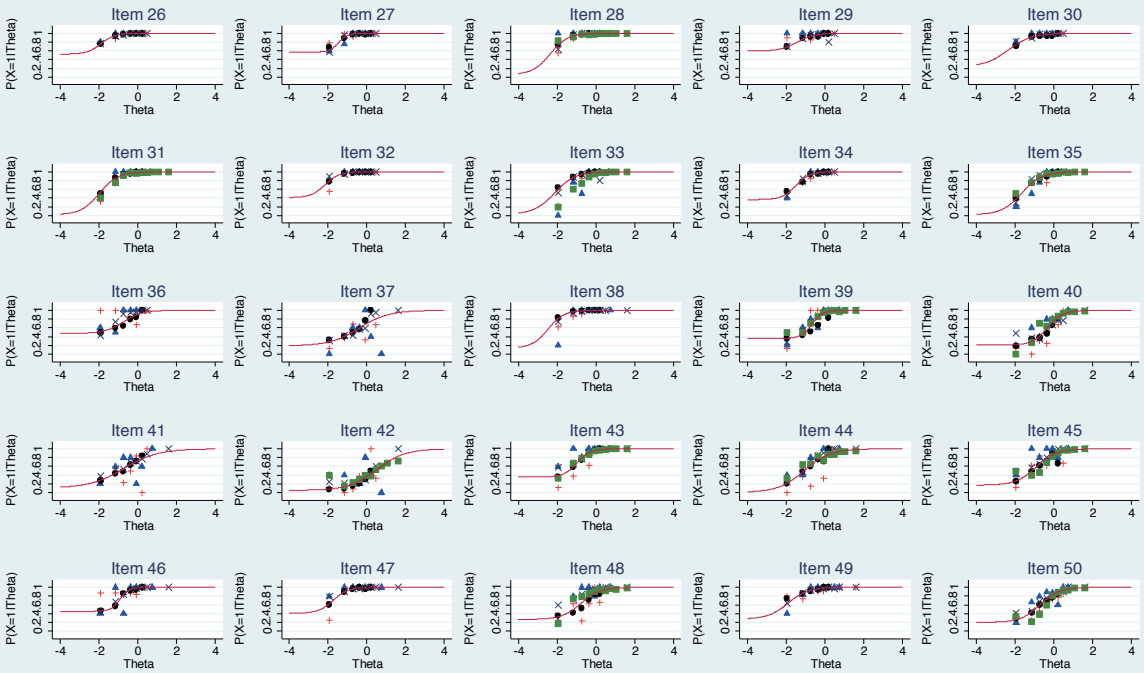
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

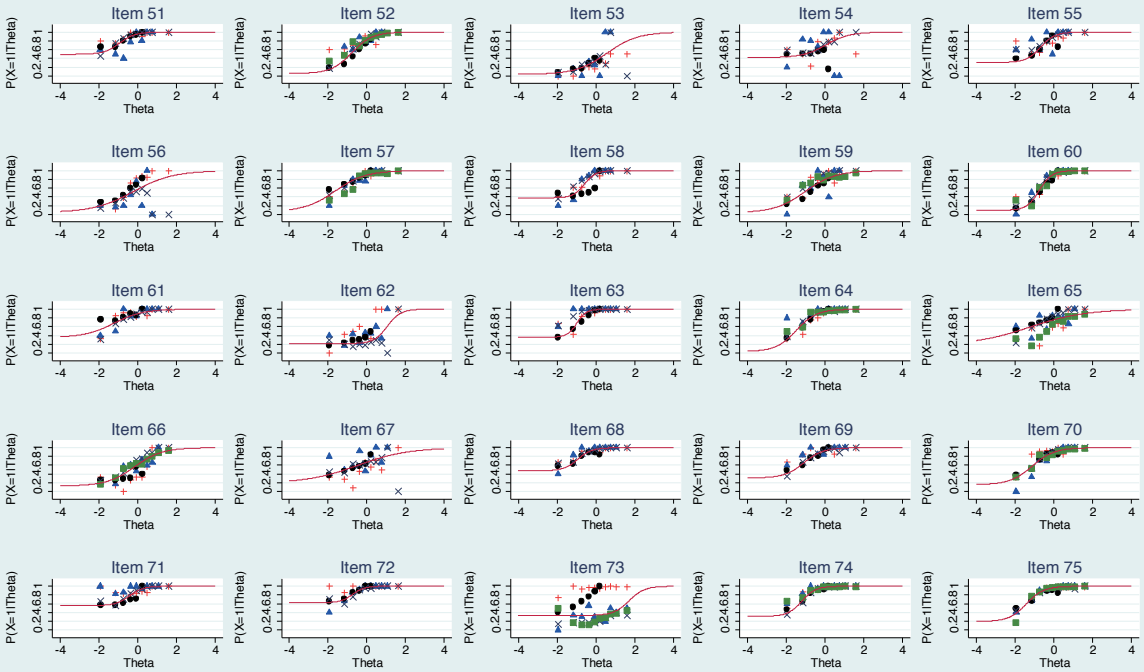
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

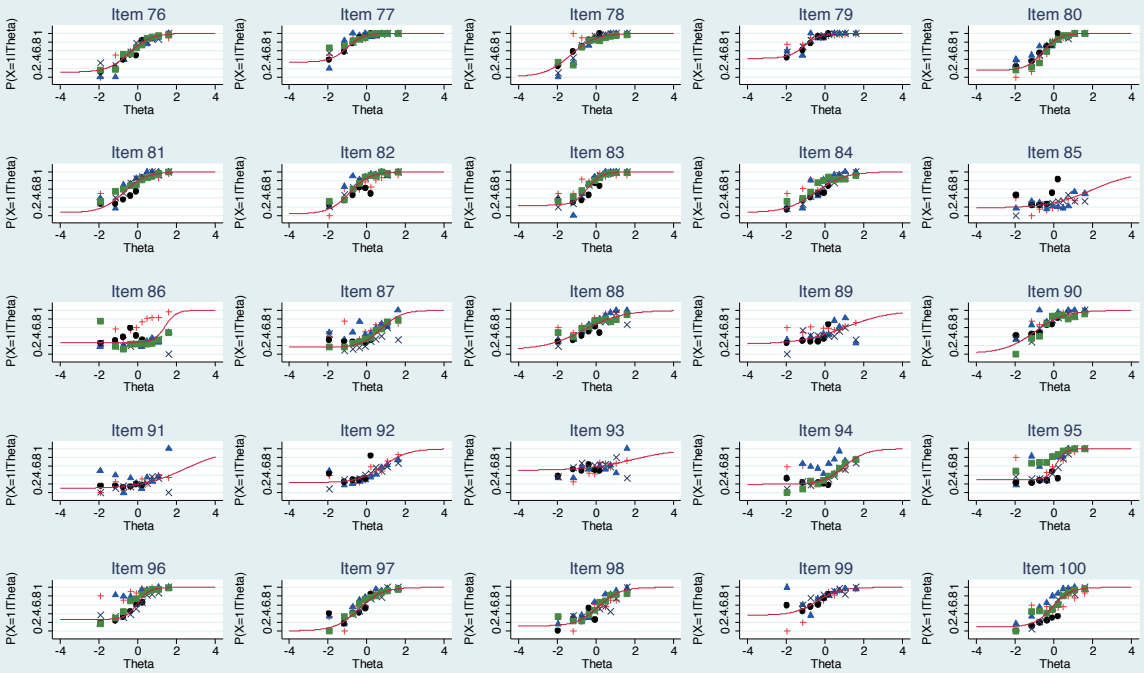
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

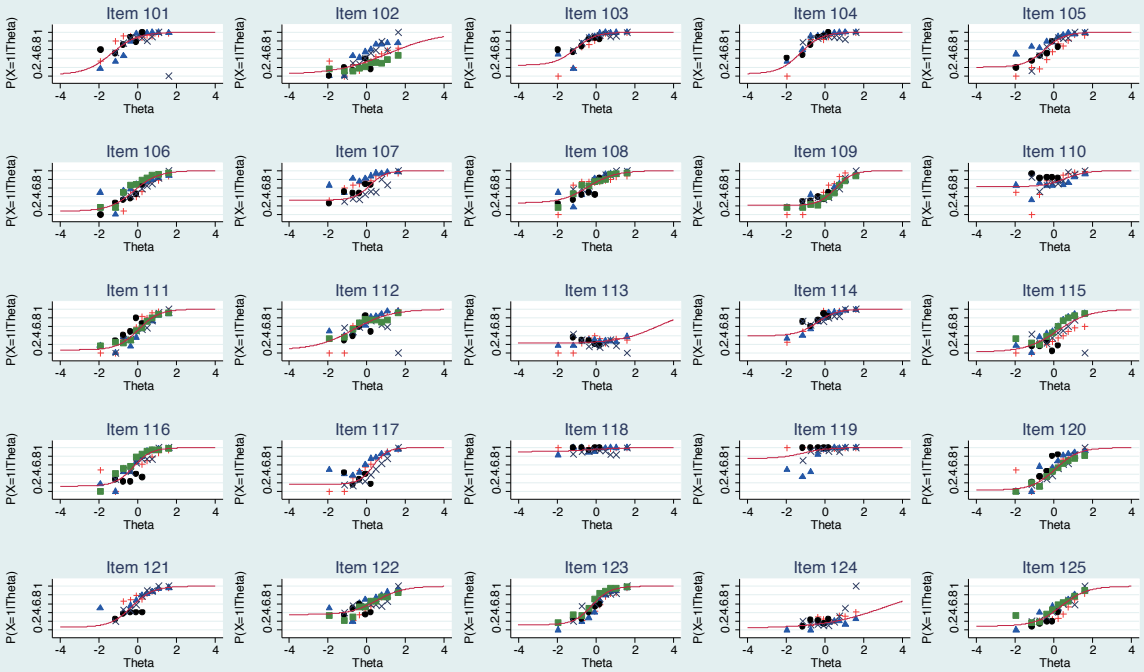
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

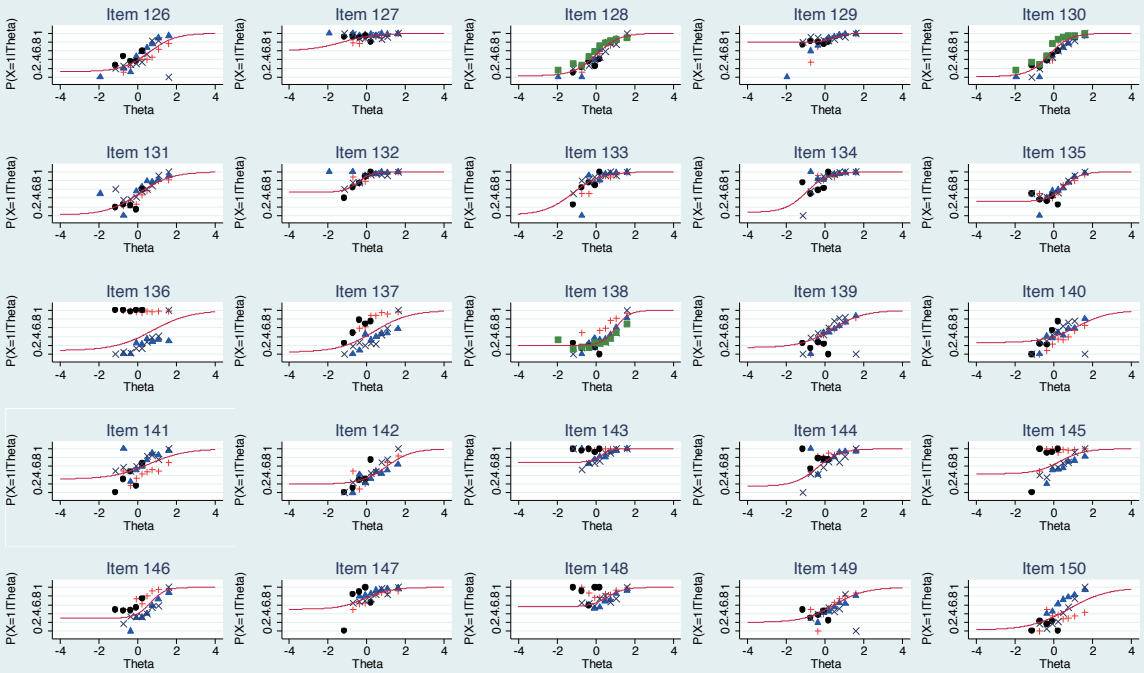
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

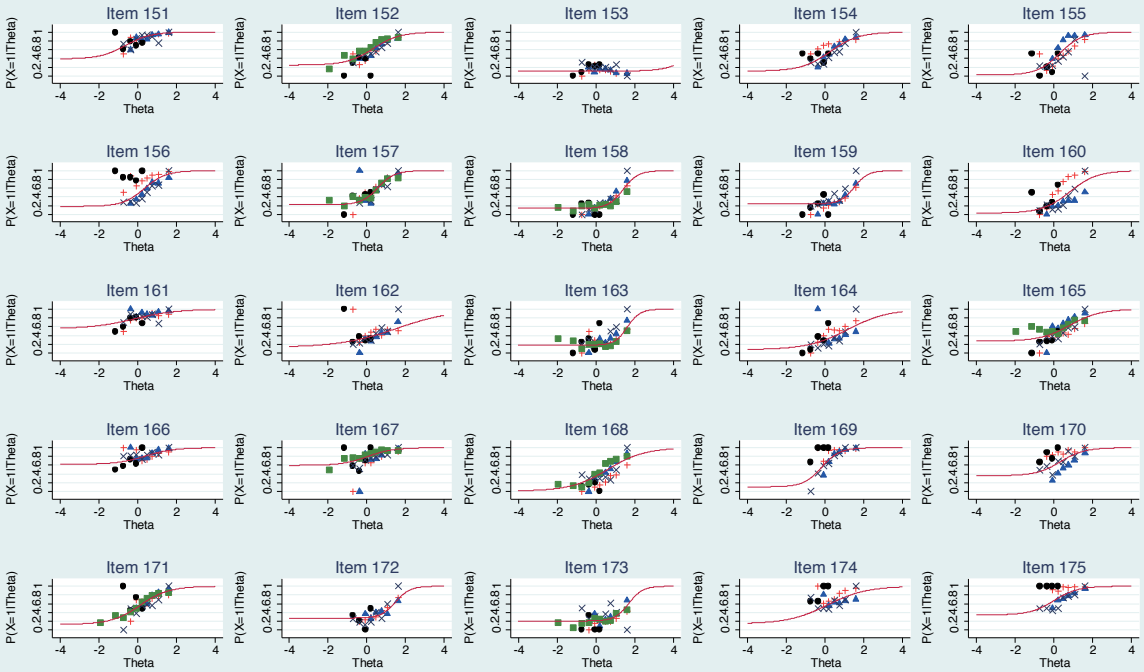
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

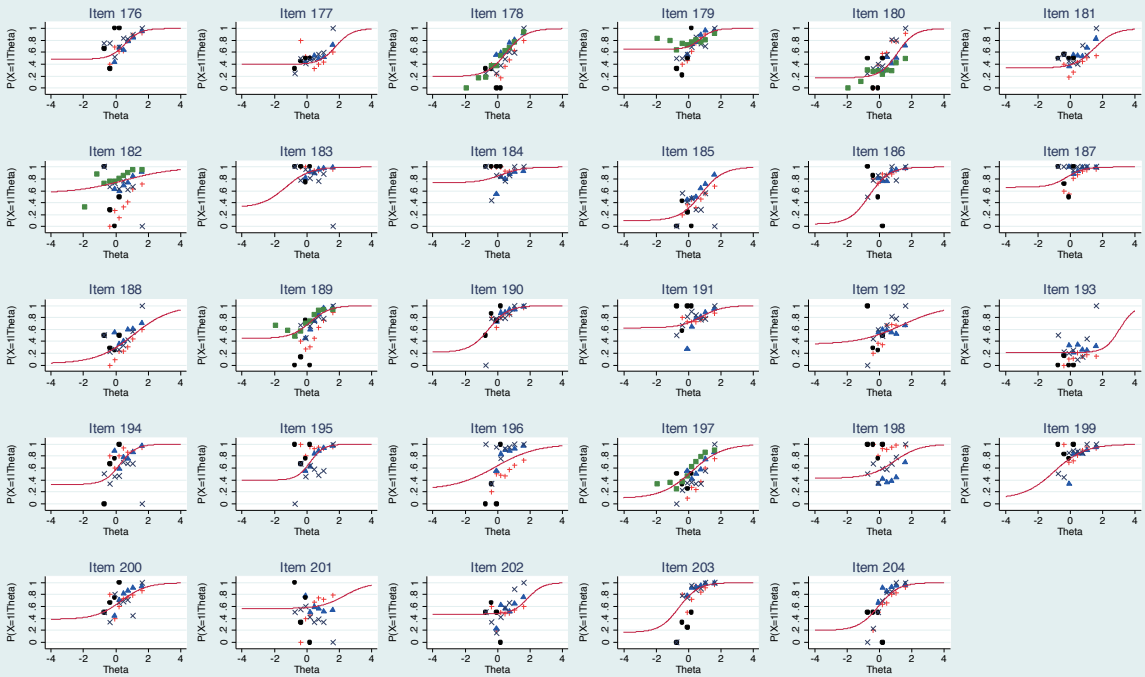
Vietnam PPVT



Combining OC and YC from R2 to R4

Item Characteristic Curves

Vietnam PPVT



Combining OC and YC from R2 to R4

Appendix D. Item analysis performed by country and main languages

Table 1. *Item fit and DIF analysis for Amharic*

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Deleted
			OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
1			26	40	677	287	0						
2			26	40	677	287	0						
3			26	40	677	287	0						
4	X		26	40	677	287	919						
5			26	40	677	287	0	x	o				
6			26	40	677	287	0						
7	X		26	40	677	287	919				o	o	
8	X		26	40	676	287	919						
9	X		26	40	677	287	919						
10		x	26	40	676	284	0	x	x	x	x		D
11	X		26	40	677	287	919						
12	X		26	40	675	287	919						
13			45	43	812	356	0						
14			45	43	811	356	0						
15			45	43	811	356	0						
16	X		45	43	811	356	919		o				
17			45	43	812	356	0						
18			45	43	812	356	0	x	x				
19			45	43	812	356	0		x				
20			45	43	811	356	0		o	x			
21			45	43	812	356	0		x				
22		x	45	43	808	356	0	x	x	x	x		D
23	X		45	43	812	356	919						
24	X		45	43	810	356	919						
25	X		93	91	854	513	919						
26	X		93	91	852	513	919						
27			93	91	854	512	0	x	o	o	o		
28	X		93	91	855	513	919						
29	X		93	91	850	513	919						
30	X		93	91	852	513	919		o				
31	X		93	91	855	513	919						
32			93	91	854	513	0						
33	X		93	91	853	513	919						
34			91	91	851	513	0						
35	X		93	91	854	513	919						
36			93	91	855	513	0	x					
37			110	101	630	573	0						
38			112	101	631	573	0						
39	X		111	101	630	573	919						
40			112	101	627	573	0						
41			112	101	631	573	0		o				
42		x	111	101	628	569	0	x	x	x	x		D
43			109	100	625	567	0	x					
44			111	101	630	573	0		x				
45	X		112	101	631	573	919						
46	X		112	101	631	572	919						
47	X		112	101	631	573	919						
48			111	101	631	573	0						
49			128	117	385	649	0			x			
50			130	117	388	653	0		x				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Deleted
			OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
51		x	130	117	387	650	0	x	x	x	x		D
52	X		130	117	388	653	919						
53			129	117	388	653	0		x				
54			127	117	387	652	0						
55	X		130	117	388	653	919						
56			129	117	388	653	0						
57	X		130	117	387	653	919						
58			129	117	387	653	0	x					
59	X		130	117	388	653	919						
60	X		130	117	388	653	919						
61		x	206	154	214	647	0						D
62			206	154	215	647	0						
63	X		206	154	215	646	919						
64	X		206	154	214	647	919						
65		x	205	154	212	646	0	x	x	x	x		D
66			204	154	214	646	0						
67			206	154	215	647	0						
68			203	154	214	645	0						
69		x	206	154	214	647	0	x	x	x	x		D
70			205	154	214	644	0						
71	X		206	154	215	647	919	x					
72			205	154	213	645	0						
73		x	283	198	172	756	0						D
74	X		283	198	172	756	919						
75	X		283	198	172	756	919						
76			282	198	171	755	0	x					
77	X		283	198	171	756	919						
78	X		282	198	172	756	919			x			
79	X		282	198	172	756	919						
80	X		282	198	172	755	919						
81			278	198	171	752	0						
82	X		283	198	172	753	919		x	x			
83			281	198	171	754	0						
84	X		283	198	172	756	919						
85			374	238	126	601	0						
86			374	238	125	599	0	1	2	1	2		
87	X		368	238	125	601	919					x	
88	X		374	238	126	601	919						
89			371	238	125	601	0						
90	X		374	238	126	601	919						
91	X		371	238	122	601	919			x			
92	X		374	238	126	601	919						
93			374	238	126	601	0						
94			372	238	125	601	0						
95			372	238	126	600	0						
96			374	238	125	601	0			x			
97			384	311	82	444	0			x			
98			385	311	82	444	0		x				
99			383	311	82	444	0						
100			385	311	82	444	0						
101	X		384	311	82	444	919						
102		x	384	311	80	443	0						D
103	X		384	311	82	444	919						
104			385	311	82	444	0						

