Understanding Response Processes in Noncognitive Measures with Explanatory Item Response Modeling

Okan Bulut

Centre for Research in Applied Measurement and Evaluation

University of Alberta

Hilal Çelik

Marmara University

Ming Lei

American Institutes for Research

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Abstract

A common criticism of noncognitive measures is the potential for cultural influences in response processes. This study employs explanatory item response modeling to understand the effects of various demographic variables on response processes, using a measure of social support. Results support validity concerns due to high sensitivity of noncognitive measures.

Keywords: Noncognitive measures, socio-emotional learning, social support, invariance, validity, response process.

Understanding Response Processes in Noncognitive Measures with Explanatory Item Response Modeling

Response process data can be helpful to understand how individuals understand and interpret items and whether individuals from different backgrounds engage in similar response processes (Ercikan & Pellegrino, 2017; Kopriva & Wright, 2017). A common criticism of noncognitive measures is the potential for cultural influences in response processes. For example, while students are away from their families, they may have different feelings and expectations about social support they receive, depending on their age, gender, and family relationships (Dwyer & Cummings, 2001), and thus respond differently to a measure of social support. To highlight differential effects, investigations of response processes can focus on item features that may be associated with item parameters, as well as whether such associations are invariant in diverse communities.

According to Embretson (2016), "explanatory IRT models can be applied to traditional item response data to understand response processes" (pp. 20-21). The effects of cognitive features of items are inherently important aspects of the internal structure of a measure. Moreover, various combinations of item features may differentially affect associations with other variables and result in DIF, and ultimately "could impact the *consequential* aspect of validity" (p. 21).

Current Study

This study explores differential response processes based on item and person characteristics in a measure of *social support*. Our research question is whether the item referent (expecting versus feeling) influences item parameter estimates, depending on gender, socio-economic status (SES), family type (conservative or liberal), and age groups.

Method

We used data from a sample of students (n=728) from 67 universities across Turkey (Gender: male=30%, female=70%; Age: M=24.9, SD = 5.5). The students completed the Social Support Scale (Frias, 2011). The first eleven items ask about social support behaviors that a person would *expect* when he or she is in trouble or in need; the second set of eleven items ask about the same behaviors that a person would actually *feel* (see the Appendix for the items). The response options are based on a 6-point Likert scale. The scale showed high internal consistency (alpha = .911). Furthermore, it indicated a unidimensional structure

based on confirmatory factor analysis (CFI = .93, TLI = .93, and RMSEA = .07) with Mplus (Muthén & Muthén, 1998-2015).

We used the explanatory partial credit model (EPCM) to analyze the effects of the item referent (feeling vs. expecting), gender (male or female), SES (low, medium, or high), family type (conservative or liberal), and age groups (18-30, 31-40, or 41-50). In the EPCM, the log-odds of selecting response *j* over *j* −1 on item *i* for person *n* can be written as:

$$\log\left(\frac{P_{nij}}{P_{ni(j-1)}}\right) = \mathbf{Z_{nij}}\theta_n - \mathbf{X'_{nij}}(\delta_i + \tau_{ij}), \quad (1)$$

where $\mathbf{Z}_{nij}$ is a matrix of fixed- and random-effects related to the latent trait θ_n. $\mathbf{X}_{nij}$ is a matrix of fixed- and random-effects related to individual items. $\boldsymbol{\delta_i}$ is the location of the threshold between the first (*j* = 0) and second (*j* = 1) response categories for item *i*. τ_{ij} is the distance between the other thresholds.

Two types of models were evaluated (see Table 1), where the effects of item and person covariates were estimated as fixed effects. With these models, we can estimate model fit to the data conditioning on item characteristics (Model 1), and compare the fit to the models where we can account for the interaction between item and person characteristics (Model 2). The models are estimated with *lme4* (Bates et al., 2015) in R (R Core Team, 2018). Model fit indices are evaluated, as well as model parameters.

Results

The model-fit indices in Table 2 show that the variants of Model 2 with item referent and its interaction with person covariates seem to the fit the data better than Model 1 with only item referent. Model 2 with the interaction of item referent and SES indicates the best fit (see the Appendix for full model outputs).

