

The Acreemagnosia Measurement: Psychometric evaluation of a new assessment of the loss of financial knowledge.

Irina Kozlova¹✉, Tom Booth^(2, 3), Mario Alfredo Parra ⁽³⁻⁶⁾, Sergio Della Sala^(1,3)

(1) Human Cognitive Neuroscience, Psychology, University of Edinburgh, UK

(2) Department of Psychology, University of Edinburgh, UK.

(3) Centre for Cognitive Ageing and Cognitive Epidemiology, University of Edinburgh, UK

(4) School of Psychological Sciences and Health, University of Strathclyde, Glasgow, UK

(5) Alzheimer's Scotland Dementia Research Centre, Edinburgh University, UK

(6) Autonomous University of the Caribbean, Barranquilla, Colombia

Correspondence concerning this article should be addressed to Irina Kozlova, Human Cognitive Neuroscience, Psychology, University of Edinburgh, UK. 7 George Square, Edinburgh, EH8 9JZ, Email: I.Kozlova@sms.ed.ac.uk

Abstract

Background and Objectives Impairment in financial management abilities, which we label “Acreemagnosia”, is an early symptom of older people experiencing cognitive decline. This article describes the development and psychometric evaluation of *The Acreemagnosia Measurement (TAM)* which assesses everyday financial abilities and could be applied to older people who are healthy, experiencing MCI, or affected by dementia. TAM is a multi-item scale combining subjective, objective and performance-based measures that assess abilities and awareness across a wide range of financial functions and tasks. **Methods** Item Response theory (IRT) was applied to examine the structure and item performance, as well as to determine scale reliability. **Results** Analysis suggests that TAM is measuring most reliably at low to average levels of financial ability which is appropriate for testing elderly retired people, experiencing MCI, or affected by dementia. All the items in TAM show a good discrimination capacity. Differential Item Functioning (DIF) analysis did not show any gender or age bias. **Discussion** TAM is a useful tool for the measurement of everyday financial abilities in older people.

Key words: financial abilities, financial awareness, scale development, Item Response theory, Differential Item Functioning

Introduction

Acreemagnosia (from the Ancient Greek ἀ- (a-, “lack of”), χρήμα (creema, “money”) and γνωστική (gnôsis, “knowledge”) defines the impairment in financial abilities (Kozlova *et al.*, 2017). Its presence is argued to be an early symptom of dementia (Marson *et al.*, 2000, Willis, 1996) and a strong predictor of future cognitive decline (Chiong *et al.*, Peres *et al.*, 2008). Testifying before the Elder Justice Coordinating Council (EJCC) (Washington testimony, April 27, 2016) Dr. J. Karlawish, Co-Director of the Penn Memory Centre, said: “Among the first signs of cognitive changes caused by diseases such as Alzheimer’s disease, and cognitive aging as well, are changes in our capacity to manage our finances” and urged to assure the financial security of ageing people.

Despite its clinical and legal relevance, little attention has been paid to this frequent symptom, mainly due to the lack of available instruments to assess it. The aim of this study was to devise an instrument which can assess the decline in financial abilities that characterizes Acreemagnosia. In addition to the new instrument, we present normative data from a sizeable group of healthy volunteers.

Clinicians routinely check for financial competence relying on clinical interviews and Activities of Daily Living/Instrumental Activities of Daily Living (ADL/IADL) scales, which do not thoroughly explore financial abilities (Kershaw and Webber, 2008). The most widely used ADL/IADL scales in clinical settings include only a few items inquiring about financial competence (Bucks *et al.*, 1996; Gelinas *et al.*, 1999; Lawton and Brody, 1969). Moreover, these few items are rather dated. Technological advances (computers, smart phones, tablets), changes in shopping styles (online shopping, online food order or tickets booking), and financial affairs (more complex banking and investment systems, ATM machines and online banking), can pose challenges to older people, especially to those experiencing cognitive decline. These are not considered in ADL/IADL scales (Muñoz-Neira *et al.*, 2012; Rosenberg *et al.*, 2009). Nevertheless, some suggestions could be derived from studies that aimed at differentiating healthy ageing from MCI/AD patients using ADL/IADL scales. These studies demonstrated that activities such as shopping, transportation, managing medication and handling finances were the best suited for this purpose (Aretouli and Brandt, 2010; Bangen *et al.*, 2010; Barberger-Gateau *et al.*, 1992; Barberger-Gateau *et al.*, 1996b; Gold, 2012; Kim *et al.*, 2009; Njegovan *et al.*, 2001; Nygård, 2003; Pedrosa *et al.*, 2010; Reppermund *et al.*, 2011; Willis, 1996). The identification of deficits in these activities has been claimed to predict dementia 3-5 years prior to the onset of clinically detectable symptoms (Barberger-Gateau *et al.*, 1996a; Cromwell *et al.*, 2003; Pérès, 2008). Further data suggest that managing

finances is among the earliest IADL impairment in MCI (Gold, 2012; Griffith *et al.*, 2003; Kim *et al.*, 2009; Marson *et al.*, 2000; Sikkes *et al.*, 2011).