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Deleted
			OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
105			382	311	82	444	0			o			
106	X		384	311	82	444	919						
107	X		384	311	82	444	919						
108			382	311	81	444	0						
109			438	461	40	396	0		o				
110	X		440	461	40	396	919			o			
111			439	461	40	396	0						
112		x	440	461	40	396	0	x	x	x	x		D
113			439	461	40	396	0	x					
114			440	461	40	396	0						
115			440	461	40	396	0			x			
116			440	461	40	396	0		x				
117			434	461	40	396	0						
118			440	461	40	396	0						
119		x	440	461	40	396	0	x	x	x	x		D
120	X		433	461	40	395	919						
121			393	458	35	376	0						
122			392	458	35	376	0						
123			392	458	35	375	0						
124			389	456	34	376	0						
125			392	458	35	376	0						
126			392	458	35	376	0			x			
127		x	391	458	35	376	0						D
128			393	458	35	376	0						
129	X		390	458	35	376	919						
130	X		392	458	35	376	919					x	
131	X		391	458	35	375	918			x			
132			390	458	35	375	0						
133			323	416	27	336	0						
134			324	416	28	336	0						
135			324	416	28	336	0						
136			323	416	28	336	0	o					
137			323	416	28	336	0			x			
138			324	415	28	336	0		x				
139		x	324	416	28	336	0	x	x	x	x		D
140			324	416	28	336	0						
141			324	416	28	336	0			x			
142			324	416	28	336	0			x			
143		x	324	416	28	336	0	x	x	x	x		D
144		x	323	416	27	335	0						D
145		x	290	396	24	312	0	x	x	x	x		D
146			290	396	24	311	0						
147			290	396	24	312	0		x				
148		x	289	396	24	312	0	x	x	x	x		D
149		x	289	396	24	312	0						D
150			288	396	24	309	0	o		o			
151	X		289	396	24	312	919						
152			288	396	24	312	0		x				
153		x	288	396	24	312	0	x	x	x	x		D
154			286	396	24	312	0			x			
155		x	290	396	24	312	0	x	x	x	x		D
156		x	290	396	24	312	0						D
157			267	369	21	284	0		x				
158			268	369	21	284	0		x				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Deleted
			OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
159			268	369	21	284	0			o			
160		x	268	369	21	284	0	x	x	x	x		D
161		x	268	369	21	284	0	x	x	x	x		D
162			268	369	21	284	0						
163	X		268	369	21	284	919			x			
164			268	369	21	284	0			x			
165			268	369	21	284	0			x			
166		x	268	369	21	284	0	x	x	x	x		D
167		x	267	369	21	284	0	x	x	x	x		D
168			265	369	21	282	0			x			
169		x	226	357	14	270	0	x	x	x	x		D
170			226	357	14	270	0			x			
171			226	357	14	270	0			x			
172			226	357	14	270	0		x				
173			225	357	14	268	0			x			
174			226	357	14	270	0						
175		x	226	357	14	270	0	x	x	x	x		D
176			226	357	14	270	0			x			
177			226	357	14	270	0			x			
178			225	357	14	270	0			x			
179	X		224	357	14	270	919						
180			226	357	14	270	0			x			
181			205	345	14	259	0			x			
182			205	345	14	259	0	x		x			
183			205	345	14	259	0			x			
184			205	345	14	259	0	x		x			
185		x	190	345	13	259	0	x	x	x	x		D
186			205	345	14	259	0			x	x		
187		x	205	345	14	259	0	x	x	x	x		D
188			202	345	13	258	0		x				
189			205	345	14	259	0			x			
190			205	345	14	259	0			x			
191			205	345	14	259	0		x	x			
192			200	344	14	259	0			x			
193			193	342	14	249	0			x			
194		x	192	342	14	249	0	x	x	x	x		D
195			193	342	14	249	0			x			
196			193	342	14	249	0			x			
197	X		193	342	14	249	919					o	
198			193	342	14	249	0			x			
199			193	342	14	249	0			x			
200			192	342	14	249	0			x			
201			193	342	14	248	0			x			
202		x	193	342	14	249	0	x	x	x	x		D
203		x	192	342	14	249	0	x	x	x	x		D
204			193	342	14	248	0			x			

Table 2. Item fit and DIF analysis for Tigrigna

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
1			5	4	302	150	0						
2			5	4	302	150	0						
3			5	4	303	150	0						
4	X		5	4	302	150	378						
5			5	4	302	150	0						
6			5	4	302	150	0						
7	X		5	4	302	150	378	x	x	x	x	x	**D**
8	X		5	4	301	150	378						
9	X		5	4	301	150	378						
10			5	4	301	150	0	x	x	x	x		**D**
11	X		5	4	302	150	378						
12	X		5	4	302	150	378					o	
13			6	5	347	180	0						
14			6	5	349	180	0	x					
15			6	5	346	180	0						
16	X		6	5	347	180	378						
17			6	5	347	180	0	x					
18			6	5	347	180	0	x	x				
19			6	5	349	180	0	x	x				
20			6	5	346	180	0	x					
21			6	5	346	180	0	x					
22		x	6	5	348	180	0	x					
23	X		6	5	346	180	378	x	x	x	x	x	**D**
24	X		6	5	348	179	378	x	x				
25	X		23	13	343	238	378						
26	X		23	13	342	237	378	x					
27		x	23	13	342	238	0	x	x				
28	X		23	13	342	238	378						
29	X		23	13	342	238	378					o	
30	X		23	13	341	238	378	x			1	1	
31	X		23	13	342	238	378	x					
32			23	13	342	238	0						
33	X		23	13	343	238	378						
34			23	13	342	238	0	x	x	x	x		**D**
35	X		23	13	342	238	378		x				
36			23	13	343	238	0	x					
37			29	18	226	264	0						
38			29	18	226	264	0						
39	X		29	18	226	264	378	x					
40			29	18	226	264	0	x	o	o			
41			29	18	227	264	0		x				
42			29	17	226	255	0						
43			29	18	227	263	0	x					
44			28	18	226	264	0						
45	X		29	18	226	263	378		o				
46	X		28	18	226	264	378		x				
47	X		29	18	226	264	378	o					
48			29	18	225	264	0	x					
49			38	19	117	296	0	x					
50		x	38	19	117	296	0	x					
51			37	19	117	294	0	x	x				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
52	X		38	19	117	296	378	x				o	
53			38	19	117	296	0	x					
54		x	38	19	117	296	0	x	x	x	x		D
55	X		38	19	117	296	378		x				
56			38	19	117	296	0						
57	X		38	19	117	296	378		o				
58			38	19	117	296	0						
59	X		38	19	117	296	378						
60	X		38	19	117	296	378						
61		x	70	35	55	311	0						D
62			70	35	55	311	0	x	x	x	x		D
63	X		70	35	55	311	378	x		o			
64	X		70	35	55	309	378		x				
65			70	34	55	309	0	x	x	x	x		D
66			70	35	55	311	0						
67			69	34	55	306	0		x				
68			70	34	55	310	0		1	1			
69			70	35	55	311	0	x	x	x	x		D
70			69	35	55	309	0		x				
71	X		70	35	55	311	378		x				
72		x	70	35	55	311	0		x				
73		x	118	56	28	333	0	x	x	x	x		D
74	X		118	56	28	331	378						
75	X		118	56	28	333	378		x	x			
76			118	56	28	333	0	x					
77	X		118	56	28	333	378	x	x	x	x	x	D
78	X		118	56	28	333	378						
79	X		118	56	28	333	378			o			
80	X		118	56	28	333	378					x	
81			118	56	28	331	0						
82	X		118	56	28	329	378						
83			117	56	28	329	0		x				
84	X		118	56	28	329	378						
85			152	71	8	266	0			x			
86			152	71	8	266	0						
87	X		152	70	8	265	378	x					
88	X		152	71	8	266	378	x	x				
89			151	71	8	260	0			x			
90	X		152	71	8	266	378			x			
91	X		152	71	8	266	378			x			
92	X		152	71	8	266	378	x	x	x	x	x	D
93		x	152	71	8	266	0	x	x				
94			152	71	8	265	0	x	o				
95			152	71	8	265	0	x					
96			151	71	8	265	0						
97			159	90	4	158	0		x				
98		x	159	90	4	158	0			x			
99			159	90	4	159	0						
100		x	159	90	4	159	0		x				
101	X		159	90	4	159	378	x					
102			159	90	4	159	0						
103	X		159	90	4	159	378						

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
104		x	159	90	4	159	0						D
105		x	159	90	4	158	0						D
106	X		159	90	4	158	378						
107	X		159	90	4	156	378		x				
108		x	159	90	4	158	0		x				
109		x	173	200	3	137	0		x				
110	X		173	200	3	137	378						
111		x	173	199	3	137	0	x					
112			173	200	3	137	0						
113			173	200	3	136	0		x				
114		x	173	200	3	137	0		x				
115			173	200	3	137	0	x	x				
116			173	200	3	137	0	x					
117			173	199	3	125	0						
118		x	173	200	3	136	0	x	x	x	x		D
119		x	173	200	3	137	0	x	x	x	x		D
120	X		173	200	3	135	378						
121			151	198	2	126	0						
122			151	198	2	127	0				x		
123			151	197	2	123	0						
124			151	197	2	124	0						
125		x	151	198	2	124	0				x		
126		x	151	198	2	127	0	x	x	x	x		D
127		x	151	198	2	127	0	x	x	x	x		D
128			151	198	2	127	0						
129	X		151	198	2	126	378						
130	X		150	197	2	119	378						
131	X		151	198	2	127	378						
132			150	198	2	127	0	x	x	x	x		D
133			128	174	0	91	0						
134			128	174	0	91	0	x					
135			128	174	0	91	0						
136			128	174	0	89	0						
137		x	128	174	0	91	0				x		
138			128	174	0	90	0				x		
139			128	174	0	91	0	x					
140		x	128	172	0	79	0	x	x	x	x		D
141			128	174	0	91	0	x	x	x	x		D
142			128	174	0	91	0				x		
143		x	128	174	0	91	0						D
144		x	127	174	0	91	0	x	x	x	x		D
145		x	109	169	0	81	0	x	x	x	x		D
146			109	169	0	79	0	x					
147			109	169	0	81	0	x					
148			109	169	0	81	0	x					
149			109	169	0	81	0						
150			109	169	0	75	0						
151	X		109	169	0	81	378						
152			109	169	0	80	0				x		
153			109	169	0	81	0	x	x	x	x		D
154			109	169	0	80	0						
155			109	169	0	80	0						

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
156			109	169	0	80	0						
157		x	92	162	0	68	0	x			x		
158			92	161	0	66	0						
159			92	162	0	68	0						
160			92	162	0	68	0						
161			92	162	0	68	0				x		
162			92	162	0	68	0						
163	X		92	162	0	68	378					o	
164			92	162	0	67	0						
165			92	162	0	68	0						
166		x	92	162	0	68	0				x		
167		x	92	162	0	68	0				x		
168		x	92	162	0	68	0						D
169		x	67	142	0	56	0	x	x	x	x		D
170		x	67	142	0	56	0	x	x	x	x		D
171		x	67	142	0	53	0	x	x	x	x		D
172		x	67	142	0	56	0	x	x	x	x		D
173			67	142	0	50	0						
174		x	67	142	0	56	0	x	x	x	x		D
175		x	67	142	0	55	0	x	x	x	x		D
176		x	67	142	0	56	0	x	x	x	x		D
177		x	67	142	0	55	0						D
178		x	67	142	0	55	0	x	x	x	x		D
179	X		67	141	0	52	378	x			x		
180			66	142	0	55	0						
181		x	47	125	0	46	0				x		
182		x	47	123	0	45	0	x	x	x	x		D
183		x	47	126	0	46	0				x		
184		x	47	126	0	46	0	x	x	x	x		D
185			47	122	0	39	0						
186		x	47	126	0	46	0	x	x	x	x		D
187		x	47	126	0	46	0	x	x	x	x		D
188			47	126	0	40	0						
189		x	47	126	0	46	0						D
190		x	47	126	0	46	0	x	x	x	x		D
191		x	47	126	0	46	0	x	x	x	x		D
192		x	47	125	0	46	0	x	x	x	x		D
193		x	39	118	0	44	0	x	x	x	x		D
194		x	39	118	0	44	0	x	x	x	x		D
195		x	39	118	0	44	0	x	x	x	x		D
196		x	39	118	0	44	0	x	x	x	x		D
197	X	x	39	118	0	42	378					x	
198		x	39	118	0	44	0	x	x	x	x		D
199		x	39	118	0	44	0	x	x	x	x		D
200		x	39	118	0	44	0	x	x	x	x		D
201			39	118	0	44	0	x	x	x	x		D
202		x	39	118	0	44	0	x	x	x	x		D
203		x	39	118	0	44	0	x	x	x	x		D
204			39	118	0	44	0				x		

Table 3. *Item fit and DIF analysis for Oromifa*

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
1			25	36	247	238	0						
2			25	36	247	238	0						
3			25	36	247	238	0						
4	X		25	36	247	238	338	x					
5			25	36	246	238	0			o			
6			25	36	247	238	0						
7	X		25	36	247	238	338	x	x				
8	X		25	36	247	238	338						
9	X		25	36	247	238	338						
10		x	25	36	247	238	0	x	x	x	x		D
11	X		25	36	247	238	338		x				
12	X		25	36	247	238	338	x	x				
13			34	50	280	281	0		x				
14			34	50	280	281	0		x				
15			34	50	280	281	0						
16	X		34	50	280	281	338		x				
17			34	50	279	281	0		x				
18			34	50	280	281	0	x	x	x	x		D
19			34	50	280	281	0	x					
20			34	50	280	281	0	x					
21			34	50	280	281	0						
22			34	50	280	281	0	x					
23	X		34	50	280	281	338	x	x	x	x	x	D
24	X		34	50	279	281	338	x					
25	X		41	67	280	328	338						
26	X		41	67	277	328	338						
27		x	41	67	280	328	0	x	x	x	x		D
28	X		41	67	279	328	338	x					
29	X		41	67	280	328	338		x				
30	X		41	67	280	328	338		x				
31	X		41	67	280	328	338						
32			41	67	280	328	0		x				
33	X		41	67	279	328	338						
34			41	67	280	328	0	x	x	x	x		D
35	X		41	67	280	328	338	x				x	
36			41	67	280	328	0		x				
37		x	44	67	194	331	0	x	x				
38			45	67	195	331	0						
39	X		45	67	195	331	338						
40		x	45	67	195	331	0	x	x	x	x		D
41			45	67	195	331	0	x	x	x	x		D
42		x	44	67	195	331	0	x	x	x	x		D
43			45	67	194	331	0	x					
44			45	67	195	331	0	x	x	x	x		D
45	X		45	67	195	331	338	x	x	x	x	x	D
46	X		45	67	195	331	338					x	
47	X		45	67	195	331	338						
48			45	67	195	331	0		x				
49		x	58	79	129	341	0	x	x				
50			58	79	130	341	0	x	x				
51			58	79	130	341	0	x	x				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
52	X		58	79	130	341	338					x	
53			58	79	130	341	0						
54			58	79	129	341	0	x	x				
55	X		58	79	130	341	338	x	x				
56			58	79	130	341	0						
57	X		58	79	130	341	338						
58			58	79	130	341	0		x				
59	X		58	79	130	341	338					x	
60	X		58	79	130	341	338	x				x	
61			79	99	64	306	0	x	x	x	x		D
62			79	99	64	306	0	x	x				
63	X		79	99	64	306	338						
64	X		79	99	64	306	338	x					
65		x	79	99	63	306	0	x	x	x	x		D
66		x	79	99	64	306	0	x	x	x	x		D
67			79	99	63	306	0	x	x				
68			79	99	64	306	0	x	x	o			
69			77	99	64	306	0	x	x	o			
70			79	99	64	306	0			x			
71	X		79	99	64	306	338	x					
72			79	99	64	306	0	x		o			
73			105	115	43	305	0	x					
74	X		105	115	43	304	338	x				x	
75	X		105	115	42	304	338	x					
76			104	115	43	304	0						
77	X		105	115	43	305	338		x	o			
78	X		105	115	43	305	338		x	x			
79	X		105	115	43	305	338	x					
80	X		105	115	43	305	338	x					
81			105	115	43	305	0						
82	X		105	115	42	305	338			x			
83			105	115	43	305	0			x			
84	X		105	115	43	305	338						
85			130	122	20	199	0	x	x	x	x		D
86			131	122	20	199	0	x					
87	X		131	122	19	199	337					x	
88	X	x	130	122	20	199	338	o					
89			131	122	20	199	0						
90	X		131	122	20	199	338		x				
91	X		131	122	20	199	338						
92	X		131	122	20	199	338						
93			131	122	20	199	0		x				
94		x	131	122	20	199	0		x				
95			130	122	20	199	0						
96			129	122	20	199	0	x	x	x	x		D
97			129	137	8	109	0			x			
98			130	137	8	109	0						
99			130	137	8	109	0	o		x			
100		x	130	137	8	109	0	x	x	x	x		D
101	X		130	137	8	109	338						
102		x	130	137	8	109	0	x	x	x	x		D
103	X		130	137	8	109	338			x			

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
104		x	130	137	8	109	0	x	x	x	x		D
105			129	137	8	109	0	x	x	x	x		D
106	X		129	137	8	109	338			x			
107	X		130	137	8	109	338		x	x			
108			130	137	8	108	0		x		x		
109			143	171	7	89	0						
110	X		143	171	7	89	338						
111			143	171	7	89	0						
112			143	171	7	89	0			x			
113			143	171	7	89	0	x	x	x	x		D
114			143	171	7	89	0		x	x			
115			143	171	7	89	0	x	x				
116			143	171	7	89	0	x	x	x	x		D
117			142	171	7	89	0		x				
118			143	171	7	89	0	x	x	x	x		D
119		x	143	171	7	89	0	x	x	x	x		D
120	X		142	171	6	89	338						
121		x	121	164	5	69	0	x	x	x	x		D
122			121	164	5	69	0	o		x			
123			121	164	5	69	0			x			
124			120	164	5	69	0	x	x	x	x		D
125			120	164	5	69	0						
126			121	164	5	69	0						
127		x	121	164	5	69	0	x	x	x	x		D
128			121	164	5	69	0	x	x	x	x		D
129	X		121	164	5	69	338			x			
130	X		119	164	5	69	338	o					
131	X		121	164	5	69	338				x		
132		x	121	164	5	69	0	x	x	x	x		D
133			105	159	5	56	0	o	o	o	o		
134			105	159	5	56	0			x			
135			105	159	5	56	0	x					
136			105	159	5	56	0	o					
137		x	105	159	5	56	0	x	x	x	x		D
138		x	105	159	5	56	0	x	x	x	x		D
139			104	159	5	56	0			x	x		
140		x	104	159	5	56	0	x	x	x	x		D
141		x	105	159	5	56	0	x	x	x	x		D
142			105	159	5	56	0			x			
143		x	105	159	5	56	0	x	x	x	x		D
144			105	159	5	56	0	x	x	x	x		D
145			92	155	5	56	0	x			x		
146			93	155	5	56	0	x	x	x	x		D
147		x	93	155	5	56	0	x	x	x	x		D
148			93	155	5	56	0			x			
149			93	155	5	56	0						
150			93	154	5	56	0	x	x	x	x		D
151	X		91	155	5	56	337			x			
152			92	155	5	56	0	o					
153		x	93	155	5	56	0	x	x	x	x		D
154			93	155	5	56	0						
155		x	93	155	5	56	0	x	x	x	x		D

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
156			93	155	5	56	0	x	x				
157		x	78	144	4	45	0	x	x	x	x		D
158		x	79	144	4	45	0	x	x	x	x		D
159		x	78	144	4	45	0	x	x	x	x		D
160			78	144	4	45	0		x	x			
161			79	144	4	45	0	x	x	x	x		D
162			78	144	4	45	0				x		
163	X		76	144	4	45	338		x				
164			78	144	4	45	0						
165			78	144	4	45	0			x			
166			78	144	4	45	0	x	x	x	x		D
167		x	78	144	4	45	0	x	x	x	x		D
168			78	144	4	45	0						
169		x	64	130	3	34	0	x			x		
170		x	64	130	3	34	0	x	x	x	x		D
171		x	64	130	3	34	0	x	x	x	x		D
172		x	64	130	3	34	0	x	x	x	x		D
173		x	62	130	3	34	0	x	x	x	x		D
174		x	64	130	3	34	0	x	x	x	x		D
175		x	64	130	3	34	0	x	x	x	x		D
176		x	64	130	3	34	0	x	x	x	x		D
177		x	64	130	3	34	0	x	x	x	x		D
178			64	130	3	34	0	x		x			
179	X	x	63	130	3	34	338	x			x		
180		x	64	130	3	34	0	x	x	x	x		D
181		x	53	127	2	33	0	x	x	x	x		D
182			53	127	2	33	0	x	x	x	x		D
183		x	52	127	2	33	0	x	x	x	x		D
184		x	53	127	2	33	0	x	x	x	x		D
185		x	52	127	2	33	0	x	x	x	x		D
186		x	53	127	2	33	0	x	x	x	x		D
187		x	53	127	2	33	0	x	x	x	x		D
188			53	127	2	33	0	x	x	x	x		D
189		x	53	127	2	33	0	o			o		
190		x	53	127	2	33	0	x	x	x	x		D
191		x	53	127	2	33	0	x	x	x	x		D
192			52	127	2	33	0	x	x	x	x		D
193		x	50	125	2	30	0			x			
194		x	50	125	2	30	0	x	x	x	x		D
195		x	50	125	2	30	0	x	x	x	x		D
196		x	50	125	2	30	0	x	x	x	x		D
197	X		50	125	2	30	337				x		
198		x	50	125	2	30	0	x	x	x	x		D
199		x	50	125	2	30	0	x	x	x	x		D
200		x	50	125	2	30	0	x	x	x	x		D
201		x	50	125	2	30	0	x	x	x	x		D
202		x	50	125	2	30	0	x	x	x	x		D
203		x	50	125	2	30	0	x	x	x	x		D
204		x	50	125	2	30	0		x				