Figure 1 highlights the difference between “expecting” and “feeling” items, where it is easier to endorse one of the “disagree” options for the feeling items and easier to endorse “Strongly agree” for the expecting items. Figures 2 to 5 demonstrate the differential effects of person covariates. Most interesting patterns are observed for SES and age groups. For example, students from medium and high SES families are more likely to endorse disagree options for the feeling support items than students from low SES families.

Furthermore, students within the 41-51 age group are more likely to choose disagree options for both feeling and expecting items, compared to younger students.

Overall, the results suggest that the functioning of the Social Support Scale may not be invariant across different SES and age categories. For more accurate interpretation of expectations and feelings about social support, scaling and scoring of the items should be done separately for different SES and age groups.

References

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Table 1

Explanatory Partial Credit Models Used in the Study

Model	Predictors
Model 1	Item referent
Model 2	Item referent * gender
Model 2	Item referent * SES
Model 2	Item referent * family type
Model 2	Item referent * age groups

Table 2

Model Fit Indices for the Explanatory Partial Credit Models

Model	AIC	BIC	logLikelihood	Deviance
Model 1	34085	34298	-17017	34034
Model 2 – Gender	33881	34175	-16905	33809
Model 2 – SES	31857	32230	-15882	31765
Model 2 – Family Type	33762	34057	-16845	33691
Model 2 – Age	33667	34043	-16788	33575

Note: Model 1: main effects for the item referent. Model 2: includes interactions for the item referent and person characteristics.

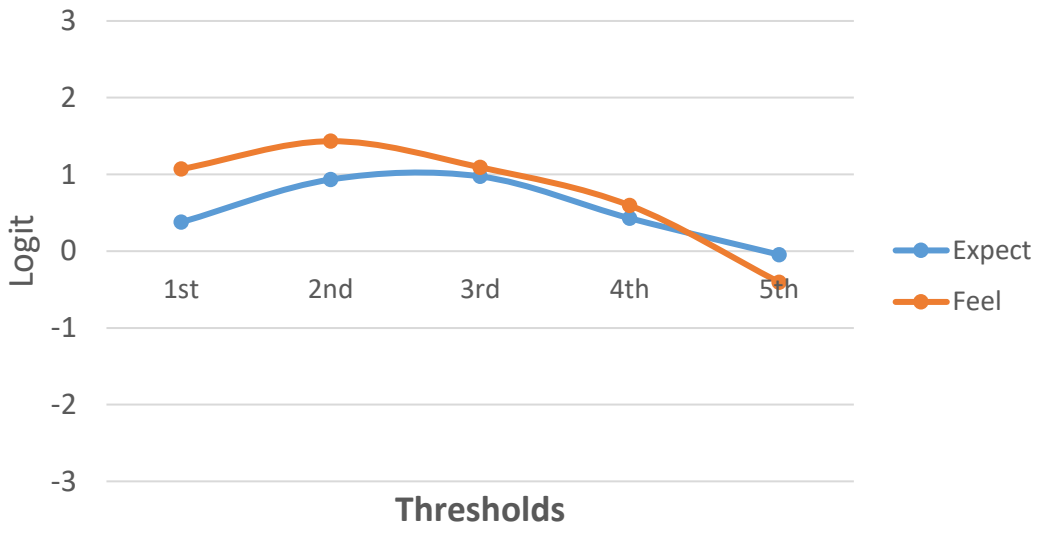

Figure 1. Locations of the item thresholds across the "expecting" and "feeling" categories