Finally, there is growing concern that clinical neuropsychological assessment is unsuitable as a proxy for evaluating financial ability (Kershaw and Webber, 2008; Stebnicki, 1997). Indeed, there is evidence that people who perform well on psychometric tests may still perform poorly on financial competence tests (Bechara *et al.*, 1994). Given the considerations above, specific assessment of financial abilities is of a paramount importance not only because it appears to be a sensitive and early functional method to detect incipient dementia, but also because a reduced competence to look after one's own finances is a major risk of being financially exploited or abused (Acierno *et al.*, 2010; James *et al.*, 2014; Kemp and Mosqueda, 2005; Reiboldt and Vogel, 2003; Tueth, 2000), hence losing independence (De Vriendt *et al.*, 2012; James *et al.*, 2014; Schmitter-Edgecombe *et al.*, 2011; Smith, 2000; Tueth, 2000).

Therefore, there is the unmet need for a new instrument, which could aid the identification of Acreemagnosia and quantify its severity. Such instrument should be informative when assessing financial competence in normal ageing, avoiding ceiling effects by including tasks with different levels of complexity (easy, moderate and difficult items). This would allow clinicians and researchers to track financial decline and monitor the development of symptoms over time, help patients to live as independently as possible for longer, and importantly identify those individuals who are potentially vulnerable to financial scams. In order to improve construct validity and considering the risk of bias and proneness to underestimation in caregivers' appraisals of patients' functional abilities (Cramer *et al.*, 2004; Fieo *et al.*, 2011), such a tool should incorporate informant-based, self-report and performance-based measures that would complement each other. A psychometrically valid tool should incorporate unidimensional items which measure specific constructs as well as items which measure more than one construct, referred to as complex (Reckase, 2009). The new instrument should refine conceptual aspects underlying both simple and complex items not addressed by existing scales.

There are several scales to specifically evaluate financial abilities that have been previously reported (See Table 1 in the Supplementary material for more details). Based on the notion that financial competence is a multidimensional concept comprising conceptual, pragmatic, and judgmental knowledge aspects, Marson *et al.* (2000) developed the "Financial Capacity Instrument" (FCI). FCI was the first instrument specifically designed to assess financial abilities in people with dementia. However, the tool has a very limited clinical utility as it encompasses more than 100 items and takes more than an hour to administer. To address this

issue the authors have devised two shorter versions of the instrument. The Semi-Structured Clinical Interview for Financial Capacity (SCIFC) (Marson *et al.*, 2009) is proposed as a brief (25 minutes) financial clinical assessment tool and comprises the same domains of the FCI scale. The other instrument is the Financial Capacity Instrument – Short Form (FCI-SF) which is also a brief (less than 15 minutes) clinical screening tool (Gerstenecker *et al.*, 2016) assessing financial competence and calculation. Based on the FCI, Wadley *et al.* (2003) developed an instrument that comprises two components, the Prior Financial Capacity Form and the Current Financial Capacity Form. They incorporate the same domains of FCI aiming at evaluating prior and current financial abilities in AD patients. The reference point for the prior functioning is assumed to be when the examinee was best at managing personal financial affairs. The FCI and its derived tools, which are all based on the US monetary system, have been fully validated and standardised on MCI and AD patients. However, none of these different versions of the FCI are available for use¹.

The other scale reported in the literature is the “Financial Competence Assessment Inventory” (FCAI) developed by Kershaw and Webber (2008). The scale, which was developed to investigate the legal component of financial competence based on legal criteria used in the United States and Australia, assesses four domains: “understanding”, “appreciation”, “reasoning”, and “expressing a choice.” The FCAI comprises 41 items (tasks and questions) related to financial abilities and consists of 6 subscales. The instrument was never published in full. Only a brief description of the validity of the tool was reported in the manuscript without detailing the actual questions for each of the domains. This questionnaire is unavailable for public use².

The Measure of Awareness of Financial Skills (MAFS) devised by Cramer and colleagues (2004) was designed so awareness of financial abilities is a central component of financial competence as loss of awareness is linked to the severity of cognitive impairment and risk of progression from MCI to AD (Tabert *et al.*, 2002). The instrument contains 34 questions about different financial tasks; participants are asked to rate, on a four-point scale, the amount of difficulty they experience when performing each of these tasks and the amount of help they would need to perform them correctly. The questionnaire takes 1.5 hours for patients to complete and 20 minutes for informants, which renders its clinical utility questionable. There is only one paper published on the instrument (Cramer *et al.*, 2004). The instrument is not

¹ The authors were contacted and replied that the instrument will be available to buy in the future

² The authors were contacted and replied that the instrument was created for the purpose of their research and not available for use

freely accessible for use³. It is validated on the Canadian population (See Table 1 in the Supplementary material for more details on each developed instrument).