Table 4. *Item fit and DIF analysis for Telugu*

Item	Anchor For R4	Item without change in R2	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with the same number are equal					Deleted
				OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
1	X			0	109	0	1011	1903						
2	X	X		307	109	1681	1011	1899						
3		X		307	109	1681	1011	0						
4		X		307	109	1681	1011	0						
5		X		307	109	1681	1011	0						
6	X	X		307	109	1681	1011	1900						
7				0	109	0	1011	0						
8				0	109	0	1011	0						
9	X	X		307	109	1681	1011	1894						
10		X		307	109	1681	1011	0						
11		X		307	109	1681	1011	0		x				
12		X		307	109	1681	1011	0						
13	X	X		429	210	1720	1193	1892						
14		X		429	210	1720	1193	0						
15	X	X		429	210	1719	1193	1898		x				
16		X		429	210	1719	1193	0						
17	X	X		429	210	1720	1193	1900						
18	X	X		429	210	1720	1193	1894						
19		X		429	210	1720	1193	0						
20	X	X		429	210	1720	1193	1896						
21				0	210	0	1193	0						
22	X	X		429	210	1720	1193	1883						
23		X		429	210	1720	1193	0	x					
24				0	210	0	1193	0						
25	X	X		534	354	1620	1433	1898						
26	X	X		534	354	1619	1433	1895						
27	X	X		534	354	1619	1433	1874						
28	X	X		534	354	1619	1433	1894						
29		X		534	354	1619	1433	0						
30				0	354	0	1433	0		x				
31				0	354	0	1433	0						
32		X		534	354	1619	1433	0		x				
33	X	X		534	354	1619	1433	1896						
34		X		534	354	1619	1433	0						
35		X		534	354	1619	1433	0						
36	X	X		535	355	1619	1433	1895						
37		X		566	371	1282	1451	0						
38	X	X		566	371	1282	1451	1896						
39	X	X		566	371	1282	1451	1873						
40				0	371	0	1451	0		o				
41	X	X		566	371	1282	1451	1896						
42			x	0	371	0	1451	0		x		x		D
43				0	371	0	1451	0						
44		X		566	371	1282	1451	0						
45				0	371	0	1451	0				x		
46	X	X		566	371	1282	1451	1894						
47	X			0	371	0	1451	1895						
48		X		566	371	1282	1451	0						
49				0	389	0	1407	0				x		
50	X	X		581	389	923	1407	1892						
51	X	X		581	389	923	1407	1866						
52	X	X		581	389	923	1407	1894						
53		X	x	581	389	923	1407	0	x	x	x	x		D

Item	Anchor For R4	Item without change in R2	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with the same number are equal					Deleted
				OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
54		X		581	389	923	1407	0	x	x	x	x		D
55	X	X		581	389	923	1407	1895						
56	X	X		581	389	923	1407	1884						
57				0	389	0	1407	0						
58		X		581	389	923	1407	0						
59	X	X		581	389	923	1407	1890						
60	X	X		581	388	923	1407	1890						
61	X	X		625	437	634	1097	1885						
62				0	437	0	1097	0						
63				0	437	0	1097	0						
64	X	X		625	437	634	1097	1893						
65		X		625	437	634	1097	0			o			
66			x	0	437	0	1097	0		x		x		D
67				0	437	0	1097	0						
68	X	X		625	437	634	1097	1898						
69	X	X		625	437	634	1097	1881						
70	X	X		625	437	634	1097	1895						
71	X	X		625	437	634	1097	1896						
72	X	X		625	438	634	1097	1881						
73				0	569	0	941	0		x				
74	X	X		740	569	561	941	1894						
75	X	X		740	569	561	941	1891						
76		X		740	569	561	941	0						
77	X	X		740	569	561	941	1891						
78	X	X		740	569	561	941	1892						
79		X		740	569	561	940	0						
80	X	X		740	569	561	940	1886						
81	X	X		740	569	561	940	1860						
82				0	569	0	940	0						
83	X	X		740	569	561	940	1895						
84				0	570	0	940	0		x				
85			x	0	615	0	611	0		x		x		D
86		X		775	614	482	611	0						
87		X		774	614	482	611	0	2	2	1	1		
88	X	X		775	614	482	611	1891						
89		X	x	775	614	482	611	0						D
90	X	X		775	614	482	611	1893						
91		X		775	614	482	611	0						
92		X		775	614	482	611	0						
93	X	X		776	614	482	611	1899						
94		X	x	776	614	482	611	0	x	x	x	x		D
95				0	614	0	611	0		x		x		D
96		X		776	616	481	611	0						
97	X	X		777	646	314	479	1884						
98			x	0	646	0	479	0		x				
99		X		777	646	314	479	0						
100			x	0	646	0	479	0		x				
101				0	646	0	479	0						
102		X	x	777	646	314	479	0	x	x	x	x		D
103				0	646	0	479	0				x		
104		X		777	646	314	479	0	x	x	x	x		D
105		X		777	646	314	479	0	x	x	x	x		D
106		X		777	646	314	479	0						
107		X		777	646	314	479	0	x	x	x	x		D
108				0	584	0	479	0						

Item	Anchor For R4	Item without change in R2	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with the same number are equal					Deleted
				OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
109		X	x	870	791	229	366	0	x	x	x	x		D
110		X		870	791	229	365	0	x	x				
111				0	791	0	365	0						
112	X	X		870	791	229	365	1878						
113		X		870	791	229	365	0	x					
114				0	791	0	365	0						
115		X		870	791	229	365	0		x				
116		X		870	791	229	365	0						
117				0	791	0	365	0						
118				0	791	0	365	0		o				
119		X		870	791	229	365	0						
120				0	731	0	365	0						
121				0	728	0	264	0						
122				0	728	0	264	0						
123	X	X		838	728	203	264	1878						
124			x	0	728	0	264	0		x		x		D
125		X		838	728	203	264	0						
126		X		838	728	203	264	0		x		x		
127				0	728	0	264	0		o		o		
128		X		838	728	203	264	0	x	x	x	x		D
129		X		838	728	203	264	0						
130				0	728	0	264	0				x		
131		X		838	728	203	264	0			o			
132		X		837	710	202	264	0	x	x	x	x		D
133	X	X		826	709	184	230	1894						
134				0	709	0	230	0						
135				0	709	0	230	0		x		x		D
136				0	709	0	230	0		x		x		D
137			x	0	709	0	230	0		x		x		D
138				0	709	0	230	0						
139			x	0	709	0	230	0		x		x		D
140	X	X		826	709	184	230	1898						
141				0	709	0	230	0				o		
142				0	709	0	230	0						
143				0	709	0	230	0						
144		X		826	615	183	230	0			o			
145			x	0	612	0	166	0		x		x		D
146		X		802	612	177	166	0	x	x	x	x		D
147		X		802	612	177	166	0	x	x	x	x		D
148			x	0	612	0	166	0		x		x		D
149		X		802	612	177	166	0				x		
150	X	X		802	612	177	166	1874				o		
151			x	0	612	0	166	0						
152			x	0	612	0	166	0	x	x	x	x		D
153		X	x	802	612	177	166	0	x	x	x	x		D
154	X	X		802	612	177	166	1892						
155	X			0	612	0	166	1881						
156	X	X		802	593	176	166	1890						
157		X		767	594	149	132	0				o		
158			x	0	594	0	132	0	x	x	x	x		D
159		X		767	594	149	132	0	x	x	x	x		D
160	X	X		767	594	149	132	1870						
161				0	594	0	132	0						
162		X		767	594	149	132	0						
163		X		767	594	149	132	0						

Item	Anchor For R4	Item without change in R2	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with the same number are equal					Deleted
				OC R2	OC R3	YC R2	YC R3	YC R4	OC R2	OC R3	YC R2	YC R3	YC R4	
164		X		767	594	149	132	0	x	x	x	x		D
165		X		767	594	149	132	0			o			
166			x	0	594	0	132	0	x	x	x	x		D
167		X	x	767	594	149	132	0	x	x	x	x		D
168				0	567	0	132	0				o		
169		X		726	564	121	105	0			o			
170				0	564	0	105	0				o		
171			x	0	564	0	105	0	x	x	x	x		D
172		X	x	726	564	121	105	0	x	x	x	x		D
173		X	x	726	564	121	105	0	x	x	x	x		D
174		X	x	726	564	121	105	0			o			
175				0	564	0	105	0						
176		X		726	564	121	105	0						
177		X	x	726	564	121	105	0	x	x	x	x		D
178	X	X		726	564	121	105	1876						
179				0	564	0	105	0						
180				0	375	0	105	0						
181		X		518	368	88	39	0	x	x	x	x		D
182		X	x	518	368	88	39	0	x	x	x	x		D
183				0	368	0	39	0						
184			x	0	368	0	39	0	x	x	x	x		D
185		X		518	368	88	39	0						
186		X	x	518	368	88	39	0	x	x	x	x		D
187				0	368	0	39	0	x	x	x	x		D
188		X	x	518	368	88	39	0	x	x	x	x		D
189	X	X		518	368	88	39	1873				x		
190		X		518	368	88	39	0				o		
191				0	368	0	39	0						
192				0	356	0	39	0						
193			x	0	356	0	25	0	x	x	x	x		D
194		X		505	356	81	25	0			o			
195		X		505	356	81	25	0	x	x	x	x		D
196		X		505	356	81	25	0				x		
197				0	356	0	25	0				x		
198		X	x	505	356	81	25	0	x	x	x	x		D
199				0	356	0	25	0						
200				0	356	0	25	0						
201			x	0	356	0	25	0	x	x	x	x		D
202			x	0	356	0	25	0	x	x	x	x		D
203			x	0	356	0	25	0	x	x	x	x		D
204			x	0	356	0	25	0	x	x	x	x		D

Table 5. *Item fit and DIF analysis for Vietnamese*

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
1		x	16	6	814	103	0						D
2		x	16	6	814	103	0						D
3		x	16	6	814	103	0						D
4			16	6	813	103	0						
5	X		16	6	811	103	1878						
6		x	16	6	813	102	0						D
7			16	6	810	103	0						
8			16	6	815	103	0						
9			16	6	812	103	0		x				
10			16	6	809	103	0		x		x		
11			16	6	810	103	0						
12	X		16	6	813	103	1878						
13			18	6	1078	128	0						
14			18	6	1079	128	0						
15			18	6	1078	128	0						
16	X		18	6	1074	128	1864	x	x				
17	X		18	6	1074	128	1880		x				
18			18	6	1063	128	0		x				
19			18	6	1078	128	0						
20	X		18	6	1078	128	1879		x				
21			18	6	1077	128	0				x		
22		x	18	6	1074	128	0			x			
23			18	6	1072	128	0		x		x		
24			18	6	1073	128	0	x	x				
25			50	21	1813	519	0						
26			50	21	1849	521	0						
27			50	21	1842	521	0						
28	X		50	21	1848	521	1881						
29			50	21	1828	521	0						
30			50	21	1841	521	0						
31	X		50	21	1840	521	1880						
32			50	21	1844	521	0						
33	X		50	21	1843	521	1880						
34			50	21	1845	521	0						
35	X		50	21	1813	521	1880						
36			50	21	1848	521	0	x					
37			49	31	1723	698	0		x				
38			49	31	1741	700	0						
39	X		49	31	1728	699	1878						
40	X		49	31	1710	697	1877						
41			49	31	1739	700	0	x	x	x	x		D
42	X		49	31	1730	684	1788		x				
43	X		49	31	1701	700	1878						
44	X		49	31	1713	699	1841	x					
45	X		49	31	1713	698	1876		x				
46			49	31	1732	698	0						
47			49	31	1737	699	0						
48	X		49	31	1729	699	1880						
49			72	40	1260	995	0						
50	X		72	40	1255	995	1865		x				
51			72	40	1258	997	0		x				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
52	X		72	40	1264	998	1881		x				
53			72	40	1248	996	0	x	x	x	x		D
54			71	40	1250	993	0	x	x	x	x		D
55			72	40	1264	997	0	x	x				
56			72	40	1260	994	0		x		x		
57	X		72	40	1254	996	1880						
58			72	40	1259	998	0						
59	X		72	40	1250	998	1877						
60	X		72	40	1249	996	1879						
61			69	71	928	1366	0						
62			69	71	913	1362	0	x	x	x	x		D
63			68	71	921	1365	0						
64	X		69	71	926	1365	1880						
65	X		68	71	927	1362	1847						
66	X		69	71	914	1362	1871	x					
67			68	71	928	1365	0	x					
68			69	71	923	1364	0						
69			69	71	925	1365	0	x					
70	X		69	71	924	1365	1879						
71			69	71	925	1366	0	x	x	x	x		D
72			69	71	922	1365	0	x					
73	X	x	384	146	825	1883	1790	x		x			
74	X		384	146	827	1891	1881						
75	X		384	146	826	1893	1881						
76	X		384	146	820	1890	1876						
77	X		384	146	823	1890	1872						
78	X		384	146	826	1892	1877						
79			384	146	826	1893	0						
80	X		383	146	826	1890	1876						
81	X		383	146	817	1890	1876						
82	X		384	145	823	1884	1877						
83	X		384	146	822	1893	1879						
84	X		380	146	823	1891	1876						
85			466	156	658	1788	0	x	x	x	x		D
86	X		476	154	662	1785	1797	x		o			
87	X		477	155	660	1791	1847						
88	X		476	155	662	1789	1876						
89			479	156	659	1791	0						
90	X		478	156	660	1790	1877						
91		x	454	154	659	1784	0	x	x	x	x		D
92			476	156	662	1787	0						
93			478	156	661	1786	0						
94	X		474	155	649	1788	1877		x				
95	X		478	156	638	1789	1878					x	
96	X		477	156	626	1782	1871						
97	X		489	523	216	905	1879						
98	X		488	522	217	905	1871						
99			488	522	217	903	0						
100	X		484	522	218	905	1859						
101			489	523	217	905	0						
102	X		489	523	216	903	1876		1		1		
103			486	523	218	905	0						

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
104			489	522	217	905	0						
105			486	522	216	905	0						
106	X		484	522	217	904	1865						
107			487	523	211	905	0				o		
108	X		487	523	202	884	1880						
109	X		936	961	135	843	1826						
110			937	961	137	844	0			o			
111	X		932	962	137	846	1863						
112	X		933	961	136	844	1866						
113		x	923	960	134	845	0	x	x	x	x		D
114			933	961	137	845	0						
115	X		937	962	135	842	1871						
116	X		934	962	136	845	1878						
117			936	959	134	846	0						
118		x	937	962	135	845	0	x	x	x	x		D
119		x	936	962	136	845	0	x	x	x	x		D
120	X		929	943	131	798	1856						
121			921	922	113	717	0			x			
122	X		910	921	114	717	1865						
123	X		919	922	112	716	1873						
124		x	900	921	110	715	0	x	x	x	x		D
125	X		897	921	113	716	1845						
126			900	922	111	716	0						
127		x	919	921	113	715	0	x	x	x	x		D
128	X		920	922	113	716	1872						
129		x	921	922	113	715	0	x	x	x	x		D
130	X		921	922	111	716	1874						
131		x	913	922	106	714	0						
132			916	916	103	671	0	x	x	x	x		D
133			883	904	67	594	0						
134			882	904	67	593	0						
135			881	904	67	592	0						
136		x	882	904	67	593	0	x	x	x	x		D
137			882	901	66	592	0		1		1		
138	X		881	904	67	593	1864						
139			881	904	66	593	0						
140			882	903	67	594	0						
141			876	904	65	593	0						
142			882	904	66	594	0						
143		x	881	904	65	592	0	x	x	x	x		D
144			882	893	64	545	0						
145			870	864	52	449	0	x	x	x	x		D
146			870	863	51	448	0	o					
147			865	864	51	449	0	x	x	x	x		D
148			870	864	52	448	0	x	x	x	x		D
149			867	863	51	448	0						
150			841	864	50	448	0	x	o	x			
151			869	863	51	447	0	x	x	x	x		D
152	X		869	863	51	449	1872						
153		x	869	864	52	449	0	x	x	x	x		D
154			870	864	52	448	0						
155			871	863	51	448	0		o				

Item	Anchor For R4	Poor Fit	N					DIF x=ítem to be deleted o=ítem to be split 1,2=ítem with same number are equal					Item
			OC R2	OC R3	3	4	5	OC R2	OC R3	YC R2	YC R3	YC R4	
156			867	859	52	412	0		x				
157	X		848	830	42	343	1863	o					
158	X		847	831	43	344	1868						
159			853	829	44	344	0						
160			853	830	44	342	0	o					
161		x	853	830	43	344	0	x	x	x	x		D
162			852	829	44	343	0						
163	X		838	831	43	344	1824				x		
164			851	831	44	344	0						
165	X		850	830	42	344	1861				x		
166			853	831	42	344	0	x	x	x	x		D
167	X		853	831	39	344	1878						
168	X		842	804	33	300	1844						
169			789	720	18	185	0	x	x	x	x		D
170			788	720	18	185	0						
171	X		789	719	18	185	1858						
172			785	720	18	185	0						
173	X		786	720	18	185	1860						
174		x	788	720	18	185	0		x				
175			788	718	18	185	0	x	x				
176			789	720	18	185	0						
177		x	789	720	18	185	0	x	x	x	x		D
178	X		786	719	18	185	1852						
179	X	x	789	720	18	185	1869					x	
180	X		787	705	17	177	1880						
181		x	768	689	15	144	0	x	x	x	x		D
182	X		777	689	15	144	1878	x	x	x	x	x	D
183		x	778	689	15	144	0	x	x	x	x		D
184		x	779	689	15	144	0	x	x	x	x		D
185			775	689	15	144	0				x		
186		x	778	688	15	144	0	x	x	x	x		D
187		x	779	689	15	144	0	x	x	x	x		D
188			768	688	15	144	0						
189	X		779	689	15	144	1875	x		x			
190			778	689	15	144	0			x			
191			778	689	15	144	0	x	x	x	x		D
192			776	684	15	141	0	x	x	x	x		D
193		x	768	675	14	140	0	x	x	x	x		D
194			769	675	14	140	0			x			
195			769	675	14	140	0	x	x	x	x		D
196			764	675	14	140	0	o		x			
197	X		770	675	14	140	1878				x		
198		x	769	674	14	140	0	x	x	x	x		D
199			769	674	14	140	0			x			
200			767	675	14	140	0						
201			768	675	14	140	0	x	x	x	x		D
202		x	768	675	14	140	0	x	x	x	x		D
203			769	675	14	140	0			x			
204			768	673	14	140	0		x	x			

Appendix E. Item parameter for all the equated scales estimated

Table 1. *Item parameters for Amharic*

Item	Item difficulty	Item discrimination	Item guessing
1	-2.09	0.79	0.66
2	-2.52	1.28	0.34
3	-2.69	1.18	0.46
4	-2.15	1.36	0.21
5	-1.23	0.75	0.18
6	-2.38	1.13	0.26
7	-1.11	0.85	0.14
8	-0.97	2.15	0.25
9	-1.05	1.36	0.33
11	-1.81	1.04	0.12
12	-0.96	0.93	0.41
13	-1.78	1.42	0.41
14	-1.55	0.60	0.38
15	-1.44	1.28	0.26
16	-1.29	0.80	0.52
17	-1.03	1.63	0.23
18	0.28	1.15	0.30
19	-0.59	1.22	0.61
20	-0.12	0.77	0.09
21	-1.68	0.58	0.19
23	-0.41	0.84	0.12
24	-0.80	0.77	0.27
25	-1.17	1.75	0.29
26	-0.87	1.74	0.20
28	-0.90	1.43	0.35
29	-1.31	0.63	0.09
30	-0.73	0.72	0.17
31	-0.61	1.42	0.21
32	-0.92	1.83	0.28
33	-0.67	1.29	0.32
34	-0.11	0.61	0.21
35	-0.43	0.83	0.22
36	-0.42	0.60	0.29
37	0.22	0.88	0.17
38	-1.00	1.83	0.53
39	-0.87	0.62	0.05
40	1.06	1.06	0.17
41	-0.22	0.63	0.18
43	0.46	0.81	0.15
44	0.92	0.52	0.08
45	-0.35	0.79	0.25
46	-0.38	1.74	0.10
47	-1.16	1.27	0.10
48	-1.16	0.69	0.45
49	0.20	1.14	0.36
50	-0.67	1.03	0.31
52	0.26	0.99	0.14
53	1.07	0.89	0.21
54	0.67	0.75	0.33
55	0.33	1.23	0.23
56	0.16	1.26	0.09
57	-0.10	1.13	0.25
58	0.82	0.78	0.11
59	-1.44	0.89	0.24