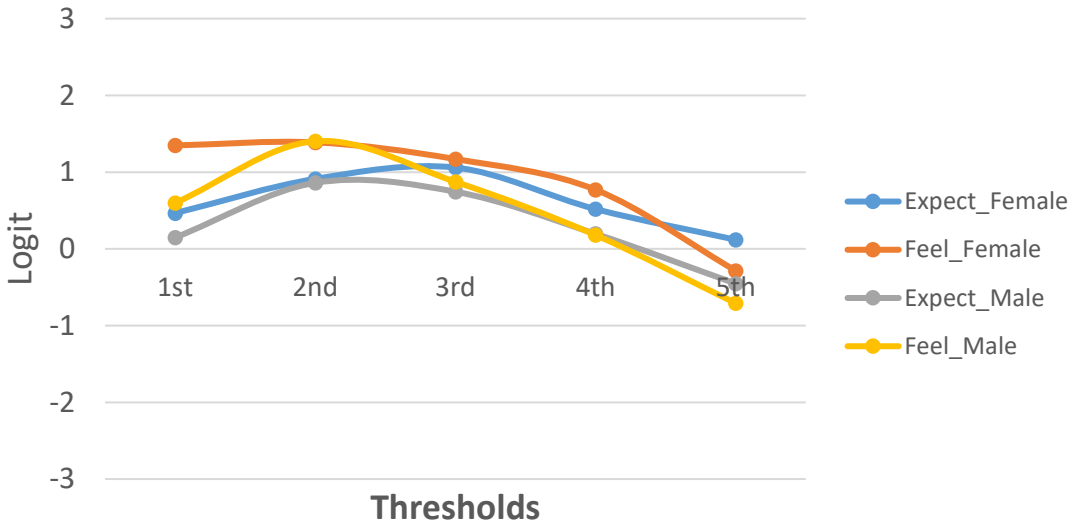

Figure 2. Locations of the item thresholds across the "expecting" and "feeling" categories and gender

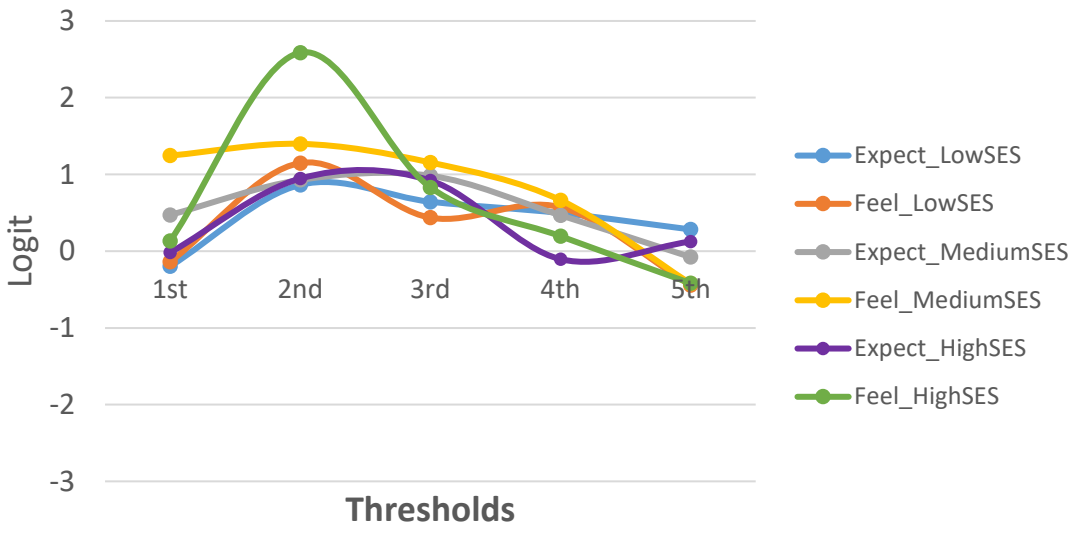

Figure 3. Locations of the item thresholds across the "expecting" and "feeling" categories and SES