Considering the above discussed needs and gaps, we developed a new instrument that we called *The Acreemagnosia Measurement (TAM)* (For more details on the initial instrument development, see the Supplementary material). Our goal was to create a psychometrically rigorous instrument that would assess abilities and awareness across a wide range of financial functions which could be applied to older people who are healthy, experiencing MCI, or affected by dementia. In this paper we describe the development and psychometric evaluation of this instrument.

Investigating the psychometric properties of the practical part of TAM

Objectives

The primary aim of the study was to investigate the psychometric properties of the TAM scale. In particular, our analyses focussed on scale dimensionality, item performance in the whole sample, differences in performance across key demographic splits (gender and age), and scale reliability. The goal was to identify those items which may be reasonably removed or modified in later scale developments.

Participants

Three hundred and twenty-two participants recruited online and from the university volunteer panel completed TAM online. For the analysis we partitioned out participants sample into younger than 65 years old and above 65 (see Figure 1). The partition of younger and older respondents was based on both theoretical consideration of key ages for MCI and dementia (Geda, 2012), and on practical limitations to maintain sufficient sample sizes in both groups.

----- Insert Figure 1 about here -----

Analyses

The psychometric evaluation of the scale followed a series of steps to evaluate item performance using Item Response Theory (IRT) models. IRT models are ideally suited to scale development in clinical settings (Reise & Waller, 2009).

³ The authors were contacted however without a reply

Step 1. Establish unidimensionality

Dimensionality refers to understanding whether all items load onto a single latent dimension (unidimensionality), or whether subsets of items load on different latent dimensions (multi-dimensional). Assessing unidimensionality is an important step in IRT analyses in order to assist the selection of an appropriate model (Embretson & Reise, 2013).

Here, the unidimensionality of the item set was established according to the combined evidence across a number of indices. First, we consider the results from parallel analysis (PA; Horn, 1965) and Velicer's minimum average partial (MAP; Velicer, 1976) test. Both tests have performed well in simulation studies investigating methods for scale dimensionality. We use PA and MAP to define a plausible range for the appropriate dimensionality of the data, where PA will set the upper bound, and MAP the lower bound.

Next, we considered model fit comparisons based on exploratory factor analytic solutions. We considered both overall fit using empirically supported guidelines (Hu & Bentler, 1998), and the difference in fit between models with a sequentially increasing number of factors. Specifically, a model fits well if the root-mean-square error approximation index (RMSEA; Steiger & Lind, 1980) is < 0.06 and the Tucker-Lewis fit index (TLI; Tucker & Lewis, 1973) is ≥ 0.95 . We also considered the improvement in fit demonstrated by the addition of an extra factor. Alongside model fit, the ratio of the first and the second eigenvalues were considered, with ratio's more than 3.0 providing indicative support for unidimensionality (Slocum-Gori & Bruno, 2011). Finally, we considered the theoretical coherence of factor solutions with more than one factor, versus the theorized structure of TAM.

Once an appropriate dimensionality had been established, we used the results from these factor models to remove items which did not appear to relate to any other items. This was assessed based on low item factor loadings, with items loading below 0.30 considered for removal from subsequent IRT analysis.

All analyses were performed using R version 3.3.3 (R Core Team, 2017) using the packages 'psych' (Revelle, 2016) and 'mirt' (Chalmers, 2012).

Step 2. Fitting 2PL model and assessment of item characteristic and test information curves

After establishing latent trait uni-dimensionality, item performance was analysed using the two-parameter logistic model (2PL) that assumes that items differ both with respect to how difficult they are to answer (*difficulty parameter* (a_i)), and how well they differentiate levels of the latent trait (θ) (*discrimination parameter* (b_{ij})). Individual items were assessed for fit

based on the $S-\chi^2$ proposed by Orlando and Thissen (2000). $S-\chi^2$ is based on a comparison of observed and model predicted item responses, given an individual's level of the latent trait (θ). Poorly fitting items were inspected with item characteristic curves (ICC). ICC is a non-linear regression line that expresses a subject's probability of a correct response to each item. The slope of the ICC characterizes the discriminability of the item; item difficulty was characterized as the point along the theta continuum with a 50% chance of correctly answering the item. In the context of evaluating item performance of TAM, items that have large discrimination parameters and which span a range of difficulty levels will be retained.

Item difficulty and discriminability parameters, standard errors, and summary statistics were obtained using maximum-likelihood estimation. The characteristic curves for each item were plotted for visual inspection. We calculated 2PL models using the `mirt()` R package (Chalmers, 2012), and item characteristic using `irtosys()` R package (Partchev, 2016).