Item	Item difficulty	Item discrimination	Item guessing
60	-0.27	1.66	0.13
62	-1.35	0.90	0.41
63	-1.03	1.14	0.35
64	-0.71	1.49	0.10
66	1.49	0.80	0.28
67	0.33	0.67	0.29
68	-0.56	0.93	0.20
70	0.06	0.93	0.30
71	0.05	0.52	0.10
72	-0.19	0.90	0.34
74	-0.41	1.51	0.12
75	-0.17	1.24	0.25
76	0.23	1.05	0.11
77	-0.42	1.27	0.33
78	-0.12	1.02	0.23
79	-1.19	0.96	0.26
80	0.31	1.36	0.18
81	1.38	0.55	0.14
82	-0.12	1.25	0.15
83	0.55	0.66	0.15
84	0.09	0.56	0.09
85	-0.88	0.76	0.22
86	2.07	0.70	0.06
87	0.27	0.94	0.20
88	1.10	0.76	0.04
89	1.59	0.64	0.18
90	0.08	1.22	0.17
91	-0.14	0.75	0.12
92	1.05	0.94	0.13
93	-0.52	1.11	0.28
94	0.55	1.09	0.38
95	0.38	1.23	0.32
96	0.87	0.90	0.37
97	1.20	0.68	0.10
98	0.96	0.96	0.15
99	0.39	0.78	0.25
100	-0.78	1.03	0.50
101	0.10	0.99	0.05
103	-0.24	1.02	0.22
104	-0.21	1.50	0.45
105	-0.56	0.65	0.36
106	1.18	0.61	0.11
107	0.78	0.50	0.39
108	0.43	1.22	0.43
109	-0.96	0.80	0.48
110	0.74	1.05	0.05
111	0.62	0.99	0.20
113	2.71	0.36	0.18
114	-0.34	0.63	0.31
115	-0.82	0.80	0.20
116	-0.28	1.09	0.31
117	0.90	0.64	0.05
118	-0.57	1.26	0.23
120	0.73	0.88	0.14
121	-0.83	0.63	0.37
122	0.42	1.23	0.10
123	0.73	1.05	0.08
124	0.89	1.22	0.06
125	1.16	0.72	0.10

Item	Item difficulty	Item discrimination	Item guessing
126	1.42	0.71	0.22
128	-0.07	0.96	0.21
129	0.55	0.92	0.07
130	0.06	1.67	0.12
131	1.17	0.82	0.04
132	0.33	1.10	0.74
133	1.09	0.79	0.21
134	0.02	1.19	0.38
135	0.69	0.98	0.09
136	-0.23	1.44	0.22
137	0.53	0.98	0.18
138	1.10	1.34	0.22
140	1.19	0.84	0.06
141	0.18	1.42	0.19
142	0.92	1.17	0.10
146	1.20	0.90	0.14
147	-1.00	0.84	0.40
150	1.95	0.78	0.10
151	0.10	0.85	0.19
152	2.03	0.97	0.27
154	1.33	0.87	0.11
157	-0.44	0.99	0.42
158	2.62	0.83	0.09
159	2.08	0.86	0.07
162	0.30	0.75	0.15
163	0.90	1.24	0.15
164	0.89	0.99	0.43
165	1.19	1.03	0.54
168	0.71	0.76	0.38
170	-0.54	0.75	0.21
171	1.22	0.82	0.44
172	2.70	1.03	0.25
173	2.56	1.08	0.16
174	0.10	0.94	0.49
176	0.90	0.58	0.12
177	1.59	0.80	0.19
178	0.98	1.10	0.73
179	0.14	1.39	0.13
180	1.89	0.89	0.08
181	0.33	0.79	0.17
182	0.96	0.79	0.19
183	0.52	0.68	0.70
184	-0.11	0.78	0.47
186	-0.16	0.74	0.43
188	1.73	0.66	0.15
189	1.31	0.70	0.28
190	-0.67	0.56	0.49
191	0.20	1.15	0.10
192	1.03	1.20	0.41
193	2.05	0.79	0.18
195	0.12	1.28	0.17
196	0.10	0.40	0.24
197	0.72	1.37	0.11
198	-0.59	0.77	0.41
199	0.79	0.64	0.53
200	0.94	1.26	0.51
201	2.34	1.76	0.37
204	0.76	1.12	0.04
300	0.89	0.89	0.20

Item	Item difficulty	Item discrimination	Item guessing
301	0.66	0.74	0.25
303	-0.36	0.76	0.33
304	-0.17	0.71	0.34
305	0.51	0.90	0.14
306	-1.21	1.05	0.24
307	-0.45	1.45	0.17
308	0.09	0.67	0.09
309	-1.01	0.74	0.90
310	0.03	1.01	0.21
311	0.82	0.76	0.14
312	0.22	1.35	0.33
313	0.04	0.72	0.22
314	1.27	1.03	0.24
315	-0.48	1.76	0.22
316	-0.58	0.84	0.04
317	0.25	2.63	0.34
318	0.38	2.18	0.23
319	-0.28	0.79	0.23

Table 2. *Item parameters for Oromifa*

Item	Item difficulty	Item discrimination	Item guessing
1	-2.27	1.02	0.46
2	-2.57	1.21	0.38
3	-2.31	1.28	0.53
4	-2.18	1.04	0.27
5	0.46	0.57	0.18
6	-2.02	1.37	0.27
7	-0.82	1.02	0.20
8	-0.70	1.51	0.20
9	-0.94	1.08	0.23
11	-1.78	1.03	0.18
12	-0.92	0.74	0.31
13	-1.43	1.14	0.34
14	-1.66	0.87	0.37
15	-1.14	0.97	0.30
16	-1.49	0.73	0.31
17	-0.72	1.23	0.19
19	-0.72	1.14	0.49
20	-0.75	1.19	0.14
21	-1.44	0.73	0.22
22	-0.91	1.15	0.28
24	-0.25	0.60	0.21
25	-0.88	1.62	0.33
26	-0.60	1.22	0.23
28	-0.29	0.99	0.34
29	-0.80	1.02	0.23
30	-0.57	0.79	0.32
31	-0.31	0.89	0.18
32	-0.77	1.34	0.30
33	-0.39	1.18	0.35
35	0.51	0.91	0.26
36	-0.09	0.76	0.32
37	1.73	0.58	0.17
38	-1.52	1.11	0.44
39	0.06	0.74	0.17
43	0.26	0.97	0.17
46	0.25	1.37	0.16
47	-1.04	1.13	0.22
48	-1.60	0.81	0.26
49	1.12	0.79	0.21
50	-0.56	1.04	0.47
51	0.83	0.74	0.25
52	0.39	1.06	0.12
53	-0.23	1.03	0.14
54	1.09	0.71	0.33
55	0.39	0.94	0.23
56	0.96	0.99	0.19
57	-0.06	1.20	0.32
58	1.58	0.65	0.25
59	-0.65	1.14	0.32
60	0.52	1.81	0.21
62	-1.06	1.41	0.24
63	-1.36	0.89	0.22
64	-0.52	1.20	0.20
67	1.13	0.66	0.34
68	-0.19	0.81	0.26
69	0.61	0.70	0.55
70	1.13	0.70	0.24

Item	Item difficulty	Item discrimination	Item guessing
71	1.07	0.85	0.24
72	0.38	0.62	0.42
73	-1.55	0.78	0.52
74	-0.09	1.49	0.14
75	0.03	1.06	0.18
76	1.52	1.25	0.18
77	-0.47	0.91	0.39
78	0.61	0.58	0.19
79	-0.90	0.58	0.18
80	0.85	0.79	0.09
81	1.25	1.00	0.13
82	0.92	1.31	0.21
83	1.03	0.93	0.30
84	0.63	0.80	0.32
86	0.72	0.96	0.15
87	1.11	1.15	0.16
88	2.50	0.74	0.19
89	1.25	1.34	0.21
90	-0.07	1.19	0.25
91	0.78	0.93	0.08
92	1.71	0.75	0.16
93	-0.15	0.72	0.41
94	0.34	0.55	0.30
95	0.20	0.97	0.29
97	1.42	0.97	0.06
98	0.82	0.76	0.15
99	2.04	0.70	0.24
101	-0.48	1.04	0.34
103	-0.18	0.99	0.24
106	1.13	1.25	0.21
107	0.08	0.64	0.30
108	-0.20	0.67	0.61
109	-0.53	1.11	0.14
110	1.31	1.03	0.03
111	0.46	1.16	0.17
112	-0.07	0.65	0.20
114	0.44	0.72	0.51
115	0.28	0.73	0.28
117	1.73	0.93	0.12
120	1.08	0.93	0.11
122	0.19	0.65	0.25
123	0.88	0.66	0.14
125	1.37	0.91	0.16
126	0.17	0.97	0.41
129	1.62	0.72	0.32
130	0.12	1.14	0.22
131	1.82	0.94	0.21
134	-0.07	0.93	0.35
135	0.58	1.01	0.26
136	-0.23	1.35	0.30
139	0.05	0.84	0.22
142	1.06	1.03	0.16
145	0.24	1.45	0.18
148	0.01	0.69	0.40
149	0.55	0.78	0.28
151	0.32	0.81	0.16
152	0.28	1.02	0.40
154	1.75	0.62	0.10
156	0.76	0.82	0.12

Item	Item difficulty	Item discrimination	Item guessing
160	1.73	0.74	0.08
162	1.35	0.99	0.13
163	0.82	0.84	0.22
164	1.18	0.84	0.13
165	0.26	0.74	0.18
168	0.97	0.93	0.26
169	-0.18	1.58	0.27
178	-0.28	1.22	0.35
179	0.77	0.75	0.16
189	1.24	0.69	0.33
193	1.21	0.60	0.35
197	0.96	0.82	0.12
204	1.31	0.89	0.24
300	1.00	0.69	0.20
301	0.31	0.65	0.19
302	0.94	0.73	0.27
303	0.87	0.71	0.21
304	1.29	1.00	0.08
305	0.49	0.74	0.34
306	0.76	0.70	0.20
307	1.22	0.62	0.14
308	0.63	1.07	0.13
309	-0.97	1.17	0.34
310	0.46	0.73	0.26
311	0.48	0.85	0.12
312	0.17	0.77	0.30
313	1.04	0.76	0.33
314	0.32	0.85	0.24
315	0.78	0.81	0.31
316	1.48	0.71	0.24

Table 3. *Item parameters for Tigrinya*

Item	Item difficulty	Item discrimination	Item guessing
1	-2.15	1.39	0.71
2	-2.76	0.98	0.38
3	-2.43	1.17	0.42
4	-1.93	1.17	0.23
5	-0.94	0.96	0.43
6	-1.95	1.21	0.55
8	-0.96	1.11	0.15
9	-0.75	1.87	0.34
11	-1.26	0.89	0.51
12	-1.47	0.70	0.44
13	-1.94	1.01	0.22
14	-1.85	0.78	0.51
15	-1.61	1.22	0.20
16	-1.51	0.88	0.27
17	-0.92	1.29	0.10
18	0.49	1.00	0.22
19	-1.07	0.68	0.22
20	-0.71	1.17	0.16
21	-1.25	0.70	0.13
22	-1.04	1.07	0.17
24	-0.79	0.69	0.17
25	-0.88	1.78	0.33
26	-0.67	1.56	0.15
27	-0.30	1.06	0.21
28	-0.87	1.31	0.29
29	-1.18	0.78	0.13
30	-0.86	1.16	0.26
31	-0.49	0.98	0.12
32	-0.89	1.43	0.13
33	-0.79	1.26	0.28
35	-0.68	0.73	0.07
36	-0.98	0.99	0.18
37	0.87	0.90	0.08
38	-1.21	1.13	0.30
39	-0.81	1.97	0.53
40	0.59	0.55	0.20
41	-0.02	1.03	0.15
42	0.46	0.69	0.06
43	0.36	0.96	0.17
44	0.15	1.01	0.20
45	-0.49	0.74	0.07
46	0.02	0.95	0.06
47	-0.91	1.76	0.08
48	-1.01	1.18	0.21
49	0.25	1.04	0.11
50	-0.35	0.98	0.14
51	-0.03	1.50	0.27
52	0.11	0.99	0.12
53	0.64	0.79	0.06
55	0.65	0.86	0.22
56	-0.21	0.80	0.18
57	0.13	0.92	0.14
58	0.34	0.63	0.10
59	-0.41	1.51	0.69
60	-0.11	1.30	0.06
63	-1.12	0.94	0.20
64	-0.75	1.18	0.11

Item	Item difficulty	Item discrimination	Item guessing
66	0.45	0.90	0.15
67	0.32	1.13	0.29
68	0.59	0.89	0.49
70	0.63	0.91	0.34
71	0.11	0.52	0.50
72	0.92	0.65	0.40
74	0.19	1.02	0.14
75	-0.55	0.46	0.32
76	0.94	1.05	0.16
78	-0.35	0.69	0.24
79	-0.94	1.05	0.21
80	0.38	1.16	0.11
81	0.92	0.85	0.08
82	0.24	0.67	0.11
83	0.20	1.24	0.19
84	1.22	0.54	0.24
85	-0.14	0.69	0.22
86	1.47	0.90	0.12
87	0.59	1.00	0.29
88	2.01	0.63	0.18
89	1.65	0.53	0.10
90	0.57	1.10	0.24
91	0.11	0.80	0.32
93	0.59	0.94	0.58
94	-0.16	0.74	0.33
95	0.21	1.28	0.10
96	0.75	1.04	0.14
97	1.69	1.16	0.13
98	2.03	0.97	0.25
99	1.11	0.89	0.47
100	-1.38	0.43	0.47
101	1.34	0.62	0.32
102	1.64	0.93	0.15
103	-0.37	0.82	0.17
106	1.15	0.97	0.22
107	0.44	0.70	0.37
108	0.08	0.93	0.45
109	-1.07	0.54	0.51
110	0.76	1.04	0.02
111	0.77	0.78	0.11
112	0.22	0.76	0.22
113	1.13	0.97	0.16
114	-0.74	0.66	0.26
115	0.05	0.68	0.48
116	-0.60	1.08	0.25
117	1.28	1.51	0.22
120	0.54	1.01	0.22
121	0.78	0.70	0.40
122	1.58	1.05	0.16
123	1.11	0.71	0.10
124	1.62	0.91	0.07
125	0.74	0.96	0.09
128	0.66	0.94	0.11
129	1.21	0.47	0.18
130	0.73	1.07	0.25
131	0.65	0.57	0.07
133	0.69	0.70	0.07
134	0.04	0.71	0.64
135	0.78	0.98	0.20

Item	Item difficulty	Item discrimination	Item guessing
136	0.67	0.94	0.21
137	0.05	0.67	0.15
138	1.25	0.70	0.08
139	-0.42	0.64	0.79
142	1.54	1.11	0.19
146	2.77	0.61	0.14
147	-0.33	0.63	0.52
148	0.26	0.60	0.57
149	1.05	1.17	0.25
150	1.63	0.68	0.30
151	0.58	0.76	0.35
152	1.10	0.92	0.21
154	1.06	0.54	0.12
155	0.86	1.59	0.54
156	0.64	1.04	0.12
157	0.35	1.14	0.34
158	3.53	0.82	0.36
159	2.37	0.72	0.07
160	0.55	0.43	0.04
161	1.06	0.71	0.51
162	1.17	0.93	0.25
163	1.49	1.15	0.07
164	1.52	0.90	0.08
165	0.81	0.73	0.19
166	0.30	0.89	0.25
167	0.58	0.77	0.46
173	1.85	0.75	0.06
179	1.28	0.55	0.23
180	2.51	0.58	0.11
181	1.90	1.19	0.39
183	1.12	0.83	0.45
185	2.19	1.23	0.07
188	1.85	0.55	0.10
197	1.84	0.74	0.12
204	1.44	0.67	0.14
300	-1.54	0.57	0.21
301	1.12	0.88	0.07
302	1.15	1.32	0.31
303	2.14	0.86	0.44
304	0.39	0.90	0.15
305	-0.34	0.95	0.08
306	0.63	0.69	0.09
307	0.47	0.91	0.09
308	-0.76	1.06	0.14
309	-0.40	0.68	0.95
310	0.87	1.15	0.07
311	0.83	1.34	0.23
312	-0.32	1.08	0.11

Table 4. *Item parameters for Telugu (India)*

Item	Item difficulty	Item discrimination	Item guessing
1	-3.43	0.54	0.59
2	-3.53	0.71	0.23
3	-3.30	1.32	0.24
4	-2.67	1.12	0.37
5	-1.17	0.62	0.13
6	-3.59	0.70	0.23
7	-2.60	0.78	0.17
8	-0.81	0.72	0.13
9	-2.13	0.81	0.15
10	-0.92	0.60	0.29
11	-1.33	1.67	0.51
12	-1.65	1.22	0.25
13	-1.19	0.96	0.27
14	-1.41	1.13	0.46
15	-1.81	0.99	0.20
16	-0.90	1.48	0.45
17	-1.44	1.14	0.20
18	-0.29	1.01	0.23
19	-0.26	1.12	0.46
20	-0.25	1.35	0.26
21	0.16	0.60	0.15
22	-1.03	0.62	0.05
23	-0.41	0.76	0.19
24	-0.15	0.48	0.16
25	-1.39	1.50	0.35
26	-1.42	1.25	0.10
27	0.47	1.29	0.13
28	-1.12	1.25	0.23
29	-1.14	0.45	0.11
30	0.42	0.48	0.45
31	-0.59	1.25	0.18
32	-0.69	0.65	0.29
33	-0.88	1.25	0.31
34	0.00	1.22	0.29
35	-0.05	1.60	0.33
36	-1.36	0.71	0.03
37	0.49	0.68	0.25
38	-2.00	0.89	0.16
39	-0.01	0.88	0.22
40	0.46	1.66	0.18
41	-0.39	1.07	0.25
43	1.04	0.60	0.15
44	1.43	0.54	0.17
45	2.27	0.98	0.25
46	0.42	1.16	0.17
47	-1.51	1.23	0.07
48	-1.82	0.70	0.32
49	1.82	1.01	0.11
50	0.97	0.70	0.19
51	0.51	1.44	0.20
52	-0.38	1.13	0.19
55	-0.05	0.94	0.30
56	0.39	1.17	0.21
57	1.53	0.70	0.32
58	0.53	0.66	0.05
59	-1.09	0.93	0.13
60	-0.36	0.84	0.15

Item	Item difficulty	Item discrimination	Item guessing
61	0.04	2.50	0.23
62	0.67	1.19	0.17
63	-0.43	0.54	0.28
64	-0.77	1.71	0.25
65	1.63	1.00	0.28
67	2.01	0.72	0.32
68	-0.43	1.59	0.31
69	-1.06	0.68	0.09
70	-0.35	1.44	0.35
71	-0.86	0.84	0.15
72	0.64	1.55	0.25
73	1.63	0.34	0.18
74	-1.13	1.38	0.16
75	-0.18	0.88	0.16
76	0.89	1.10	0.18
77	-0.25	1.16	0.30
78	-0.78	1.32	0.21
79	-0.04	0.61	0.23
80	0.29	1.04	0.16
81	0.81	0.80	0.21
82	0.09	1.64	0.21
83	0.08	1.15	0.22
84	0.95	0.77	0.23
86	1.81	1.01	0.16
87	0.40	0.36	0.33
88	-0.04	1.13	0.10
90	0.55	1.47	0.28
91	0.27	0.72	0.14
92	1.25	1.04	0.30
93	-1.16	0.99	0.19
96	-0.10	1.01	0.10
97	1.18	0.97	0.19
98	1.42	0.86	0.32
99	-0.11	0.71	0.12
100	0.87	1.77	0.07
101	-0.31	1.08	0.10
103	1.76	0.93	0.11
105	0.17	1.33	0.29
106	0.51	1.03	0.20
108	0.57	0.49	0.38
110	-0.84	0.58	0.23
111	0.68	1.40	0.21
112	0.84	1.51	0.34
113	1.98	1.03	0.26
114	0.87	0.95	0.13
115	0.08	0.87	0.41
116	0.38	1.20	0.26
117	1.22	1.10	0.05
118	0.52	1.20	0.20
119	0.49	1.83	0.29
120	1.12	0.93	0.08
121	0.63	1.02	0.25
122	0.92	0.86	0.24
123	0.48	1.28	0.31
125	0.77	0.73	0.20
126	-0.91	1.37	0.09
129	0.60	0.94	0.24
130	0.69	1.07	0.10
131	-0.56	0.46	0.13

Item	Item difficulty	Item discrimination	Item guessing
133	-0.65	1.16	0.18
134	1.76	1.29	0.07
138	1.61	1.04	0.11
140	0.92	0.62	0.18
141	1.28	0.95	0.23
142	0.78	0.80	0.19
143	1.00	1.85	0.31
144	1.03	1.31	0.07
149	0.92	0.69	0.20
150	0.59	0.86	0.22
151	1.55	0.60	0.32
154	0.72	0.74	0.22
155	0.68	1.66	0.24
156	0.64	1.08	0.25
157	0.05	1.54	0.38
160	1.60	0.97	0.18
161	0.28	0.47	0.16
162	2.20	0.38	0.26
163	1.67	1.09	0.17
165	1.19	1.98	0.36
168	1.16	0.99	0.19
169	1.51	1.66	0.18
170	1.81	0.87	0.03
174	1.88	1.70	0.17
175	1.00	1.08	0.10
176	1.36	0.54	0.06
178	0.89	2.03	0.26
179	0.02	1.20	0.16
180	0.88	0.76	0.05
183	0.13	0.55	0.16
185	1.23	0.97	0.24
189	1.54	0.93	0.31
190	0.59	0.86	0.06
191	0.46	1.06	0.05
192	0.20	1.28	0.10
194	1.52	1.04	0.14
196	1.37	0.52	0.21
197	1.21	0.73	0.14
199	1.02	0.76	0.14
200	1.82	1.20	0.08
205	-3.02	0.80	0.53
211	-1.87	1.03	0.28
212	-1.00	0.97	0.10
225	0.25	0.92	0.26
228	-0.76	0.95	0.12
234	-0.08	0.50	0.29
235	-0.41	1.39	0.23
244	1.24	0.92	0.20
246	2.17	0.94	0.21
247	-0.29	1.11	0.12
249	0.44	0.74	0.09
251	-1.64	1.03	0.27
253	-0.66	0.83	0.27
261	0.10	1.03	0.41
266	-1.84	0.95	0.27
267	-0.34	1.77	0.55
270	1.95	0.87	0.20
271	1.40	0.79	0.50
277	-1.94	0.83	0.39