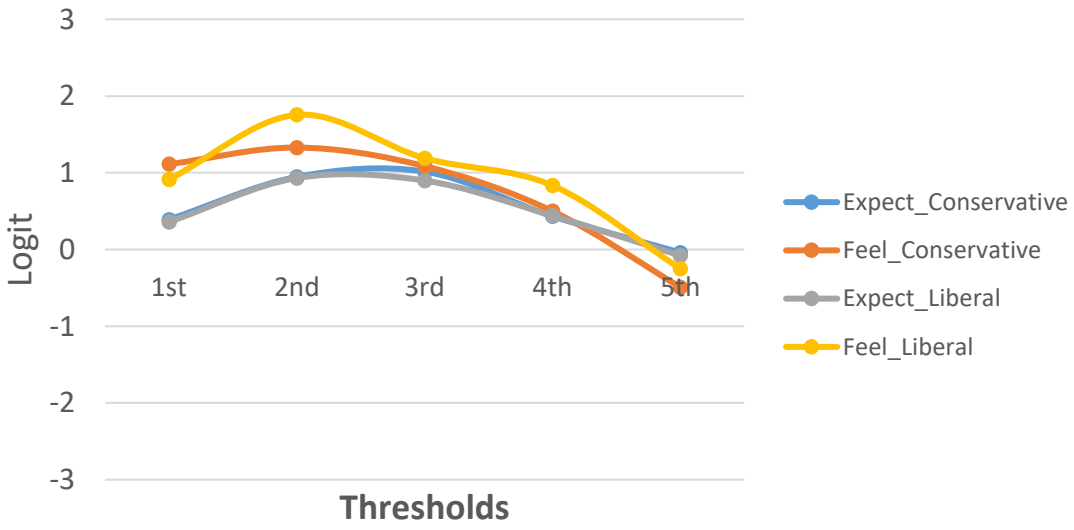

Figure 4. Locations of the item thresholds across the "expecting" and "feeling" categories and family type

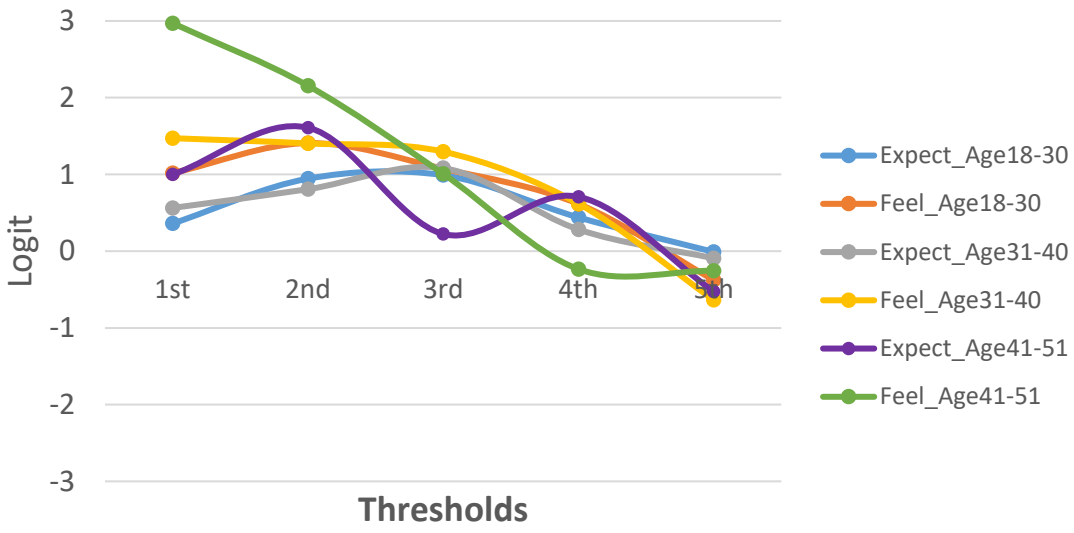

Figure 5. Locations of the item thresholds across the "expecting" and "feeling" categories and age groups

Appendix

The next set of questions concerns people you turn to when you are troubled or in need. Take a minute to think about who these people are and what their relationships with you are like. Keeping those people in mind, complete the following sentence**: When I am in trouble or in need, I ask them:**

1. To understand my feelings.	1	2	3	4	5	6
2. For money.	1	2	3	4	5	6
3. To comfort me.	1	2	3	4	5	6
4. To help me perform physical tasks that are hard for me to do.	1	2	3	4	5	6
5. To be with me and keep me company.	1	2	3	4	5	6
6. To understand what I do or have done.	1	2	3	4	5	6
7. To listen.	1	2	3	4	5	6
8. To give good advice.	1	2	3	4	5	6
9. To provide what I need.	1	2	3	4	5	6
10. To show their concern for me.	1	2	3	4	5	6
11. To take care of me when I'm ill.	1	2	3	4	5	6

Keeping those same people in mind, complete the following sentence: **When I am troubled or in need, I feel that they ACTUALLY do:**

12. Understand my feelings.	1	2	3	4	5	6
13. Provide money.	1	2	3	4	5	6
14. Comfort me.	1	2	3	4	5	6
15. Help me perform physical tasks that are hard for me to do.	1	2	3	4	5	6
16. Stay wirh me and kep me company.	1	2	3	4	5	6
17. Understand what I do or have done.	1	2	3	4	5	6
18. Listen.	1	2	3	4	5	6
19. Give me good advice.	1	2	3	4	5	6
20. Provide what I need.	1	2	3	4	5	6
21. Show their concern for me.	1	2	3	4	5	6
22. Take care of me when I'm ill.	1	2	3	4	5	6