A second purpose of our IRT analyses was to explore the reliability of the total score on TAM. Reliability in IRT differs from conventional reliability metrics such as Cronbach's alpha as with IRT models, reliability is assessed across levels of the latent ability factor (θ). For a given level of θ , if the amount of information is large, it means that an individual's ability at that level can be estimated with higher precision and thus is more reliable. If the amount of information is small, it means that an individual's ability at that level cannot be estimated with precision and the estimates will be widely scattered about the true ability.

In order to investigate information across the range of measured ability, we computed the test information curve by plotting the amount of test information against ability. The curve will allow us to identify how robust the test is in estimating ability over the whole range of ability scores. In evaluating TAM, we calculate the range of ability levels that can be reliably assessed. To do this, we consider the range within which conditional test information is greater than 10. For comparative purposes, conditional test information of 10 approximately equates to a classical test theory reliability (Cronbach's alpha) of .90 (Embretson & Reise, 2013, page 270).

Step 3. Evaluation of differential item functioning by age and sex

Finally, we used Differential Item Functioning (DIF) analyses to identify differences in item parameters across groups. DIF occurs when individuals who have the same standing on the latent trait do not have the same probability of item endorsement (Edelen et al, 2006). In other words, DIF analyses identify items which perform differently in different groups of individuals. Failure to identify items which show DIF can result in biased tests. Given the

proposed use of the current measure, we investigated DIF across sex (Male vs. Female) and across age group (Younger vs. Older).

The `mirt()` R package (Chalmers, 2012) was used to assess DIF. We set no anchors a priori; all items were tested for DIF by adding item constraints one item at a time. In the analysis by sex, the male group was our reference group, with the mean and standard deviation of the female group estimated (focal group). In the analysis by age group, the younger participants group was our reference group, with the mean and standard deviation of the older participants estimated (focal group). The test compares parameter estimates (difficulty level and discriminability of each item) across the reference and focal group. Wald tests based on the procedure proposed by Lord (1977), providing separate chi-square statistics for the discrimination and threshold parameters for each studied item, are used to evaluate the presence of DIF. When DIF is detected, effect sizes for the threshold and/or slope parameters will aid the description and interpretation of the group differences (Steinberg & Thissen, 2006).

Item selection

Based on the results of the whole sample and DIF analyses, items were selected for removal. Items which show DIF across either group, or which have poor discrimination in the total sample or sub-groups, were removed. Once items were removed, we re-calculated test information in order to assess whether the removal of items impacts on test reliability.

Results

Step1. Establish unidimensionality

Eigenvalues suggest one general factor: eigenvalues for first four factors were 7.83, 1.71, 1.47 and 1.28, with a large ratio between the first and the second eigenvalues (4.5) when compared to the second and third (1.16). MAP suggested a single factor, whilst PA suggested 3 factors (See Appendix A Figure 1 and 2).

Examination of model fit across the one (RMSEA = .081, TLI = .795), two (RMSEA = .064, TLI = .852) and three (RMSEA = .040, TLI = .91) factor models suggested, as expected, that fit improved as the number of factors increased. All models met minimum criteria for the RMSEA, and no models reached the minimum criteria according to the TLI. The difference in fit across models was significant ($p < .001$) according to the chi-square tests. Thus collectively, the suite of test of dimensionality suggested between one and three factors.

In order to select between the solutions, we explored the item factor loadings. All items from

the scale loaded significantly on one general factor with loadings above 0.3 for all items, except for three items (items 36, 37, and 38) with factor loading 0.03, 0.14, and -0.11 respectively. In the two factor solution, 4 items loaded on the second factor (items 36, 37, 38, and 46), and on the 3-factor model items 38, 39, 40, and 41 formed the third factor. Neither 2 nor 3 factor-model seem to reflect a coherent theoretical interpretation. We inspected these items more closely.

Taking all the above information into account, we retained a single factor model, primarily driven by the theoretical coherence of the model. Due to the low loadings noted above, items 36, 37 and 38 were excluded from subsequent analyses.

Step 2

Items characteristics

Table 1 reports item parameter (difficulty and discrimination) estimates and their standard errors for the 2PL model. Item discrimination parameters were between 0.53 and 4.38. Discrimination parameters greater than 1.70 are considered large and therefore have excellent discrimination capacity (Baker, 2001, pg 34). Most of the items in the scale have a excellent discrimination. Item difficulty estimates were distributed between -1.80 and 0.19. This indicates that a majority of items are positioned at below, or just above average ($\theta = 0$) levels of performance. Item 41 has large and significant $S-\chi^2$, meaning that this item does not fit into a predicted response model. Inspecting its ICC and item discrimination, however, revealed that the item has an excellent discrimination capacity ($a = 2.3$), that is why we decided to retain item 41 for further inspection.