Item	Item difficulty	Item discrimination	Item guessing
286	-0.30	0.93	0.17
288	-0.37	0.75	0.22
289	1.72	1.08	0.39
299	-0.06	1.04	0.19
302	1.21	0.71	0.37
304	-0.06	0.89	0.81
305	0.02	0.84	0.20
307	0.92	1.22	0.22
312	1.03	0.55	0.39
315	0.14	1.33	0.21
318	-0.93	1.02	0.19
321	1.91	0.54	0.08
322	-1.22	0.95	0.48
324	1.37	1.08	0.17
325	0.55	0.87	0.22
326	-0.56	0.68	0.11
328	0.72	0.89	0.25
331	0.39	0.58	0.95
334	0.29	1.02	0.20
338	0.48	1.26	0.80
339	0.97	0.98	0.21
340	-1.19	0.46	0.23
341	2.20	0.57	0.72
342	0.94	0.63	0.10
343	1.91	1.51	0.42
345	0.36	0.65	0.87
346	0.51	0.95	0.18
347	0.39	0.98	0.80
349	0.08	1.09	0.40
352	1.20	1.31	0.51
355	1.13	0.49	0.31
356	2.17	0.61	0.28
359	-0.43	1.10	0.13
362	3.14	0.97	0.21
365	0.57	0.63	0.18
370	-0.90	0.92	0.57
372	0.28	0.92	0.25
374	-0.76	0.97	0.22
375	1.51	0.82	0.22
379	1.25	2.01	0.44
383	-0.53	0.91	0.12
384	1.32	0.54	0.08
387	0.33	0.65	0.66
388	-0.41	1.19	0.28
391	0.78	0.87	0.59
395	0.11	0.77	0.21
396	0.37	0.82	0.42
397	3.22	0.79	0.07
401	1.95	0.76	0.34
403	0.22	0.43	0.56
404	1.60	1.03	0.20
405	1.74	2.57	0.37
406	2.16	1.15	0.47
407	1.18	1.24	0.37
408	1.36	1.81	0.24
500	1.13	1.10	0.07
501	0.37	1.92	0.21
502	2.27	0.91	0.03
503	0.74	0.62	0.19

Item	Item difficulty	Item discrimination	Item guessing
504	2.63	0.96	0.38
505	0.29	1.30	0.42
506	-0.03	1.20	0.36
507	1.28	0.91	0.54
508	0.03	0.85	0.19
509	0.98	0.93	0.38
510	1.05	1.66	0.11
511	0.69	1.54	0.24
512	1.57	0.70	0.15
513	0.94	0.57	0.59
514	1.68	0.79	0.08
515	1.22	1.39	0.23
516	1.42	1.00	0.15
517	-0.06	0.46	0.74

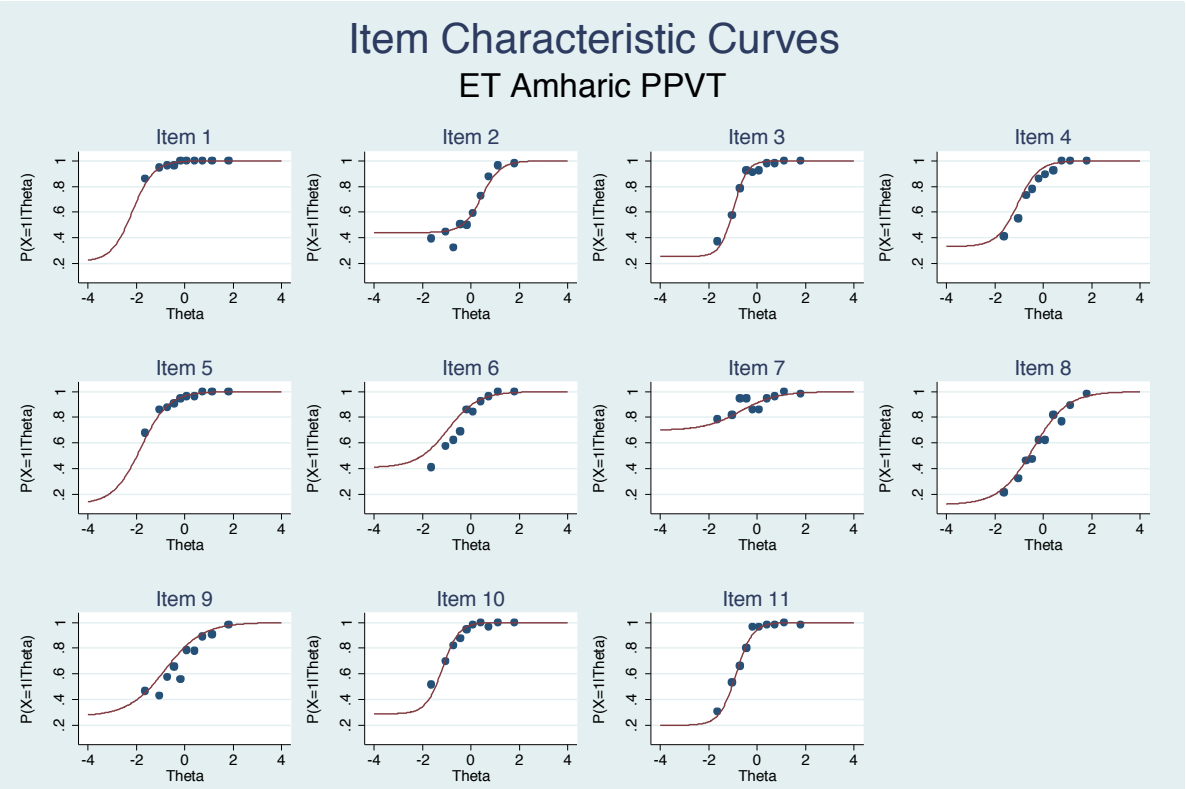
Table 5. *Item parameters for Vietnamese (Vietnam)*

Item	Item difficulty	Item discrimination	Item guessing
4	-2.54	1.74	0.36
5	-1.94	0.85	0.04
7	-2.64	1.38	0.13
8	-1.74	1.44	0.33
9	-2.28	1.40	0.14
10	-2.04	0.63	0.12
11	-1.67	1.24	0.52
12	-1.49	1.18	0.46
13	-1.99	1.60	0.63
14	-0.76	0.92	0.65
15	-1.75	2.76	0.66
16	-1.47	1.04	0.25
17	-1.88	1.18	0.05
18	0.00	0.88	0.35
19	-0.97	1.26	0.73
20	-1.51	0.64	0.03
21	-0.87	0.90	0.72
22	-1.12	0.74	0.33
23	-1.81	1.19	0.07
24	-1.89	1.07	0.05
25	-1.37	0.67	0.05
26	-1.63	2.05	0.60
27	-1.42	2.32	0.56
28	-2.37	1.31	0.04
29	-1.38	1.46	0.61
30	-1.75	1.28	0.52
31	-1.84	1.32	0.04
32	-2.42	1.41	0.17
33	-2.14	1.03	0.04
34	-1.41	1.70	0.37
35	-1.59	1.23	0.02
36	-0.75	1.39	0.44
37	-0.46	0.65	0.13
38	-2.29	1.54	0.33
39	-0.67	1.83	0.31
40	-0.30	1.55	0.21
42	0.56	0.79	0.04
43	-0.99	1.64	0.29
44	-1.04	0.86	0.02
45	-0.96	1.14	0.10
46	-0.93	2.25	0.44
47	-1.52	2.03	0.47
48	-0.74	1.25	0.29
49	-1.99	1.11	0.20
50	-0.64	1.24	0.23
51	-0.87	1.69	0.55
52	-0.67	1.22	0.08
55	-0.67	1.37	0.33
56	-0.23	0.61	0.05
57	-1.52	0.80	0.09
58	-0.52	1.65	0.37
59	-0.98	0.77	0.03
60	-0.71	1.93	0.11
61	-1.40	0.78	0.29
63	-0.86	2.86	0.46
64	-1.37	1.23	0.09
65	-1.37	0.43	0.09

Item	Item difficulty	Item discrimination	Item guessing
66	-0.27	0.83	0.09
67	0.05	0.55	0.31
68	-0.92	1.61	0.48
69	-1.13	1.17	0.25
70	-1.14	1.07	0.11
72	-0.78	1.79	0.59
73	1.74	0.67	0.09
74	-1.19	1.66	0.27
75	-1.33	1.41	0.21
76	-0.40	1.12	0.09
77	-0.88	1.47	0.41
78	-1.22	0.95	0.03
79	-1.00	1.52	0.40
80	-0.50	1.41	0.19
81	-0.58	1.14	0.11
82	-0.78	1.20	0.09
83	-0.43	1.66	0.20
84	-0.53	0.78	0.04
86	2.29	0.70	0.14
87	0.79	1.16	0.16
88	-0.63	0.62	0.05
89	1.07	0.62	0.25
90	-0.93	0.75	0.03
92	0.73	1.19	0.24
93	1.55	0.50	0.49
94	0.92	1.32	0.19
95	0.25	1.79	0.25
96	-0.05	1.73	0.24
97	-0.31	1.11	0.09
98	0.15	1.00	0.13
99	-0.60	0.92	0.30
100	-0.01	1.39	0.13
101	-1.18	0.87	0.14
102	1.62	0.62	0.10
103	-0.95	1.20	0.24
104	-1.27	0.99	0.14
105	-0.49	1.12	0.12
106	-0.18	0.95	0.08
107	-0.34	1.14	0.36
108	-0.67	0.83	0.07
109	0.54	1.25	0.20
110	0.46	1.06	0.60
111	0.13	1.15	0.13
112	-0.36	0.72	0.20
114	-0.52	1.10	0.31
115	0.22	0.80	0.02
116	-0.27	1.24	0.13
117	0.34	1.71	0.17
120	0.12	1.03	0.05
121	-0.34	1.11	0.06
122	0.24	0.80	0.25
123	-0.21	1.16	0.13
125	0.34	0.90	0.07
126	0.63	1.02	0.18
128	0.02	0.97	0.04
130	-0.16	1.18	0.07
131	0.14	0.79	0.05
133	-0.96	0.81	0.28
134	-0.78	1.21	0.15

Item	Item difficulty	Item discrimination	Item guessing
135	0.45	1.31	0.31
137	-0.75	0.93	0.08
138	0.95	1.22	0.13
139	0.30	0.72	0.11
140	1.07	0.69	0.20
141	0.17	0.58	0.13
142	0.76	0.68	0.05
144	-0.15	1.13	0.26
146	0.99	1.37	0.26
149	0.38	0.72	0.11
150	1.92	0.50	0.07
152	0.26	0.83	0.24
154	0.30	0.88	0.10
155	0.69	1.14	0.10
156	0.50	2.27	0.38
157	0.57	1.17	0.17
158	1.44	1.50	0.15
159	1.49	1.21	0.20
160	1.92	0.60	0.06
162	1.73	0.59	0.23
163	1.60	1.69	0.18
164	1.20	0.54	0.05
165	1.04	0.86	0.37
167	-0.29	0.73	0.47
168	0.69	0.75	0.06
170	0.07	0.74	0.26
171	-0.02	0.72	0.10
172	1.16	0.83	0.08
173	1.75	1.39	0.19
174	0.57	1.65	0.50
175	-0.01	0.49	0.18
176	0.35	1.11	0.37
178	0.52	1.03	0.15
179	0.88	1.84	0.69
180	1.19	0.99	0.19
185	0.84	0.88	0.13
188	1.15	0.66	0.07
189	0.19	1.27	0.46
190	0.11	1.00	0.62
194	0.25	1.08	0.39
196	0.38	0.93	0.69
197	0.32	0.72	0.14
199	0.44	0.84	0.67
200	-0.10	0.63	0.30
203	-0.63	1.03	0.09
204	0.24	1.03	0.31
300	-0.23	1.12	0.30
301	0.21	1.24	0.07
302	0.09	1.51	0.14
303	0.70	0.60	0.14
304	0.18	0.88	0.23
305	-0.37	0.80	0.13
306	0.27	0.74	0.21
307	2.81	0.94	0.18
308	0.78	0.95	0.27
309	0.20	0.87	0.02
310	1.56	0.59	0.11

Appendix F. ICC curves for IRT equating analysis performed with siblings in Round 4



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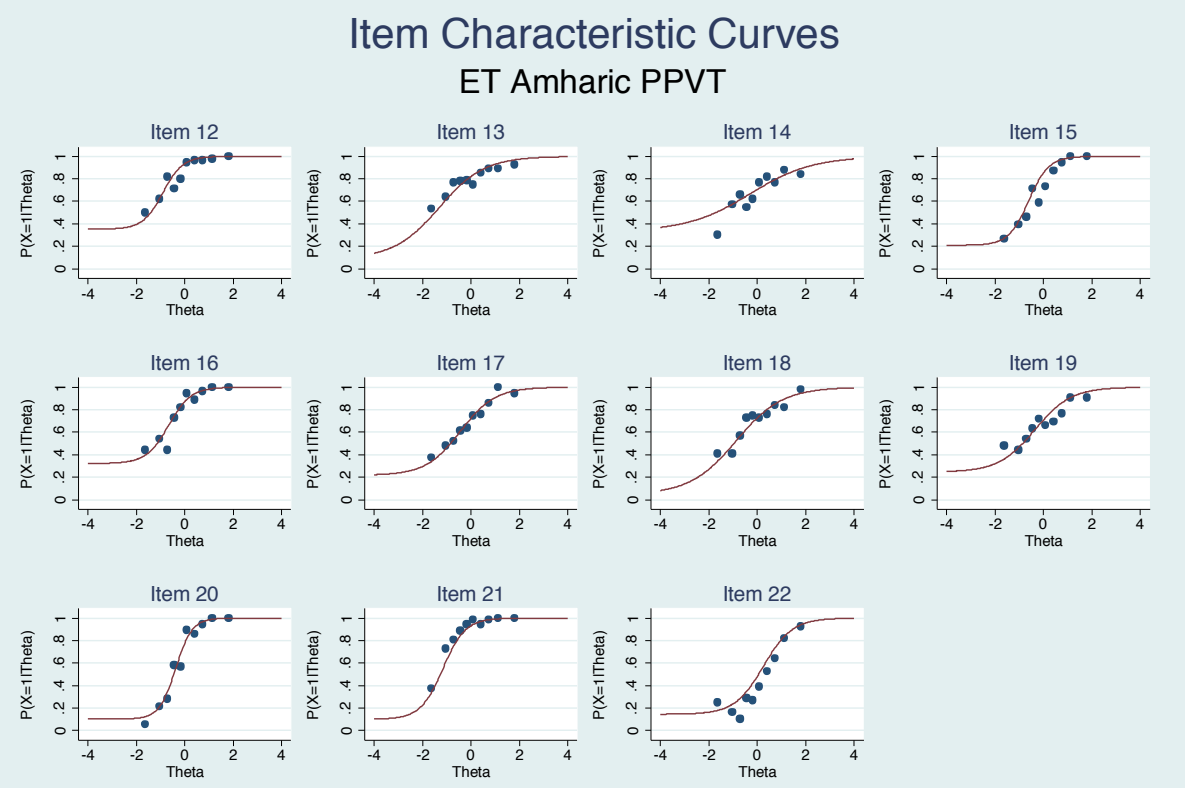