Response options: 1. Disagree strongly; 2. Disagree moderately; 3. Disagree slightly; 4. Agree slightly; 5. Agree moderately; 6. Agree strongly

Model 1 with Item Referent

```
Generalized linear mixed model fit by maximum likelihood (Laplace
Approximation) ['glmerMod']
 Family: binomial  ( logit )
Formula: PCM ~ -1 + PCMcategory:itemtype + (1 | id) + (1 + PCMcategory |
item)
   Data: datlong2
Control: control

     AIC      BIC   logLik deviance df.resid
 34085.8  34298.3 -17016.9  34033.8    26130

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.5621 -0.9475  0.5630  0.7973  2.6251

Random effects:
 Groups Name             Variance Std.Dev. Corr
 id     (Intercept)      0.49463  0.7033
 item   (Intercept)      0.17088  0.4134
        Threshold_3 0.02742  0.1656   -0.94
        Threshold_4 0.06567  0.2563   -0.73  0.85
        Threshold_5 0.12706  0.3565   -0.27  0.57  0.77
        Threshold_6 0.19434  0.4408   -0.77  0.93  0.83  0.78
Number of obs: 26156, groups:  id, 728; item, 22

Fixed effects:
                                Estimate Std. Error z value Pr(>|z|)
Threshold_2:itemtypeexpect  0.37745    0.14706   2.567  0.01027 *
Threshold_3:itemtypeexpect  0.93368    0.10415   8.965  < 2e-16 ***
Threshold_4:itemtypeexpect  0.97393    0.10194   9.553  < 2e-16 ***
Threshold_5:itemtypeexpect  0.42912    0.14777   2.904  0.00368 **
Threshold_6:itemtypeexpect -0.04567    0.09773  -0.467  0.64030
Threshold_2:itemtypefeel    1.06965    0.15737   6.797 1.07e-11 ***
Threshold_3:itemtypefeel    1.43259    0.10725  13.357  < 2e-16 ***
Threshold_4:itemtypefeel    1.09246    0.10067  10.852  < 2e-16 ***
Threshold_5:itemtypefeel    0.59571    0.14672   4.060 4.90e-05 ***
Threshold_6:itemtypefeel   -0.40428    0.09683  -4.175 2.98e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Model 2 with Item Referent and SES

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: binomial  ( logit )
Formula: PCM ~ -1 + PCMcategory:itemtype:ses2 + (1 | id) + (1 + PCMcategory |
item)
   Data: datlong2
Control: control

     AIC      BIC   logLik deviance df.resid
 31857.3  32230.2 -15882.7  31765.3    24439

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.5085 -0.9391  0.5576  0.7918  2.5698

Random effects:
 Groups Name             Variance Std.Dev. Corr
 id     (Intercept)      0.49763  0.7054
 item   (Intercept)      0.17797  0.4219
        Threshold_3 0.02795  0.1672   -0.94
        Threshold_4 0.07337  0.2709   -0.73  0.90
        Threshold_5 0.12821  0.3581   -0.22  0.53  0.73
        Threshold_6 0.18893  0.4347   -0.76  0.90  0.79  0.74
Number of obs: 24485, groups:  id, 681; item, 22

Fixed effects:
                                     Estimate Std. Error z value Pr(>|z|)
Threshold_2:itemtypeexpect:ses21 -0.19756    0.33043  -0.598 0.549915
Threshold_3:itemtypeexpect:ses21  0.86419    0.31047   2.783 0.005378 **
Threshold_4:itemtypeexpect:ses21  0.64369    0.25997   2.476 0.013286 *
Threshold_5:itemtypeexpect:ses21  0.49700    0.26268   1.892 0.058488 .
Threshold_6:itemtypeexpect:ses21  0.28304    0.20894   1.355 0.175537
Threshold_2:itemtypefeel:ses21   -0.13875    0.33789  -0.411 0.681328
Threshold_3:itemtypefeel:ses21    1.14831    0.29368   3.910 9.23e-05 ***
Threshold_4:itemtypefeel:ses21    0.43593    0.23800   1.832 0.067007 .
Threshold_5:itemtypefeel:ses21    0.57179    0.24917   2.295 0.021746 *
Threshold_6:itemtypefeel:ses21   -0.44411    0.21310  -2.084 0.037159 *
Threshold_2:itemtypeexpect:ses22  0.47220    0.15368   3.073 0.002122 **
Threshold_3:itemtypeexpect:ses22  0.92808    0.10963   8.465  < 2e-16 ***
Threshold_4:itemtypeexpect:ses22  0.98232    0.10582   9.283  < 2e-16 ***
Threshold_5:itemtypeexpect:ses22  0.46789    0.15579   3.003 0.002671 **
Threshold_6:itemtypeexpect:ses22 -0.07722    0.10045  -0.769 0.442028
Threshold_2:itemtypefeel:ses22    1.24504    0.16745   7.435 1.04e-13 ***
Threshold_3:itemtypefeel:ses22    1.39867    0.11391  12.279  < 2e-16 ***
Threshold_4:itemtypefeel:ses22    1.15562    0.10482  11.025  < 2e-16 ***
Threshold_5:itemtypefeel:ses22    0.66398    0.15459   4.295 1.75e-05 ***
Threshold_6:itemtypefeel:ses22   -0.42386    0.09932  -4.267 1.98e-05 ***
Threshold_2:itemtypeexpect:ses23 -0.01895    0.32908  -0.058 0.954088
Threshold_3:itemtypeexpect:ses23  0.94589    0.32215   2.936 0.003323 **
Threshold_4:itemtypeexpect:ses23  0.92000    0.26930   3.416 0.000635 ***
Threshold_5:itemtypeexpect:ses23 -0.10427    0.27048  -0.385 0.699876
Threshold_6:itemtypeexpect:ses23  0.12555    0.23072   0.544 0.586334
Threshold_2:itemtypefeel:ses23    0.13232    0.52060   0.254 0.799366
Threshold_3:itemtypefeel:ses23    2.58726    0.42959   6.023 1.72e-09 ***
Threshold_4:itemtypefeel:ses23    0.83118    0.24490   3.394 0.000689 ***
Threshold_5:itemtypefeel:ses23    0.19446    0.25135   0.774 0.439126
Threshold_6:itemtypefeel:ses23   -0.41781    0.22302  -1.873 0.061005 .
```