Inspection of ICC (Figure 2) and parameter estimates indicates that Item 46 had near-zero discrimination parameter (slope is 0.14) and subsequently a flatter ICC, suggesting that this item was poor in discriminating between respondents and yielding minimal psychometric information. Based on these findings, item 46 was identified as a potential item for removal from the final version of TAM.

----- Insert Table 1 about here -----

----- Insert Figure 2 about here -----

Maximal information in the whole sample for the final scale (23.92) is at the trait level (θ) of -1.04, with the reliable range of measurement (information > 10) for the ability range

between -1.89 and -0.14 (See Figure 3 in Supplementarial material). Therefore, TAM is best capturing moderately low to average levels financial abilities.

Step 3. Establis DIF by age and gender– remove any items which do not have DIF by age and by gender

Parameters estimated for the 2PL model across younger and older groups individually are provided in Table 2.

Most of the items were found to have very good discrimination abilities, with discriminating parameters ranging from 1.30 to 4.45. Items 42-45 in the younger sample were found to have very high difficulty and discriminating parameters ($d = 16.56, 10.56, 10.15$ and 13.24 respectively and $a = 12.52, 9.00, 7.38, 15.56$) meaning that only those in the younger group at very high levels of the latent trait get these items correct. Generally, difficulty level for most of the items on the scale for younger participants was higher than for older participants. However, despite this, based on the Wald statistics, no DIF was identified across age groups in either the discrimination or difficulty parameters (Table 2).

----- Insert Table 2 about here -----

Visual inspection of the item curves (Figure 3), and inspection of the item parameters in Table 2, reveals again that Item 46 has low difficulty level for both age groups and has very low discrimination.

----- Insert Figure 3 about here -----

Parameters estimated for the 2PL fit for different gender groups individually are provided in Table 3. Most of the items were found to have high discrimination parameters ranging from 0.80 to 4.18. Again, Item 46 was found to have the lowest discrimination parameter in both gender groups. Generally, difficulty level for most of the items on the scale for male participants was higher than for female participants. However, despite this, based on the Wald statistics, no DIF was identified across gender in either the discrimination or difficulty parameters (Table 3, Figure 4).

----- Insert Table 3 about here -----

----- Insert Figure 4 about here -----

Item removal

We eliminated all the poorly fitted items and items with poor discriminability (Items 36, 37, 38 after the first step and Item 46 after initial reliability analysis) and analyse the final, shorter scale. Maximal information in the whole sample for the final scale (25.28) is at $\theta = -1.07$, with the reliable range of measurement (information > 10) for the ability range between -1.89 and -0.14 (See Figure 4 in Appendix A) which is not very different from the test information curve that we initially had (See Figure 3 in Appendix A). Examination of model fit after elimination of the items for one factor model showed that the model did not meet minimum criteria for RMSEA or TLI (RMSEA = .076, TLI = .87). As removing these items add little value in improvement of the test information, we decided to retain all the items to explore further on clinical population to ensure their performance to be robust, discriminative and responsive.

Discussion

In order to assess financial knowledge researchers and clinicians are currently using ADL/IADL scales that do not sufficiently address the intricacy of everyday financial requirements. Almost every IADL scale has a question of everyday financial ability. However, these questions are usually very general inquires of the participant's problems to deal with everyday financial tasks. Another limitation across IADL scales is that they are not providing the information on whether there is a decline in performance or the testee has always had problems with finances. Lastly, commonly used ADL/IADL questionnaires inquire if the person is capable of performing a particular task, in other words require the assumption of ability to perform. Standard scales cannot answer that question on whether the person can actually perform the task. There are a few financial scales devised to look particularly at financial abilities, competence, and awareness. Unfortunately, these scales are unavailable for use and are not fully validated.

The aim of the study was to design a psychometrically rigorous instrument that would assess abilities and awareness across a wide range of financial functions which could be applied to older people who are healthy, experiencing MCI, or affected by dementia.

We used two-parameter IRT model to analyse the psychometric properties of the Skills part of TAM and established the best items that would describe financial abilities of participants in different age and gender groups. First, we found evidence of multidimensionality due to item clustering, but this multidimensionality did not distort the primary dimension. A unidimensional model was therefore sufficient to describe financial ability, as measured by TAM. This multidimensionality of the financial construct was supported by studies carried by Marson et al (2000) and Kershaw and Webber (2008).

Secondly, the analysis suggests that TAM is measuring most reliably at low to average levels of financial ability, meaning that TAM is potentially a good financial measure for people with limited financial proficiency, which is in keeping with the design and intended use of the instrument with elderly retired people and people with cognitive impairment. In addition, all the items in TAM prove to have a good discrimination capacity and were distributed with respect to difficulty level within this specific discriminability range. Collectively the results suggest that TAM has initially promising psychometric properties.