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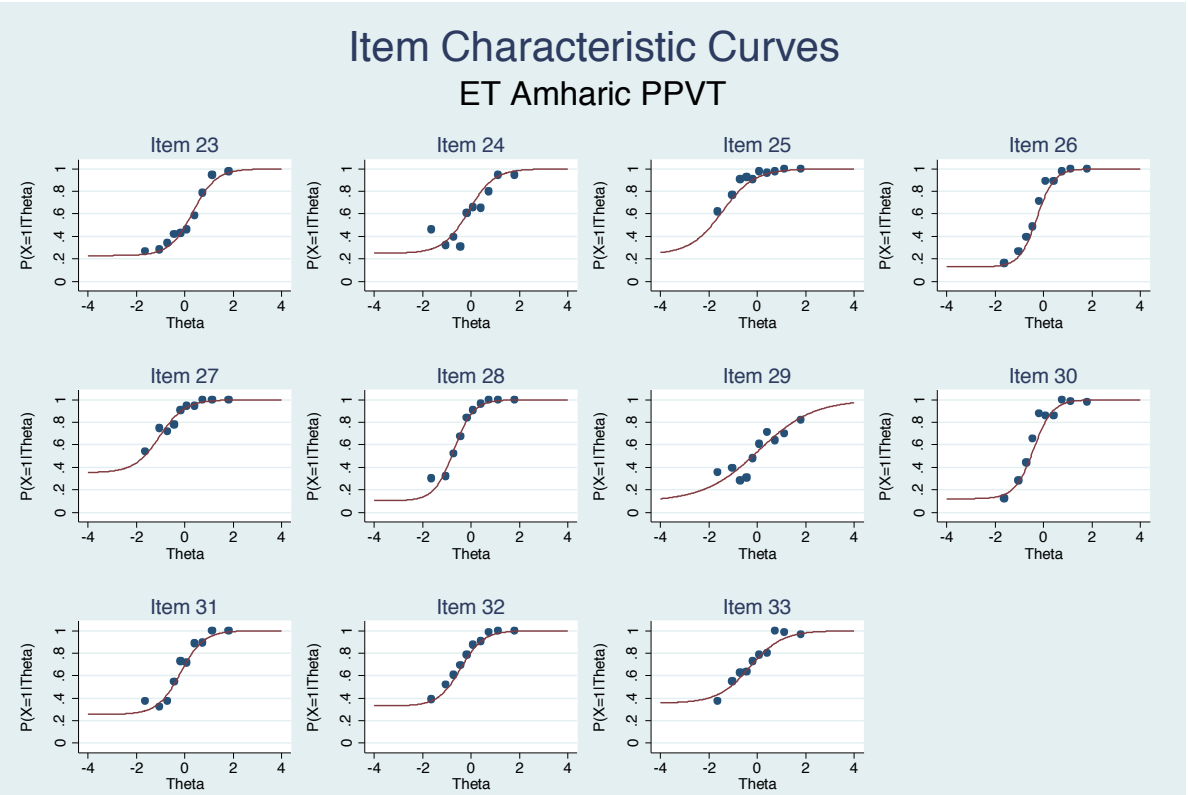
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Item 23
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Item 26
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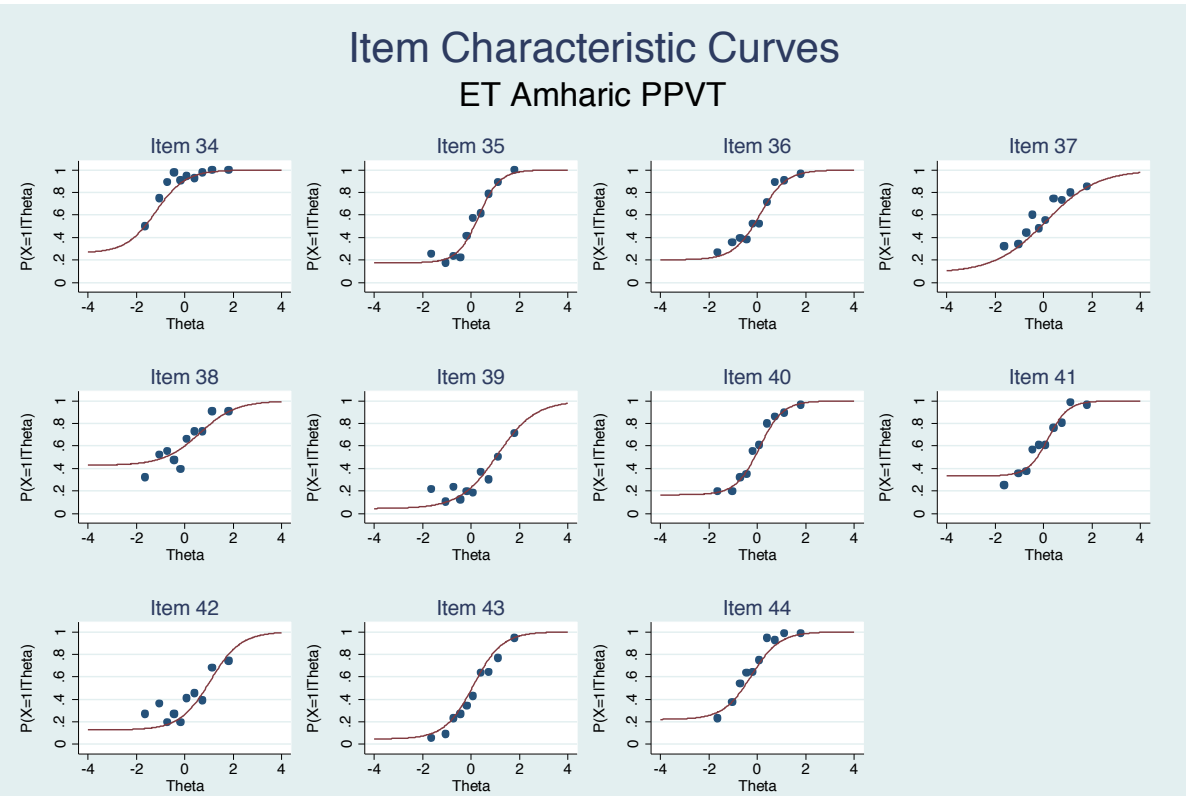
Item 28
Item 29
Item 30
Item 31
Item 32
Item 33
P(X=1|Theta)
Theta
Sibling data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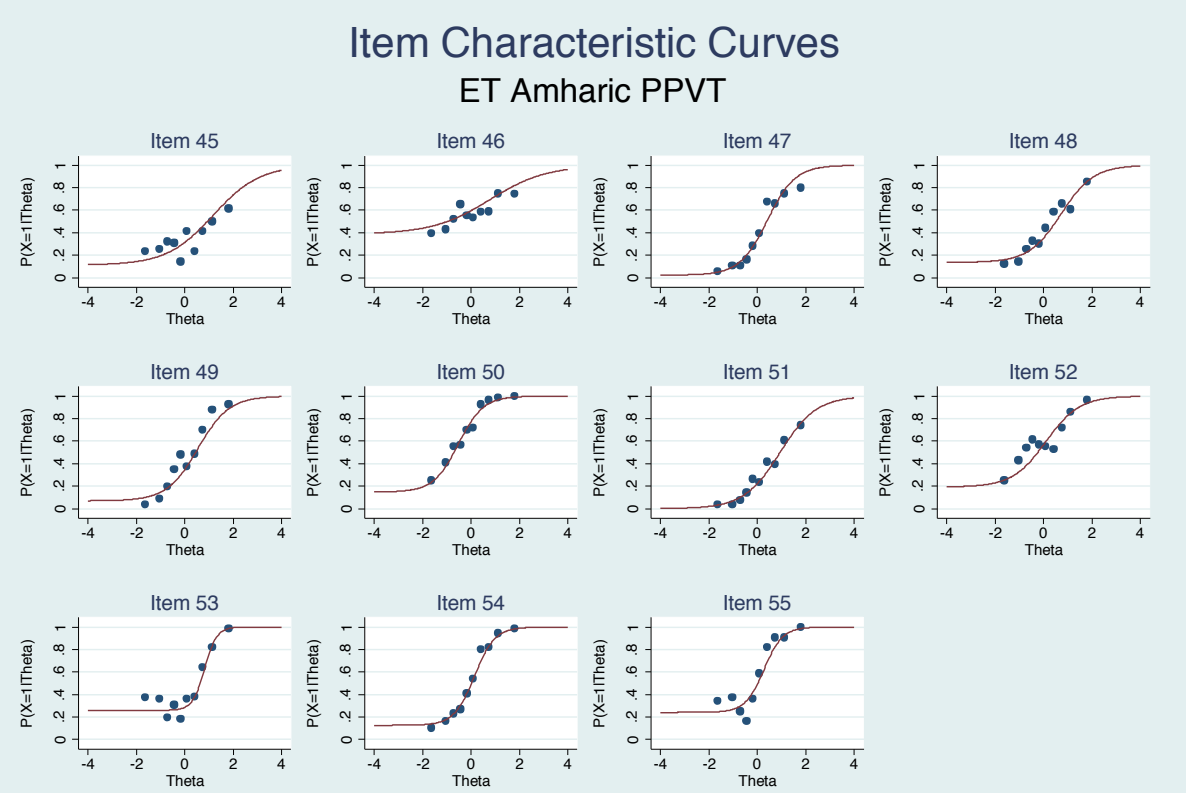
Item 40
Item 41
Item 42
Item 43
Item 44
P(X=1|Theta)
Theta
Sibling data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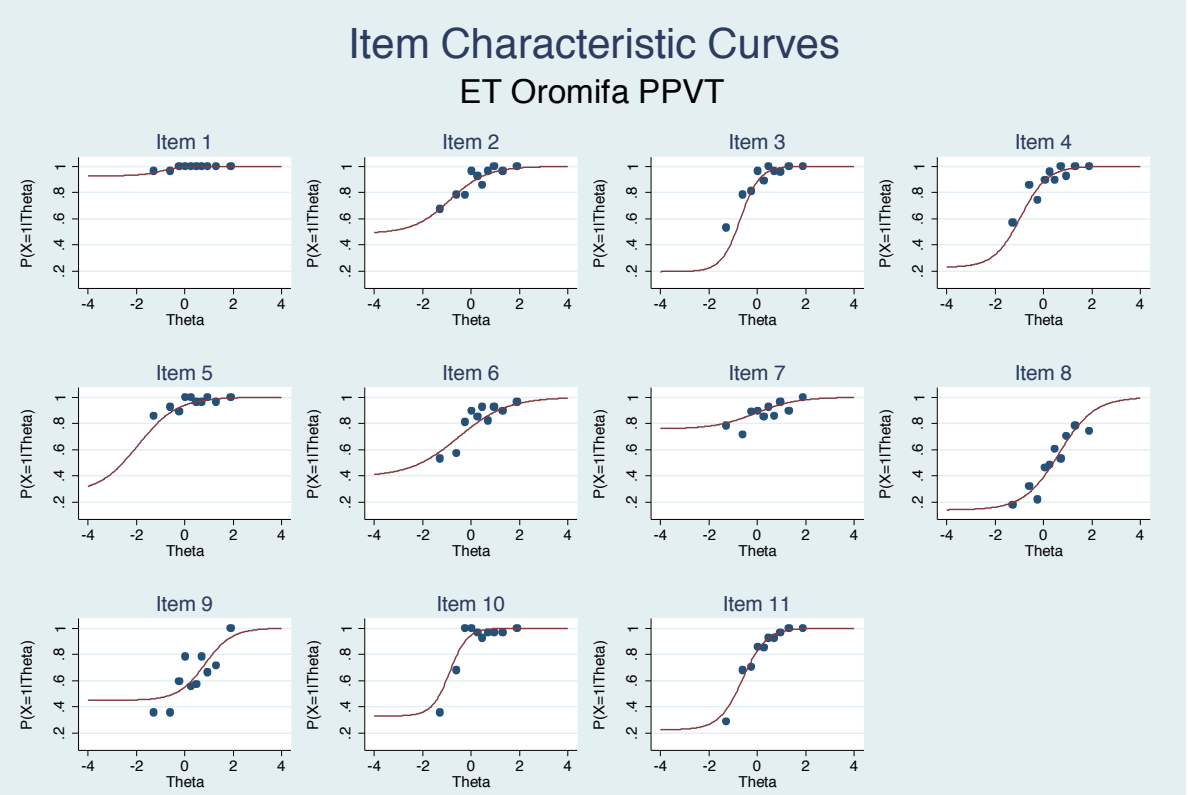
Item 54
Item 55
P(X=1|Theta)
Theta
Sibling data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Item 7
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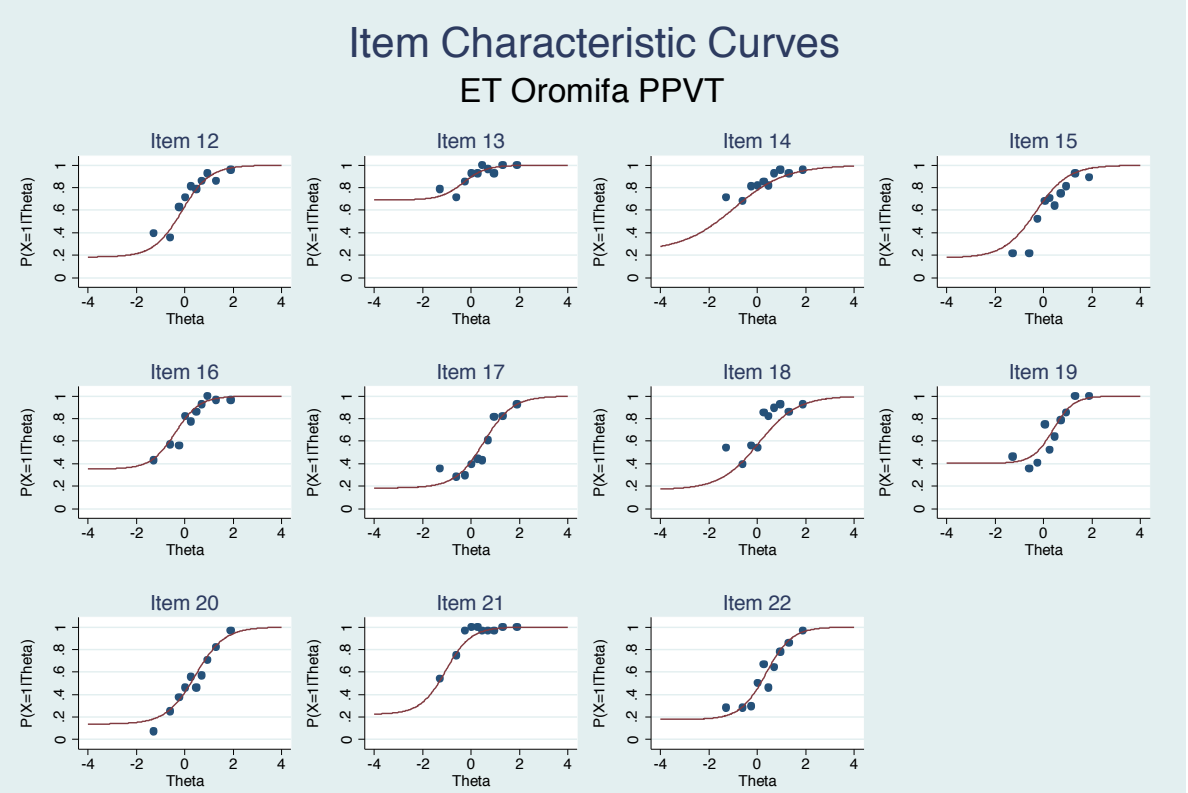
Item 9
Item 10
Item 11
P(X=1|Theta)
Theta
Sibling data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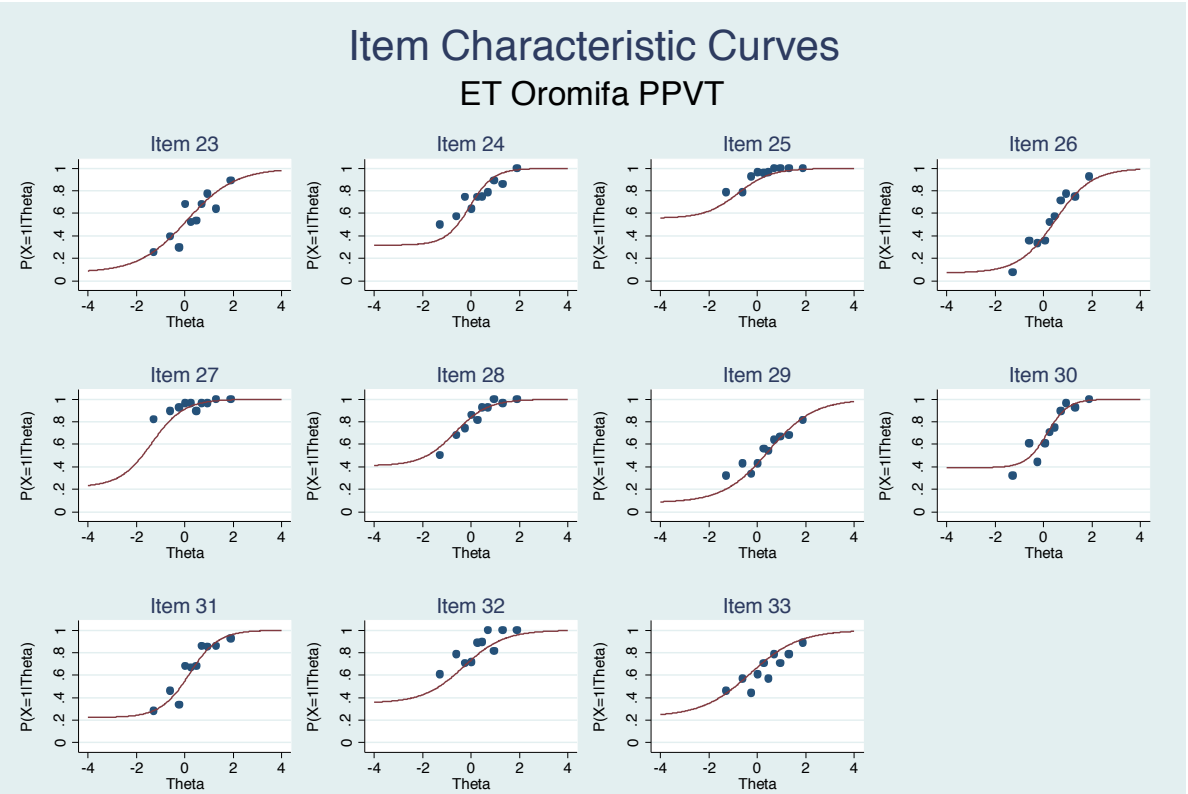
Item 19
Item 20
Item 21
Item 22
P(X=1|Theta)
Theta
Sibling data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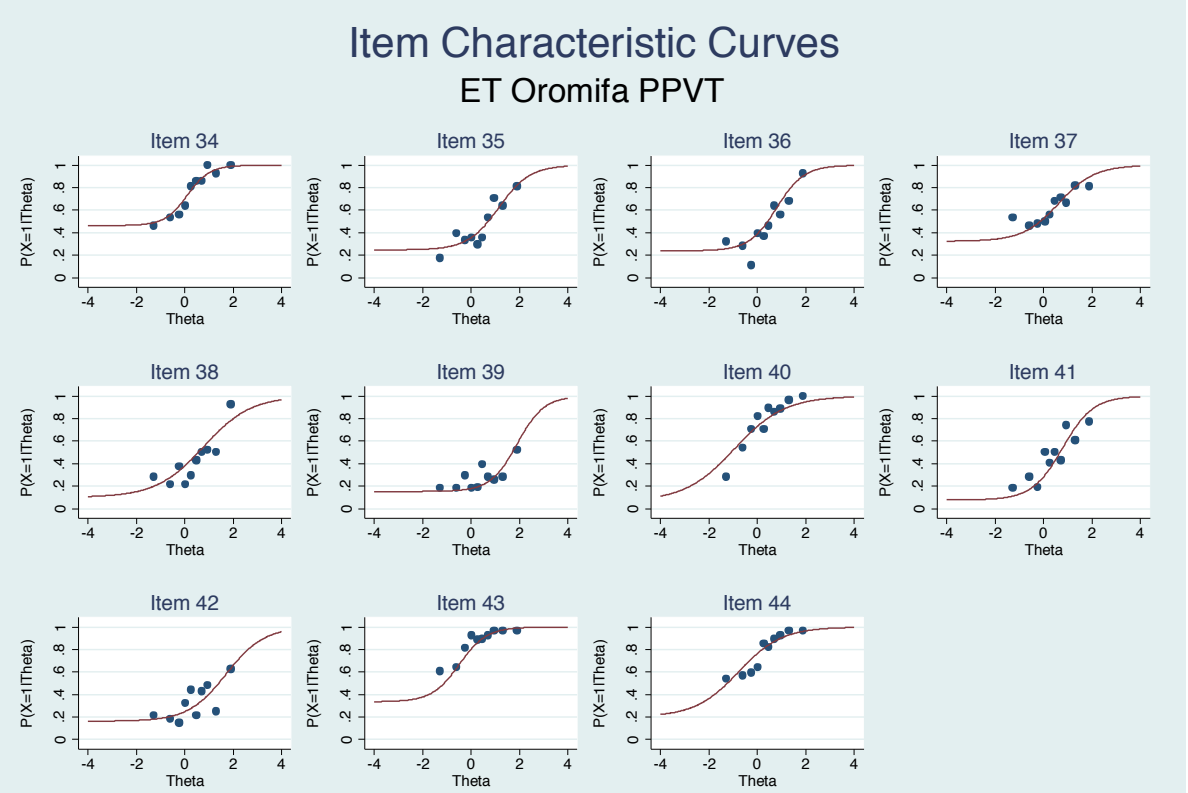
Item 31
Item 32
Item 33
P(X=1|Theta)
Theta
Sibling data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ET Oromifa PPVT
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Item 39
Item 40
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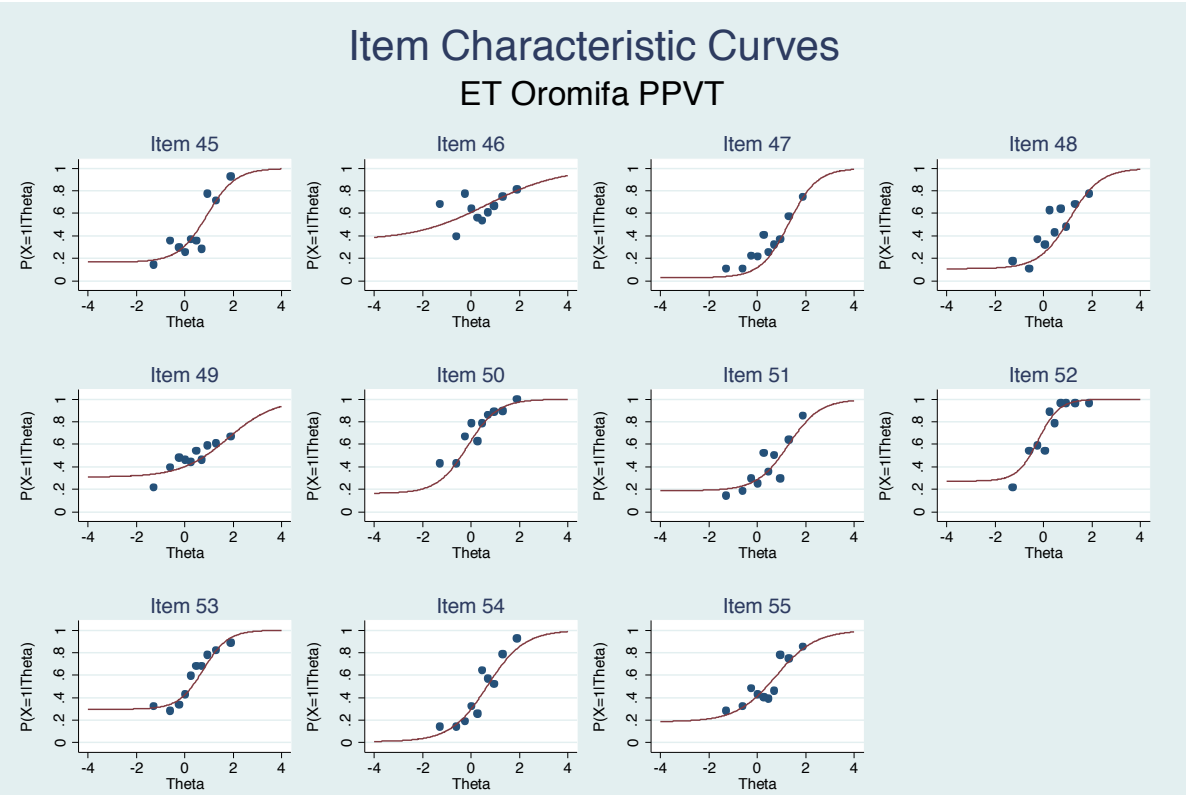
Item 42
Item 43
Item 44
P(X=1|Theta)
Theta
Sibling data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Item 51
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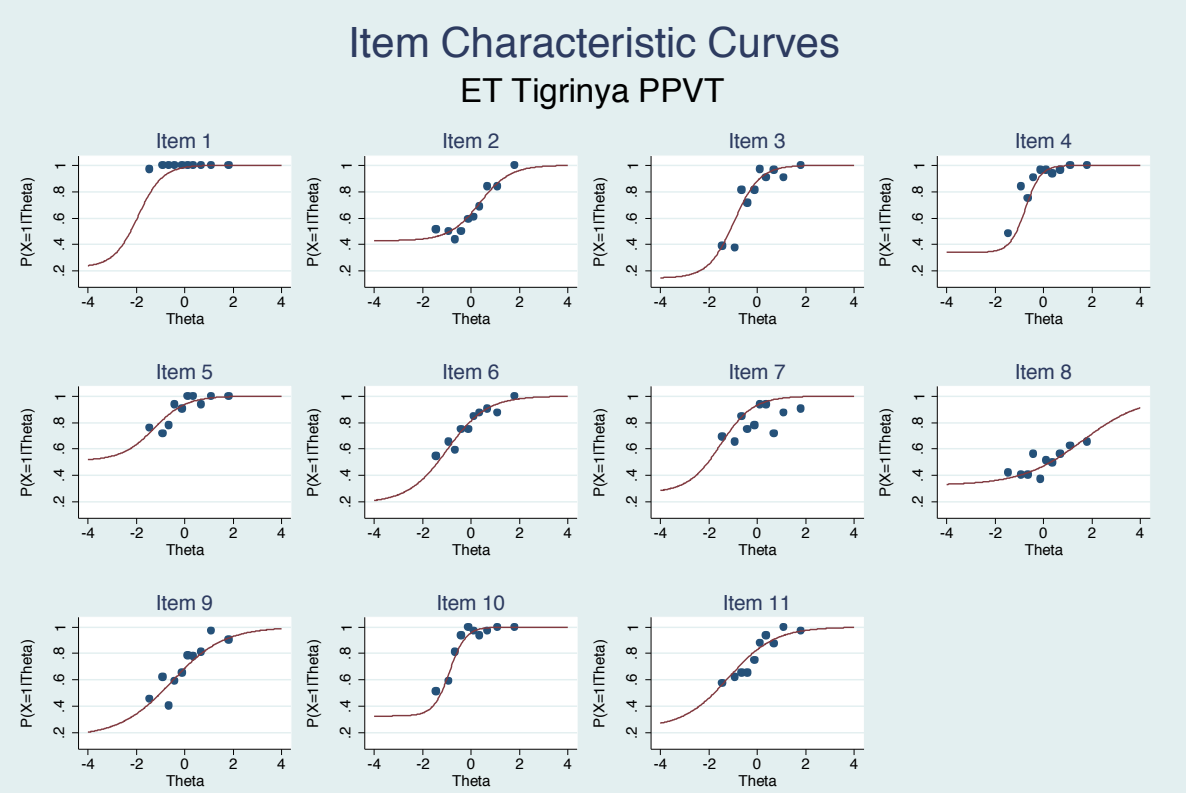
Item 53
Item 54
Item 55
P(X=1|Theta)
Theta
Sibling data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Item 1
Item 2
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Item 4
Item 5
Item 6
Item 7
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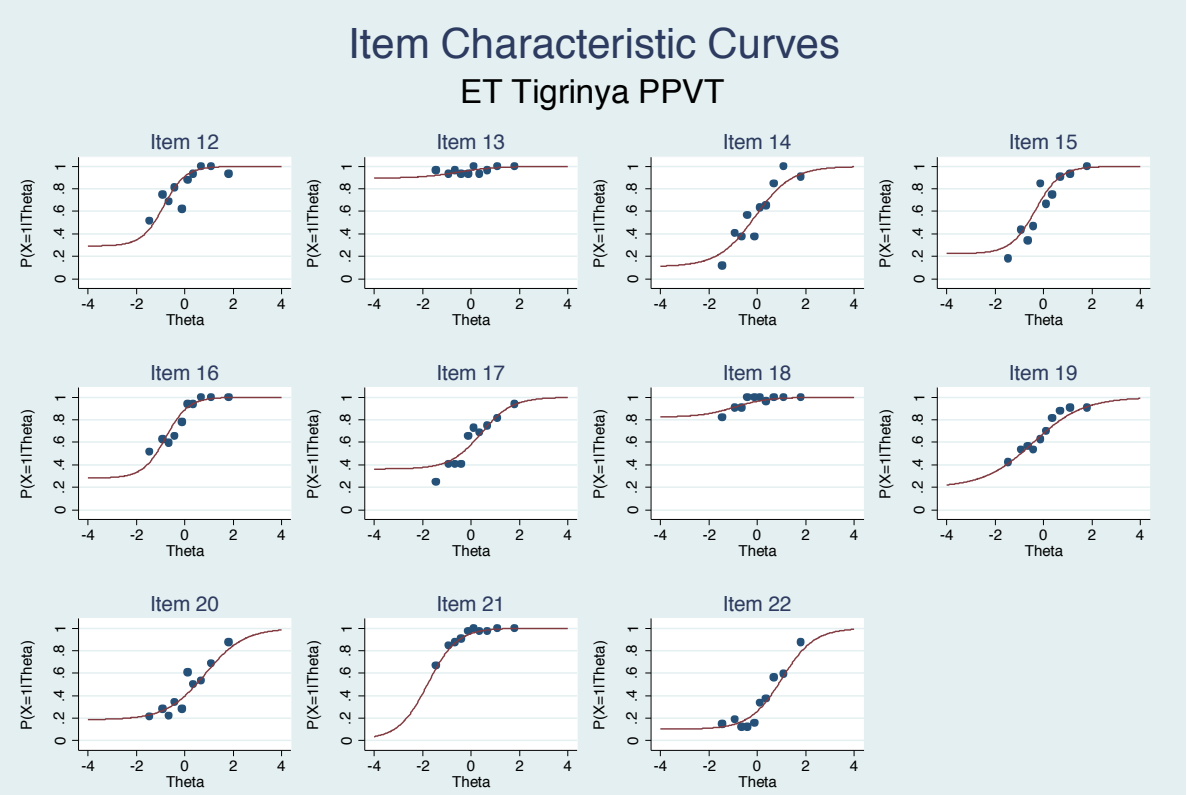
Item 10
Item 11
P(X=1|Theta)
Theta
Sibling data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Item 14