Model 2 with Item Referent and Family Type

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: binomial  ( logit )
Formula: PCM ~ -1 + PCMcategory:itemtype:familyenv2 + (1 | id) + (1 +
PCMcategory | item)
   Data: datlong2
Control: control

     AIC      BIC   logLik deviance df.resid
 33762.6  34056.5 -16845.3  33690.6    25903

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.8543 -0.9457  0.5583  0.7935  2.6160

Random effects:
 Groups Name             Variance Std.Dev. Corr
 id     (Intercept)      0.49814  0.7058
 item   (Intercept)      0.17163  0.4143
        Threshold_3 0.02761  0.1662   -0.93
        Threshold_4 0.06595  0.2568   -0.73  0.85
        Threshold_5 0.13160  0.3628   -0.28  0.61  0.78
        Threshold_6 0.19776  0.4447   -0.76  0.95  0.83  0.79
Number of obs: 25939, groups:  id, 722; item, 22

Fixed effects:
                                                    Estimate Std. Error z value
Pr(>|z|)
Threshold_2:itemtypeexpect:Conservative  0.38950    0.15608   2.495 0.012579 *
Threshold_3:itemtypeexpect:Conservative  0.94526    0.11615   8.138 4.00e-16 ***
Threshold_4:itemtypeexpect:Conservative  1.01452    0.10918   9.292  < 2e-16 ***
Threshold_5:itemtypeexpect:Conservative  0.43333    0.15136   2.863 0.004199 **
Threshold_6:itemtypeexpect:Conservative -0.04006    0.10327  -0.388 0.698070
Threshold_2:itemtypefeel:Conservative    1.11185    0.16867   6.592 4.34e-11 ***
Threshold_3:itemtypefeel:Conservative    1.32799    0.11741  11.311  < 2e-16 ***
Threshold_4:itemtypefeel:Conservative    1.08595    0.10647  10.200  < 2e-16 ***
Threshold_5:itemtypefeel:Conservative    0.49932    0.14976   3.334 0.000856 ***
Threshold_6:itemtypefeel:Conservative   -0.49154    0.10277  -4.783 1.73e-06 ***
Threshold_2:itemtypeexpect:Modern        0.35855    0.17719   2.024 0.043017 *
Threshold_3:itemtypeexpect:Modern        0.93107    0.13984   6.658 2.77e-11 ***
Threshold_4:itemtypeexpect:Modern        0.89793    0.12692   7.075 1.49e-12 ***
Threshold_5:itemtypeexpect:Modern        0.44067    0.16183   2.723 0.006468 **
Threshold_6:itemtypeexpect:Modern       -0.07953    0.11616  -0.685 0.493536
Threshold_2:itemtypefeel:Modern          0.91352    0.22384   4.081 4.48e-05 ***
Threshold_3:itemtypefeel:Modern          1.75423    0.16540  10.606  < 2e-16 ***
Threshold_4:itemtypefeel:Modern          1.18931    0.12951   9.183  < 2e-16 ***
Threshold_5:itemtypefeel:Modern          0.83300    0.16002   5.206 1.93e-07 ***
Threshold_6:itemtypefeel:Modern         -0.25073    0.11318  -2.215 0.026732 *
```

Model 2 with Item Referent and Gender