Third, we assess item functioning across different gender and age groups. Results did not reveal any DIF in the scale. If there were items that would perform differently across different groups the results from the scores from males and females and from young and old adults would be incompatible. The results indicate that tendency to endorse the item should only reflect the ability level and should not be affected by variables such as gender and age. Nevertheless, these results should be interpreted with caution as they were drawn from relative small samples and thus the statistical power to detect DIF was low. Another limitation of this part of the study is that the data were gathered online and participants were self-selected; this may restrict generalizability.

In summary, financial ability is shown to be vulnerable to early effects of cognitive decline (Aretouli and Brandt, 2010; Gold 2012; Griffith *et al.*, 2003; Kim *et al.*, 2009; Marson *et al.*, 2000). We designed TAM in order to address the limitations of the existing ADL/IADL scales. TAM is a multi-items measure that inquires about person's awareness of financial abilities and examine actual performance on the broad range of everyday financial tasks. The present data indicate that TAM is a promising tool for the measurement of the everyday financial abilities in frail older people. Future studies will look at the performance on TAM by patients with various level of cognitive impairment. It would serve not only in detecting early impairments but it would also help health care professionals (i.e., general practitioners, nurses, clinical psychologists) and other relevant professionals (i.e., social workers, financial or family counselors) to make an evidence-based decision about the person's everyday financial knowledge and it would allow them to follow up the patients' performance.

In order to make TAM easily accessible for a clinical, research, and public use it is made freely available here: <http://www.ed.ac.uk/profile/sergio-della-sala>.

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Table 1

Item fit statistics and Item parameter estimates (SE) of a Two-parameter Unidimensional Item Response Model

Item	S_X2	p	b_{ij}	SE	a_i	SE
Q25	9.31	0.59	1.71	0.27	-1.34	0.16
Q26	17.19	0.07	1.54	0.27	-1.8	0.22
Q27	10.83	0.54	1.13	0.19	-1.07	0.18
Q28	8.39	0.39	2.22	0.38	-1.55	0.15
Q29	5.44	0.90	1.38	0.23	-1.62	0.21
Q30	11.61	0.31	2.02	0.32	-1.30	0.14
Q31	7.61	0.66	2.18	0.34	-1.27	0.13
Q32	5.87	0.75	3.11	0.48	-0.84	0.09
Q33	3.27	0.97	2.00	0.31	-1.20	0.13
Q34	8.4	0.75	1.17	0.19	-0.84	0.16
Q35	13.71	0.32	0.96	0.17	-0.71	0.10
Q39	10.68	0.30	2.25	0.35	-0.12	0.09
Q40	6.82	0.74	1.61	0.26	-0.08	0.10
Q41	23.30	0.003	2.30	0.36	-0.37	0.09
Q42	4.30	0.37	4.38	0.88	-1.23	0.09
Q43	6.96	0.54	2.95	0.50	-1.30	0.11
Q44	14.07	0.08	2.09	0.38	-1.72	0.18
Q45	6.35	0.70	3.45	0.55	-0.87	0.09
Q46	5.71	0.93	0.53	0.14	0.19	0.24
Q47	13.53	0.19	1.94	0.32	-1.45	0.16
Q48	14.71	0.19	1.32	0.23	-1.57	0.21

Note: S_X2 = goodness of fit index , b_{ij} = item discrimination, a_i = item difficulty

Table 2

Item parameters estimates and DIF results for different Age groups

Item	<65					>65				
	Mean	b_{ij}	a_i	Total χ^2 (df)	p	Mean	b_{ij}	a_i	Total χ^2 (df)	p
Q25	0.86	4.06	4.43	1.27	0.26	0.81	1.09	1.96	0.45	0.50
Q26	0.92	4.04	5.94	1.43	0.23	0.86	1.03	2.43	1.16	0.28
Q27	0.77	1.41	1.55	-0.072	1.00	0.70	0.81	1.06	-0.19	1.00
Q28	0.92	3.19	5.00	0.095	0.75	0.86	1.63	3.11	-0.02	1.00
Q29	0.84	2.36	2.70	0.33	0.56	0.84	0.97	2.15	-0.17	1.00
Q30	0.80	1.92	2.01	-0.21	1.00	0.84	1.82	3.04	-0.34	1.00
Q31	0.84	2.81	2.99	-0.16	1.00	0.83	1.74	2.78	-0.24	1.00
Q32	0.82	4.46	3.92	0.001	0.97	0.75	2.43	2.44	-0.16	1.00
Q33	0.85	4.96	4.86	0.98	0.32	0.80	1.31	2.05	0.21	1.00
Q34	0.72	1.22	1.13	-0.35	1.00	0.66	0.85	0.86	-0.29	1.00
Q35	0.72	1.24	1.13	0.09	0.76	0.60	0.63	0.50	-0.18	1.00
Q39	0.55	2.12	0.25	-0.27	1.00	0.53	1.51	0.20	-0.32	1.00
Q40	0.55	1.49	0.45	-0.29	1.00	0.49	1.14	-0.05	-0.2	1.00
Q41	0.66	1.71	0.91	0.14	0.71	0.60	1.83	0.68	-0.06	1.00
Q42	0.92	11.35	14.59	1.57	0.21	0.84	3.19	4.66	1.33	0.24
Q43	0.89	9.14	10.36	2.30	0.13	0.85	2.00	3.30	1.56	0.21
Q44	0.92	7.35	9.78	2.41	0.12	0.89	1.30	3.05	1.85	0.17
Q45	0.84	12.48	10.65	2.19	0.14	0.75	2.27	2.41	1.22	0.27
Q46	0.41	1.30	-0.55	0.98	0.32	0.49	0.38	-0.03	-0.06	1.00
Q47	0.88	1.58	2.69	-0.08	1.00	0.84	1.70	2.90	-0.17	1.00
Q48	0.84	2.58	2.85	0.96	0.32	0.82	0.84	1.87	-0.03	1.00