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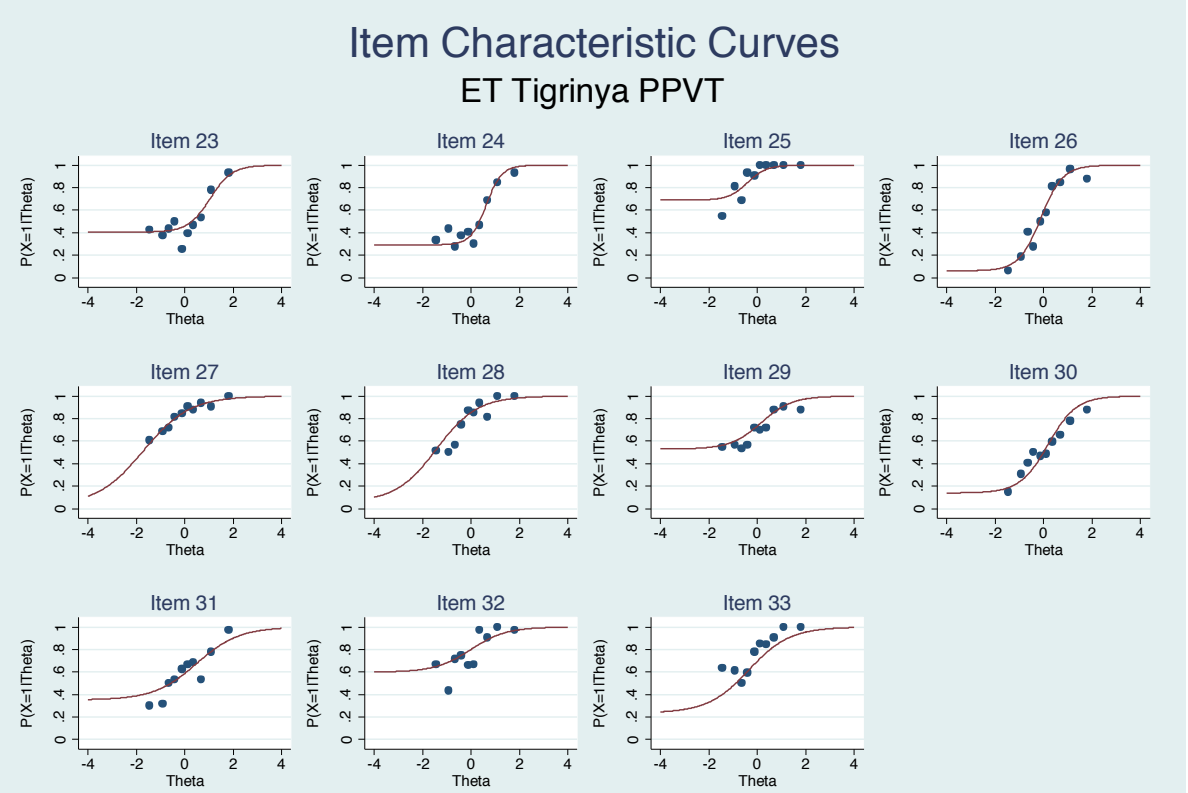
Item 17
Item 18
Item 19
Item 20
Item 21
Item 22
P(X=1|Theta)
Theta
Sibling data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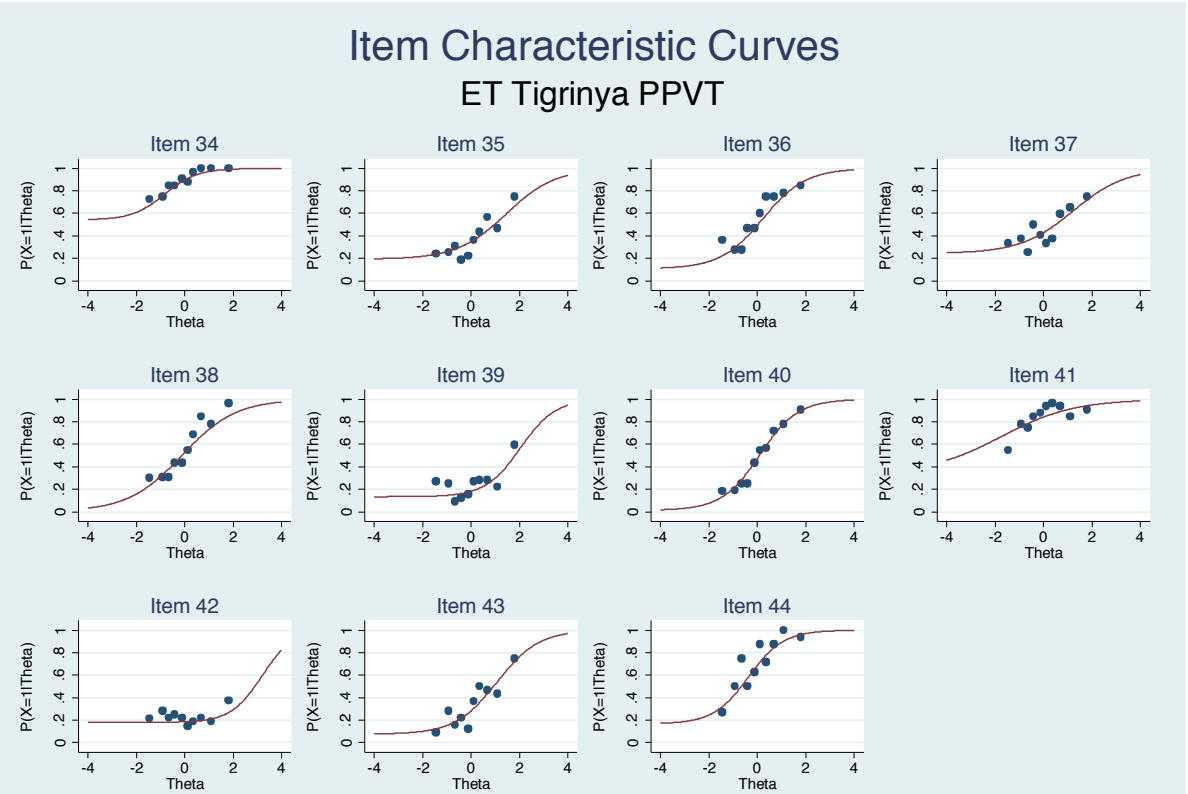
Item 31
Item 32
Item 33
P(X=1|Theta)
Theta
Sibling data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ET Tigrinya PPVT
Item 34
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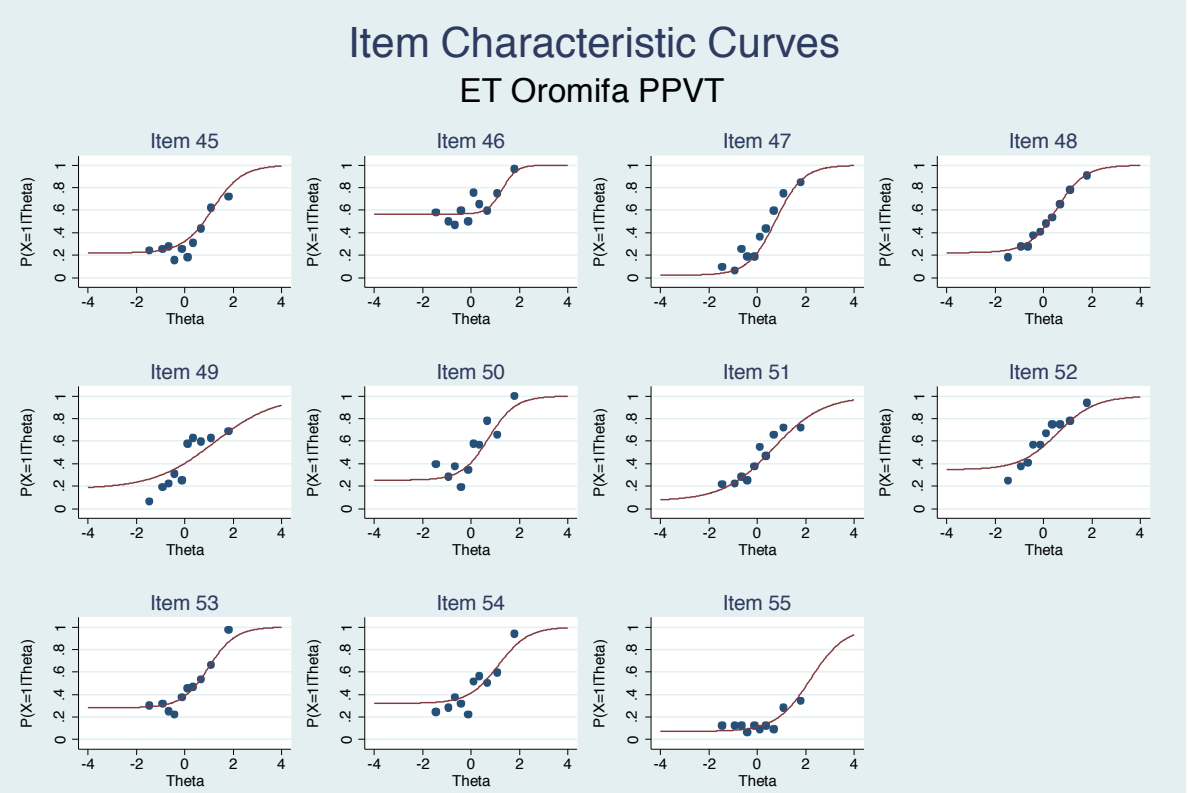
Item 39
Item 40
Item 41
Item 42
Item 43
Item 44
P(X=1|Theta)
Theta
Sibling data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Item 45
Item 46
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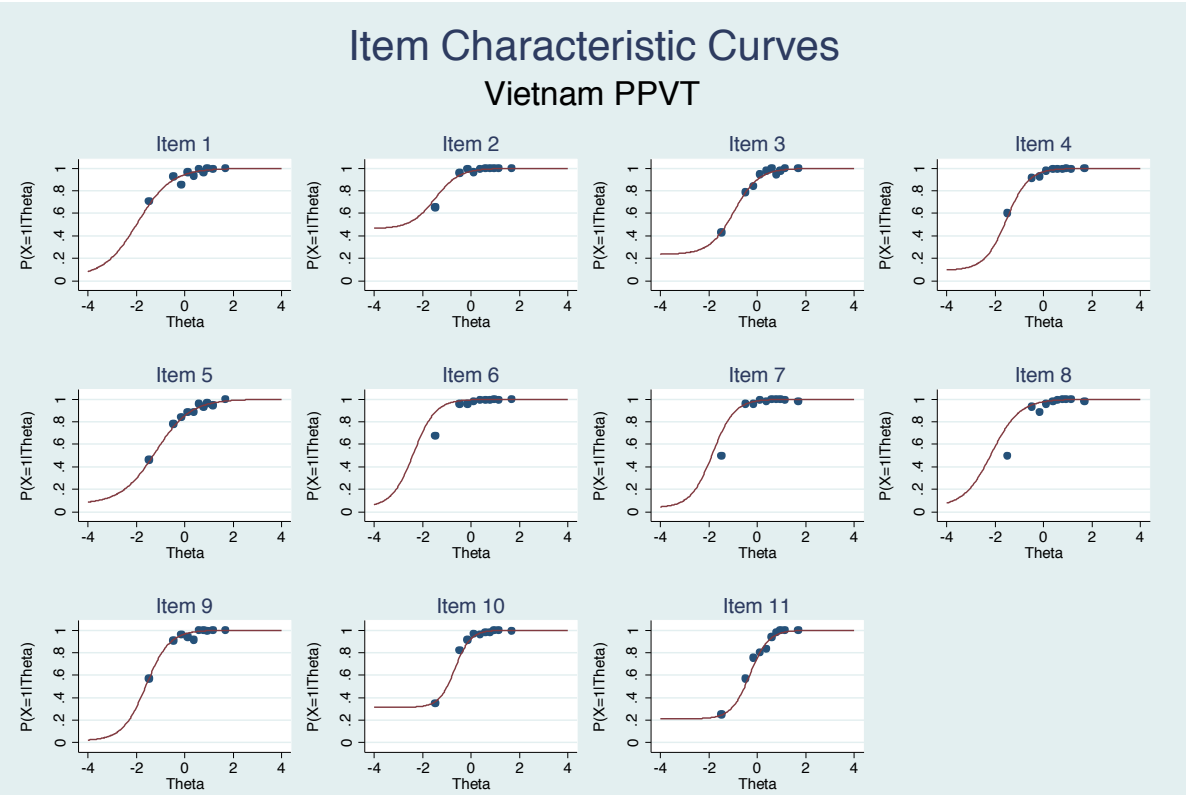
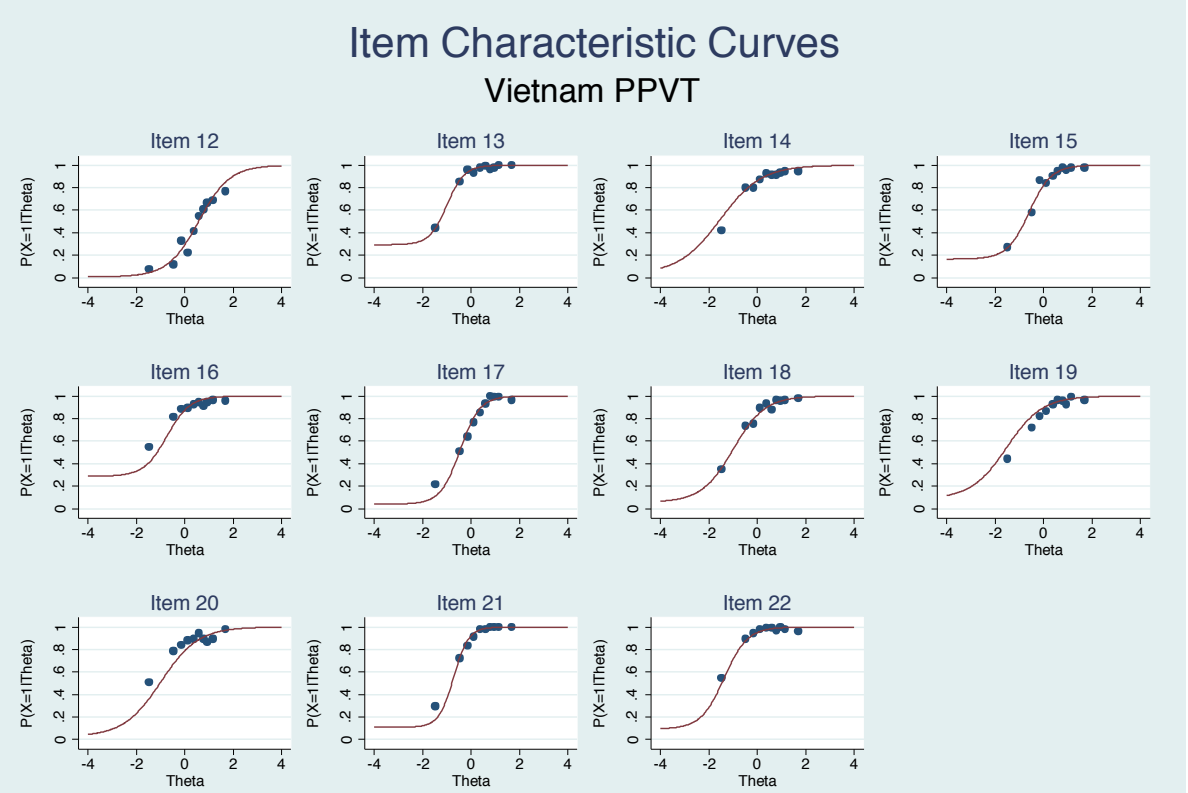
Item 50
Item 51
Item 52
Item 53
Item 54
Item 55
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
Vietnam PPVT
Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8
Item 9
Item 10
Item 11
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
Vietnam PPVT
Item 12
Item 13
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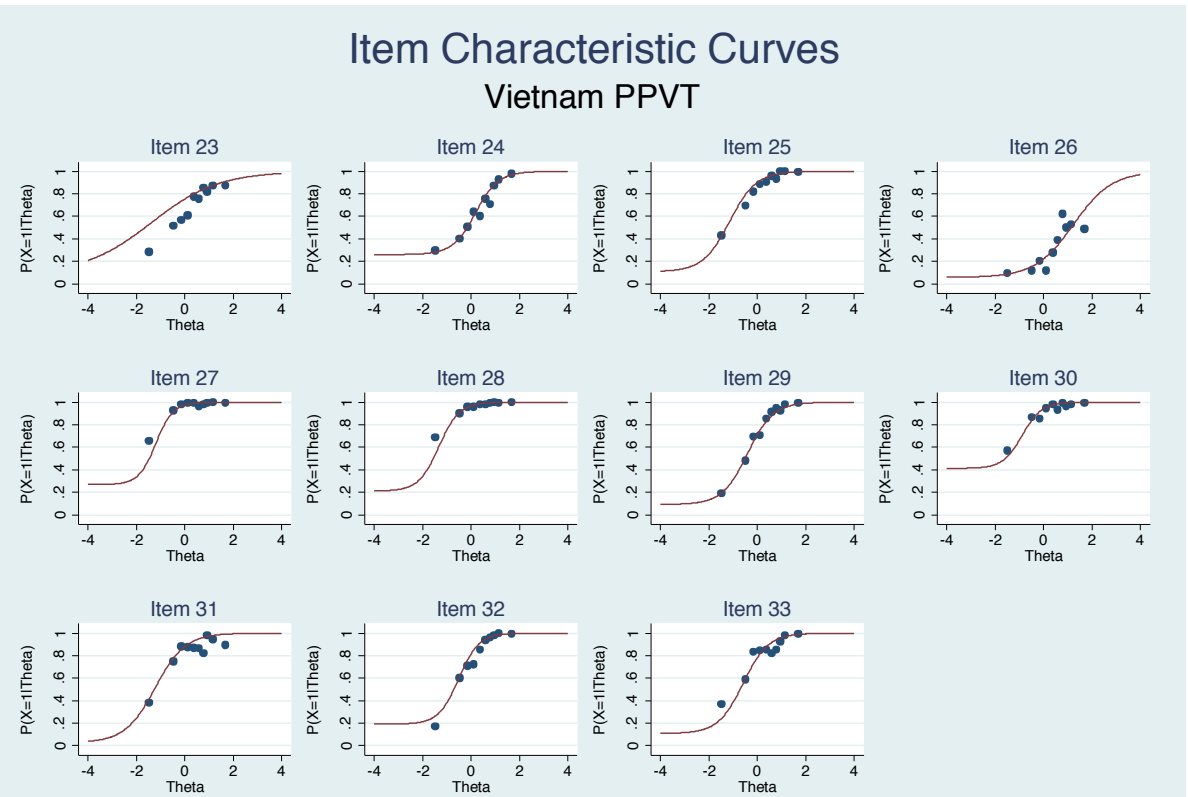
Item 17
Item 18
Item 19
Item 20
Item 21
Item 22
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
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Item 23
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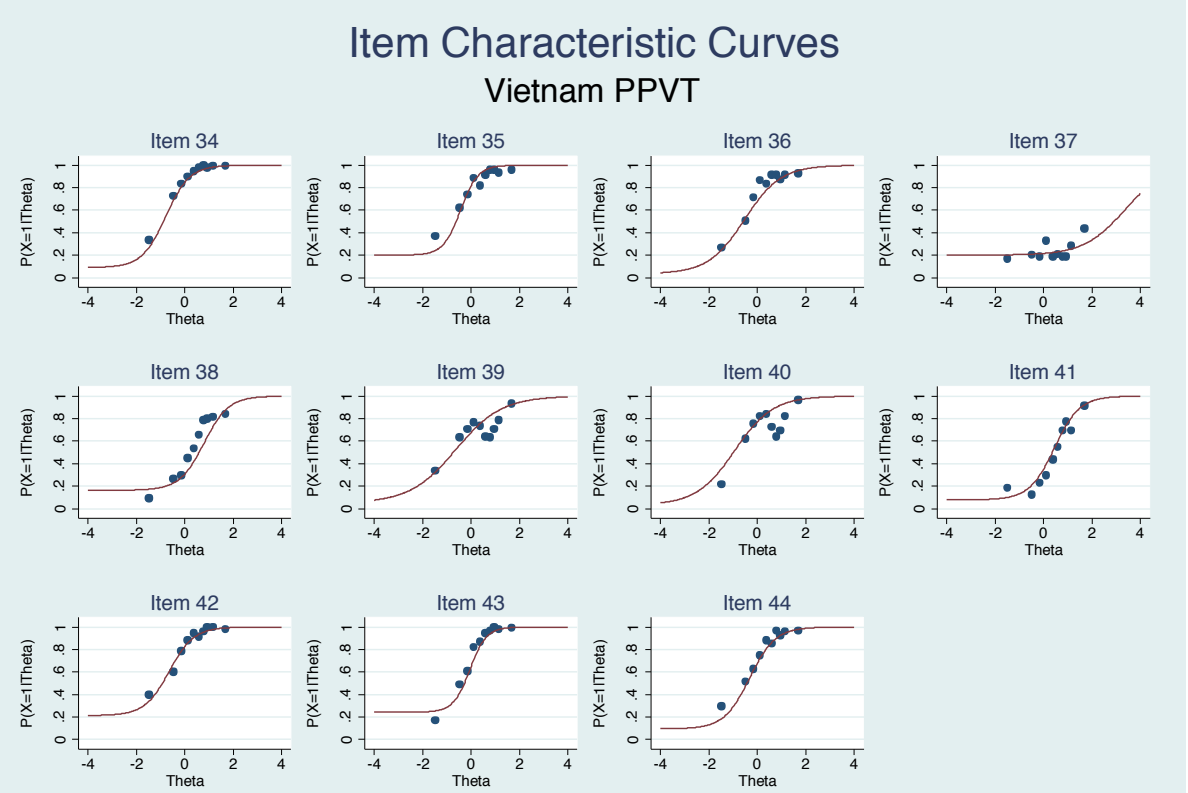
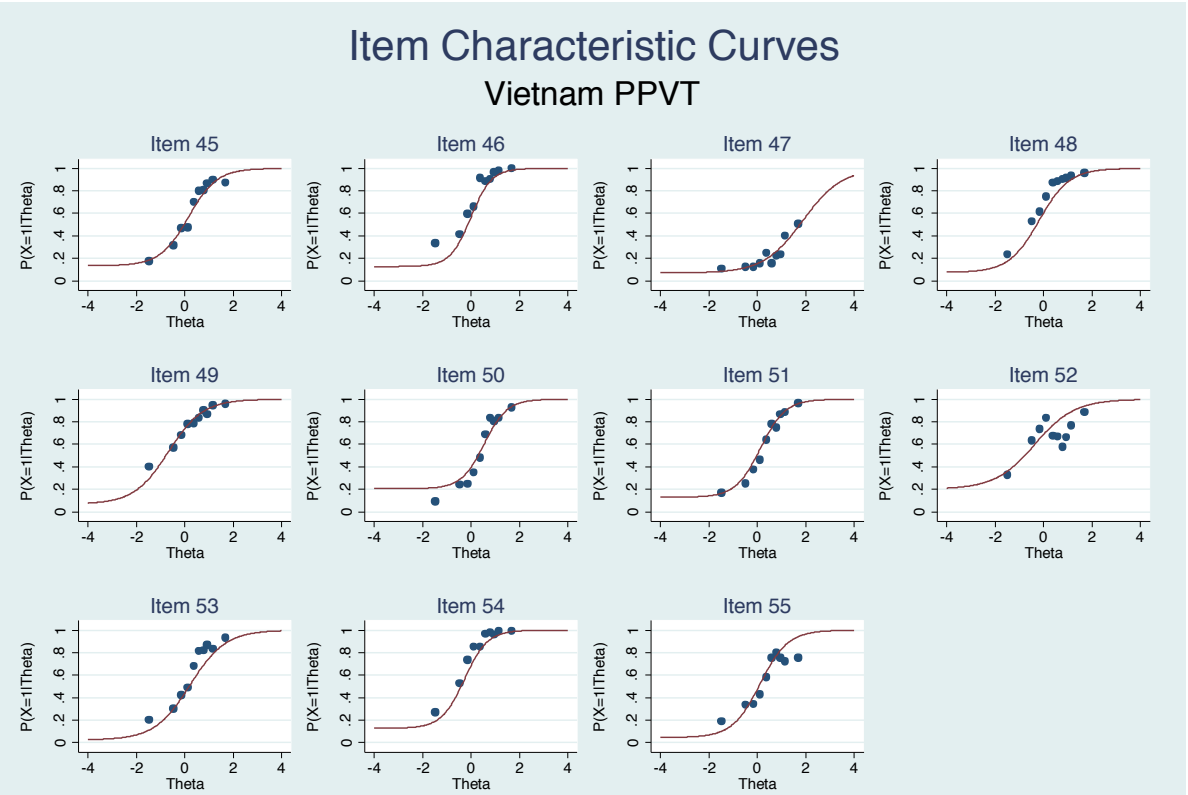
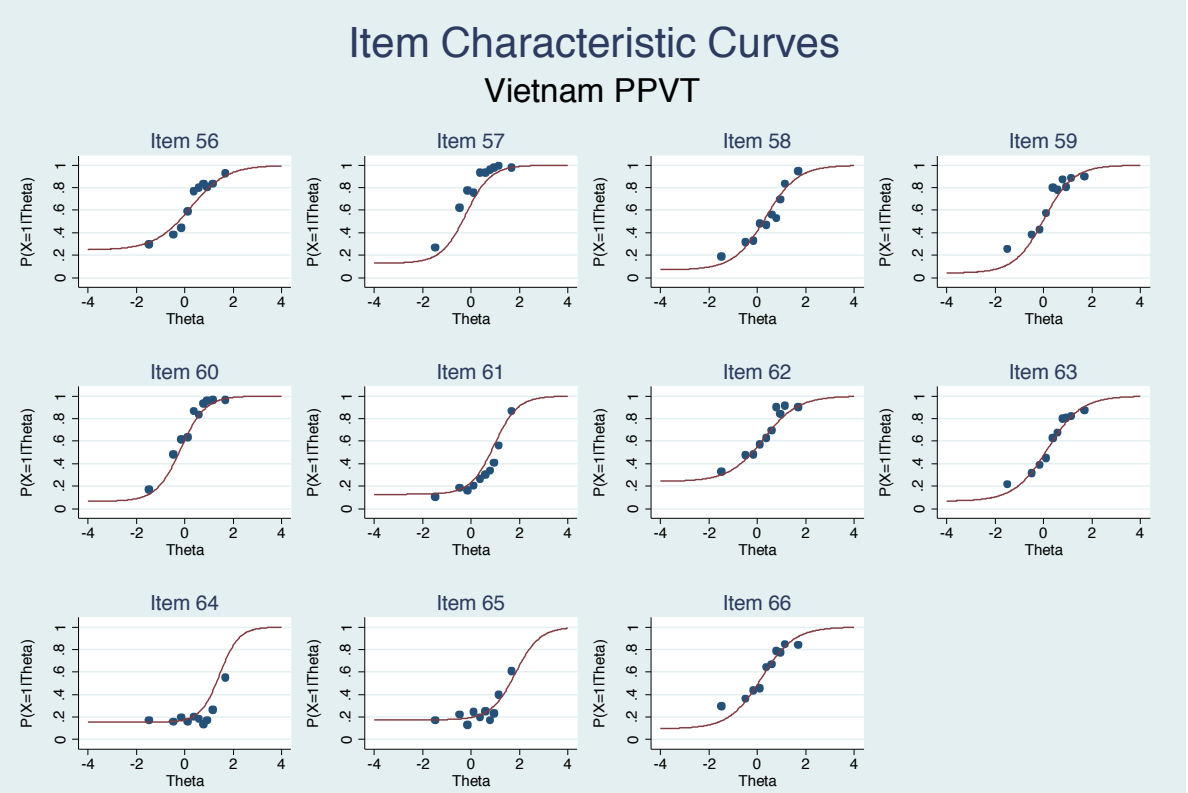
Item 26
Item 27
Item 28
Item 29
Item 30
Item 31
Item 32
Item 33
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
Vietnam PPVT
Item 34
Item 35
Item 36
Item 37
Item 38
Item 39
Item 40
Item 41
Item 42
Item 43
Item 44
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
Vietnam PPVT
Item 45
Item 46
Item 47
Item 48
Item 49
Item 50
Item 51
Item 52
Item 53
Item 54
Item 55
P(X=1|Theta)
Theta
Sibling data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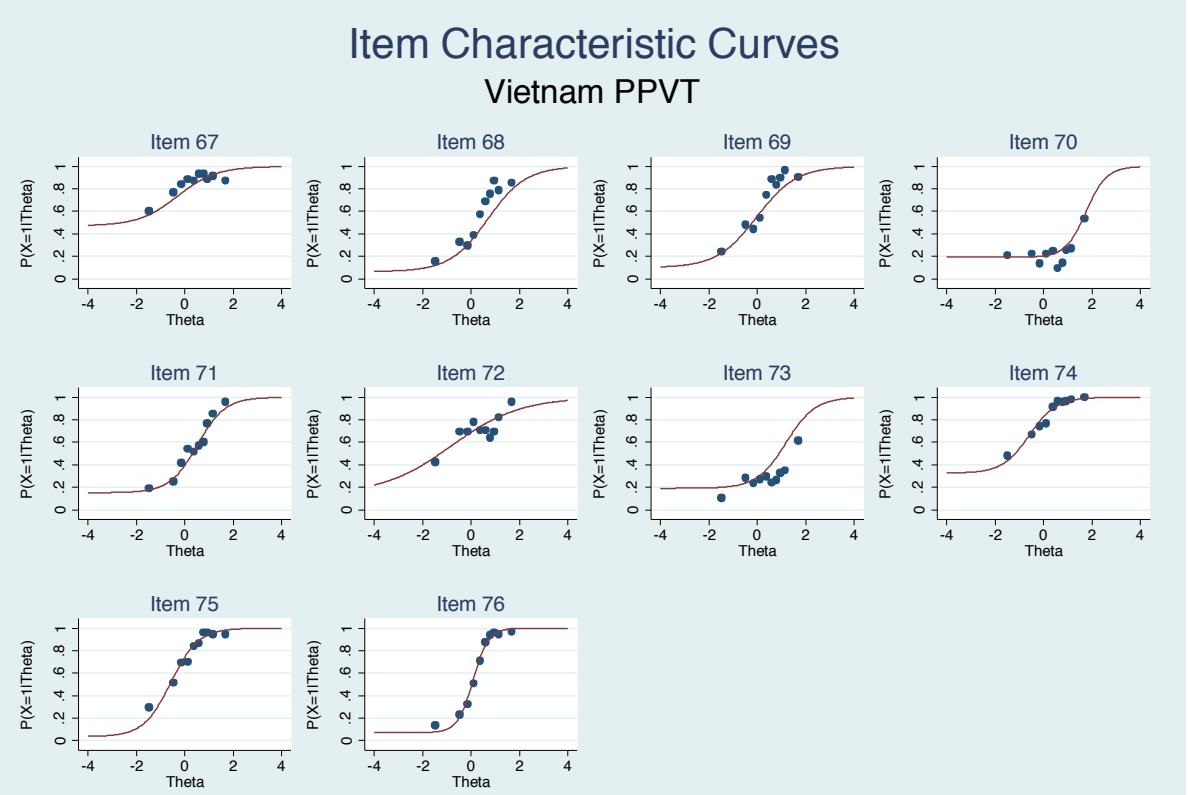
Vietnam PPVT
Item 56
Item 57
Item 58
Item 59
Item 60
Item 61
Item 62
Item 63
Item 64
Item 65
Item 66
P(X=1|Theta)
Theta
Sibling data