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: binomial  ( logit )
Formula: PCM ~ -1 + PCMcategory:itemtype:gender2 + (1 | id) + (1 + PCMcategory |
item)
   Data: datlong2
Control: control

     AIC      BIC   logLik deviance df.resid
 33881.3  34175.3 -16904.7  33809.3    25998

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.8858 -0.9434  0.5614  0.7950  2.5812

Random effects:
 Groups Name             Variance Std.Dev. Corr
 id     (Intercept)      0.45228  0.6725
 item   (Intercept)      0.17181  0.4145
        Threshold_3 0.02966  0.1722   -0.98
        Threshold_4 0.06616  0.2572   -0.73  0.81
        Threshold_5 0.12253  0.3500   -0.28  0.44  0.76
        Threshold_6 0.19770  0.4446   -0.78  0.88  0.82  0.77
Number of obs: 26034, groups:  id, 724; item, 22

Fixed effects:
                                                Estimate Std. Error z value Pr(>|z|)
Threshold_2:itemtypeexpect:gender2Female  0.46583    0.15935   2.923 0.003464 **
Threshold_3:itemtypeexpect:gender2Female  0.91162    0.11264   8.093 5.81e-16 ***
Threshold_4:itemtypeexpect:gender2Female  1.05920    0.10906   9.712  < 2e-16 ***
Threshold_5:itemtypeexpect:gender2Female  0.51820    0.14978   3.460 0.000541 ***
Threshold_6:itemtypeexpect:gender2Female  0.11842    0.09921   1.194 0.232622
Threshold_2:itemtypefeel:gender2Female    1.34782    0.17930   7.517 5.61e-14 ***
Threshold_3:itemtypefeel:gender2Female    1.38744    0.11753  11.805  < 2e-16 ***
Threshold_4:itemtypefeel:gender2Female    1.17011    0.10761  10.874  < 2e-16 ***
Threshold_5:itemtypefeel:gender2Female    0.76987    0.14837   5.189 2.11e-07 ***
Threshold_6:itemtypefeel:gender2Female   -0.28509    0.09795  -2.911 0.003608 **
Threshold_2:itemtypeexpect:gender2Male    0.14765    0.17097   0.864 0.387808
Threshold_3:itemtypeexpect:gender2Male    0.86058    0.13184   6.528 6.68e-11 ***
Threshold_4:itemtypeexpect:gender2Male    0.74474    0.12367   6.022 1.72e-09 ***
Threshold_5:itemtypeexpect:gender2Male    0.19563    0.16023   1.221 0.222112
Threshold_6:itemtypeexpect:gender2Male   -0.45322    0.11658  -3.887 0.000101 ***
Threshold_2:itemtypefeel:gender2Male      0.59877    0.19028   3.147 0.001651 **
Threshold_3:itemtypefeel:gender2Male      1.40261    0.13868  10.114  < 2e-16 ***
Threshold_4:itemtypefeel:gender2Male      0.87344    0.12035   7.257 3.95e-13 ***
Threshold_5:itemtypefeel:gender2Male      0.17920    0.15778   1.136 0.256066
Threshold_6:itemtypefeel:gender2Male     -0.70945    0.11639  -6.096 1.09e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Model 2 with Item Referent and Age Groups