Note. b_{ij} = item discrimination, a_i = item difficulty

Table 3

Item parameters estimates and DIF results for different gender groups

Item	MALE					FEMALE				
	Mean	b_{ij}	a_i	Total χ^2 (df)	p	Mean	b_{ij}	a_i	Total χ^2 (df)	p
Q25	0.82	1.76	2.24	0.12	0.72	0.79	1.04	1.55	0.07	0.79
Q26	0.84	1.48	2.24	0.05	0.82	0.92	1.23	3.1	0.04	0.84
Q27	0.66	0.83	0.76	0.05	0.82	0.78	0.95	1.45	0.02	0.89
Q28	0.86	2.94	3.61	0.18	0.67	0.9	1.53	3.14	0.09	0.77
Q29	0.83	1.18	1.98	0.06	0.80	0.83	0.95	1.85	0.02	0.89
Q30	0.81	2.56	2.71	0.14	0.70	0.86	1.33	2.36	0.05	0.82
Q31	0.83	3.20	3.44	0.15	0.70	0.85	1.70	2.56	0.08	0.78
Q32	0.72	3.99	2.54	0.11	0.74	0.80	2.34	2.41	0.00	1.00
Q33	0.74	1.89	1.67	0.02	0.89	0.88	1.73	3.06	0.01	0.92
Q34	0.68	1.08	0.92	0.07	0.78	0.68	0.69	0.76	0.05	0.82
Q35	0.67	1.22	0.9	0.29	0.64	0.63	0.53	0.46	0.13	0.72
Q39	0.49	2.13	-0.06	0.05	0.81	0.54	1.46	-0.07	0.01	0.93
Q40	0.47	2.11	-0.19	0.17	0.68	0.58	1.01	0.22	0.03	0.87
Q41	0.55	3.55	0.37	0.35	0.55	0.62	1.32	0.37	0.02	0.90
Q42	0.81	4.39	4.17	0.13	0.71	0.90	2.99	4.87	0.09	0.76
Q43	0.84	2.49	2.98	0.02	0.88	0.88	2.73	4.16	0.02	0.88
Q44	0.89	2.30	3.60	0.08	0.78	0.90	1.44	3.04	0.07	0.78
Q45	0.69	3.26	1.84	0.06	0.81	0.81	3.78	3.67	-0.01	1.00
Q46	0.44	0.59	-0.24	0.36	0.55	0.51	0.26	-0.01	0.23	0.63
Q47	0.81	2.02	2.32	0.003	0.95	0.87	1.96	3.04	0.01	0.90
Q48	0.84	1.40	2.19	0.03	0.87	0.87	1.23	2.30	0.04	0.85