Item Characteristic Curves
Vietnam PPVT
Item 67
Item 68
Item 69
Item 70
Item 71
Item 72
Item 73
Item 74
Item 75
Item 76
P(X=1|Theta)
Theta
Sibling data

Appendix G. Item parameters used to equate sibling scores with main survey sample

Table 1. *Item parameters for Amharic*

Anchor Item	Item discrimination	Item Difficulty	Item Guessing
4	1.36	-2.15	0.21
8	2.15	-0.97	0.25
9	1.36	-1.05	0.33
11	1.04	-1.81	0.12
12	0.93	-0.96	0.41
23	0.84	-0.41	0.12
24	0.77	-0.80	0.27
25	1.75	-1.17	0.29
26	1.74	-0.87	0.20
28	1.43	-0.90	0.35
29	0.63	-1.31	0.09
31	1.42	-0.61	0.21
33	1.29	-0.67	0.32
35	0.83	-0.43	0.22
39	0.62	-0.87	0.05
45	0.79	-0.35	0.25
46	1.74	-0.38	0.10
47	1.27	-1.16	0.10
52	0.99	0.26	0.14
55	1.23	0.33	0.23
57	1.13	-0.10	0.25
59	0.89	-1.44	0.24
60	1.66	-0.27	0.13
63	1.14	-1.03	0.35
64	1.49	-0.71	0.10
71	0.52	0.05	0.10
74	1.51	-0.41	0.12
75	1.24	-0.17	0.25
77	1.27	-0.42	0.33
79	0.96	-1.19	0.26
80	1.36	0.31	0.18
84	0.56	0.09	0.09
88	0.76	1.10	0.04
90	1.22	0.08	0.17
92	0.94	1.05	0.13
101	0.99	0.10	0.05
103	1.02	-0.24	0.22
106	0.61	1.18	0.11
107	0.50	0.78	0.39
120	0.88	0.73	0.14
129	0.92	0.55	0.07
151	0.85	0.10	0.19
179	1.39	0.14	0.13

Table 2. *Item parameters for Oromifa*

Anchor Item	Item discrimination	Item Difficulty	Item Guessing
8	1.51	-0.70	0.20
9	1.08	-0.94	0.23
25	1.62	-0.88	0.33
26	1.22	-0.60	0.23
31	0.89	-0.31	0.18
33	1.18	-0.39	0.35
39	0.74	0.06	0.17
47	1.13	-1.04	0.22
57	1.20	-0.06	0.32
63	0.89	-1.36	0.22
84	0.80	0.63	0.32
91	0.93	0.78	0.08
92	0.75	1.71	0.16
101	1.04	-0.48	0.34
110	1.03	1.31	0.03
120	0.93	1.08	0.11

Table 3. *Item parameters for Tigrinya*

Anchor Item	Item discrimination	Item Difficulty	Item Guessing
4	1.17	-1.93	0.23
8	1.11	-0.96	0.15
9	1.87	-0.75	0.34
11	0.89	-1.26	0.51
16	0.88	-1.51	0.27
25	1.78	-0.88	0.33
28	1.31	-0.87	0.29
33	1.26	-0.79	0.28
59	1.51	-0.41	0.69
60	1.30	-0.11	0.06
74	1.02	0.19	0.14
78	0.69	-0.35	0.24
82	0.67	0.24	0.11
84	0.54	1.22	0.24
103	0.82	-0.37	0.17
106	0.97	1.15	0.22
110	1.04	0.76	0.02
120	1.01	0.54	0.22
129	0.47	1.21	0.18
130	1.07	0.73	0.25
131	0.57	0.65	0.07
151	0.76	0.58	0.35

Table 4. *Item parameters for Vietnam*

Anchor Item	Item discrimination	Item Difficulty	Item Guessing
5	0.85	-1.94	0.04
12	1.18	-1.49	0.46
28	1.31	-2.37	0.04
31	1.32	-1.84	0.04
33	1.03	-2.14	0.04
35	1.23	-1.59	0.02
39	1.83	-0.67	0.31
40	1.55	-0.30	0.21
43	1.64	-0.99	0.29
48	1.25	-0.74	0.29
57	0.80	-1.52	0.09
59	0.77	-0.98	0.03
60	1.93	-0.71	0.11
64	1.23	-1.37	0.09
65	0.43	-1.37	0.09
70	1.07	-1.14	0.11
74	1.66	-1.19	0.27
75	1.41	-1.33	0.21
76	1.12	-0.40	0.09
77	1.47	-0.88	0.41
78	0.95	-1.22	0.03
80	1.41	-0.50	0.19
81	1.14	-0.58	0.11
82	1.20	-0.78	0.09
83	1.66	-0.43	0.20
84	0.78	-0.53	0.04
87	1.16	0.79	0.16
88	0.62	-0.63	0.05
90	0.75	-0.93	0.03
96	1.73	-0.05	0.24
97	1.11	-0.31	0.09
98	1.00	0.15	0.13
100	1.39	-0.01	0.13
106	0.95	-0.18	0.08
108	0.83	-0.67	0.07
109	1.25	0.54	0.20
111	1.15	0.13	0.13
112	0.72	-0.36	0.20
115	0.80	0.22	0.02
116	1.24	-0.27	0.13
120	1.03	0.12	0.05
122	0.80	0.24	0.25
123	1.16	-0.21	0.13
125	0.90	0.34	0.07
128	0.97	0.02	0.04
130	1.18	-0.16	0.07
138	1.22	0.95	0.13
152	0.83	0.26	0.24
158	1.50	1.44	0.15
167	0.73	-0.29	0.47
168	0.75	0.69	0.06
171	0.72	-0.02	0.10
173	1.39	1.75	0.19
178	1.03	0.52	0.15
180	0.99	1.19	0.19

Equating Test Scores for Receptive Vocabulary Across Rounds and Cohorts in Ethiopia, India and Vietnam

Young Lives

An International Study of Childhood Poverty

About Young Lives

Young Lives is an international study of childhood poverty, involving 12,000 children in 4 countries over 15 years. It is led by a team in the Department of International Development at the University of Oxford in association with research and policy partners in the 4 study countries: Ethiopia, India, Peru and Vietnam.

Through researching different aspects of children's lives, we seek to improve policies and programmes for children.

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Young Lives is coordinated by a small team based at the University of Oxford, led by Professor Jo Boyden.

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- *Instituto de Investigación Nutricional (IIN), Peru*
- *Centre for Analysis and Forecasting, Vietnamese Academy of Social Sciences, Vietnam*
- *General Statistics Office, Vietnam*
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