```
Generalized linear mixed model fit by maximum likelihood (Laplace Approximation)
['glmerMod']
 Family: binomial  ( logit )
Formula: PCM ~ -1 + PCMcategory:itemtype:age2 + (1 | id) + (1 + PCMcategory |
item)
   Data: datlong2
Control: control

     AIC      BIC   logLik deviance df.resid
 33667.4  34042.7 -16787.7  33575.4    25808

Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.7528 -0.9460  0.5593  0.7943  2.6833

Random effects:
 Groups Name             Variance Std.Dev. Corr
 id     (Intercept)      0.50112  0.7079
 item   (Intercept)      0.18043  0.4248
        Threshold_3 0.02835  0.1684   -0.94
        Threshold_4 0.07126  0.2669   -0.75  0.91
        Threshold_5 0.13299  0.3647   -0.31  0.62  0.79
        Threshold_6 0.20157  0.4490   -0.78  0.93  0.85  0.79
Number of obs: 25854, groups:  id, 720; item, 22

Fixed effects:
                                     Estimate Std. Error z value Pr(>|z|)
Threshold_2:itemtypeexpect:age21  0.36069    0.15312   2.356 0.018495 *
Threshold_3:itemtypeexpect:age21  0.94427    0.11074   8.527  < 2e-16 ***
Threshold_4:itemtypeexpect:age21  0.99047    0.10472   9.458  < 2e-16 ***
Threshold_5:itemtypeexpect:age21  0.43959    0.14952   2.940 0.003282 **
Threshold_6:itemtypeexpect:age21 -0.01022    0.09944  -0.103 0.918152
Threshold_2:itemtypefeel:age21    1.01815    0.16391   6.212 5.25e-10 ***
Threshold_3:itemtypefeel:age21    1.40821    0.11371  12.384  < 2e-16 ***
Threshold_4:itemtypefeel:age21    1.07460    0.10323  10.410  < 2e-16 ***
Threshold_5:itemtypefeel:age21    0.61575    0.14834   4.151 3.31e-05 ***
Threshold_6:itemtypefeel:age21   -0.37632    0.09851  -3.820 0.000133 ***
Threshold_2:itemtypeexpect:age22  0.56304    0.24030   2.343 0.019126 *
Threshold_3:itemtypeexpect:age22  0.80721    0.20353   3.966 7.31e-05 ***
Threshold_4:itemtypeexpect:age22  1.08223    0.17362   6.233 4.57e-10 ***
Threshold_5:itemtypeexpect:age22  0.28299    0.18861   1.500 0.133499
Threshold_6:itemtypeexpect:age22 -0.09328    0.14735  -0.633 0.526689
Threshold_2:itemtypefeel:age22    1.47189    0.32553   4.521 6.14e-06 ***
Threshold_3:itemtypefeel:age22    1.40416    0.22588   6.216 5.09e-10 ***
Threshold_4:itemtypefeel:age22    1.29659    0.17191   7.542 4.62e-14 ***
Threshold_5:itemtypefeel:age22    0.61874    0.18306   3.380 0.000725 ***
Threshold_6:itemtypefeel:age22   -0.63661    0.14546  -4.377 1.21e-05 ***
Threshold_2:itemtypeexpect:age23  0.99916    0.57360   1.742 0.081523 .
Threshold_3:itemtypeexpect:age23  1.60922    0.47490   3.389 0.000703 ***
Threshold_4:itemtypeexpect:age23  0.22390    0.36335   0.616 0.537753
Threshold_5:itemtypeexpect:age23  0.70918    0.35074   2.022 0.043182 *
Threshold_6:itemtypeexpect:age23 -0.52651    0.31525  -1.670 0.094894 .
Threshold_2:itemtypefeel:age23    2.97067    1.13525   2.617 0.008877 **
Threshold_3:itemtypefeel:age23    2.15585    0.50209   4.294 1.76e-05 ***
Threshold_4:itemtypefeel:age23    1.00793    0.33685   2.992 0.002769 **
Threshold_5:itemtypefeel:age23   -0.23369    0.33805  -0.691 0.489386
Threshold_6:itemtypefeel:age23   -0.25603    0.32888  -0.778 0.436288
```