Note. b_{ij} = item discrimination, a_i = item difficulty

Figure Captions

Figure 1

Participants distribution according to age and gender

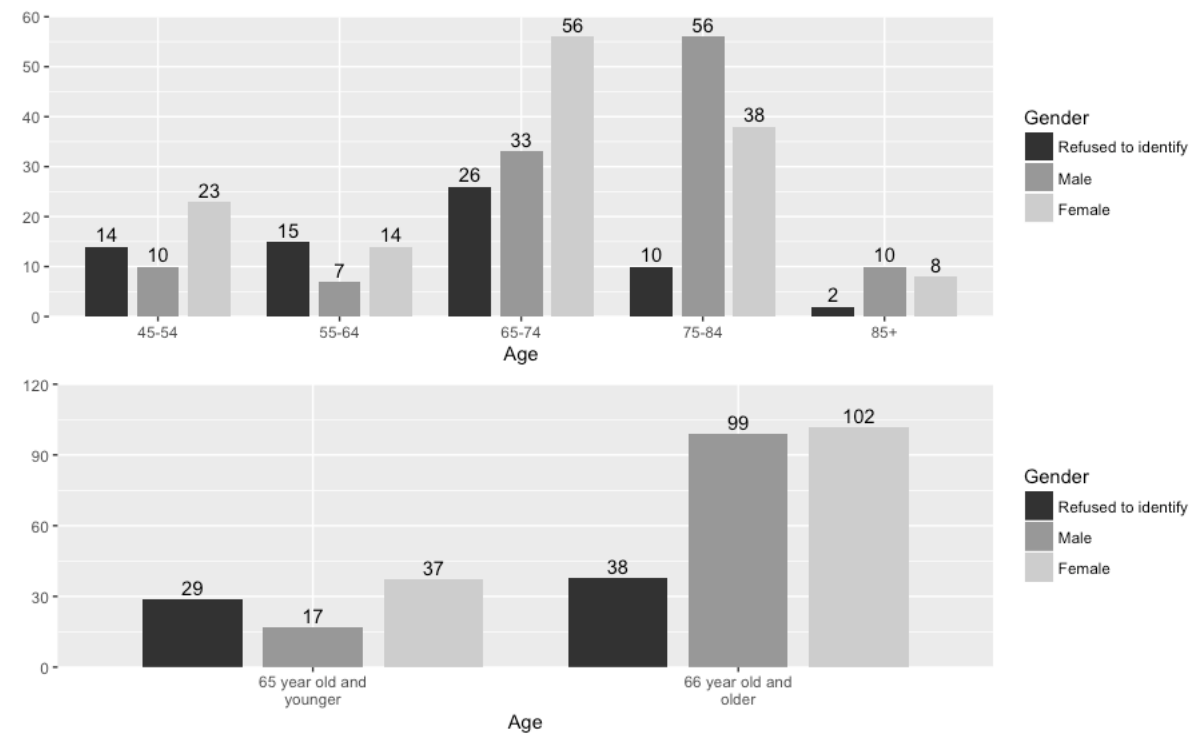


Figure 2

Item Characteristic Curves (ICC)

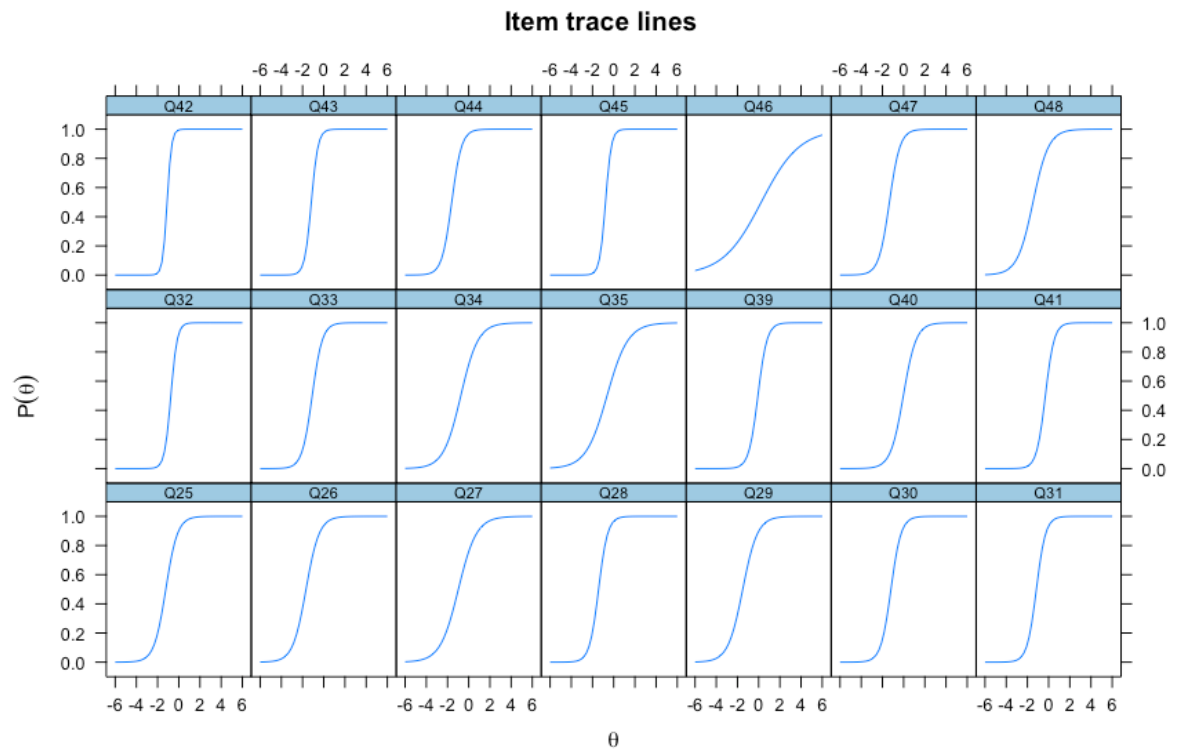


Figure 3
Item Characteristic Curves (ICC) for different age group

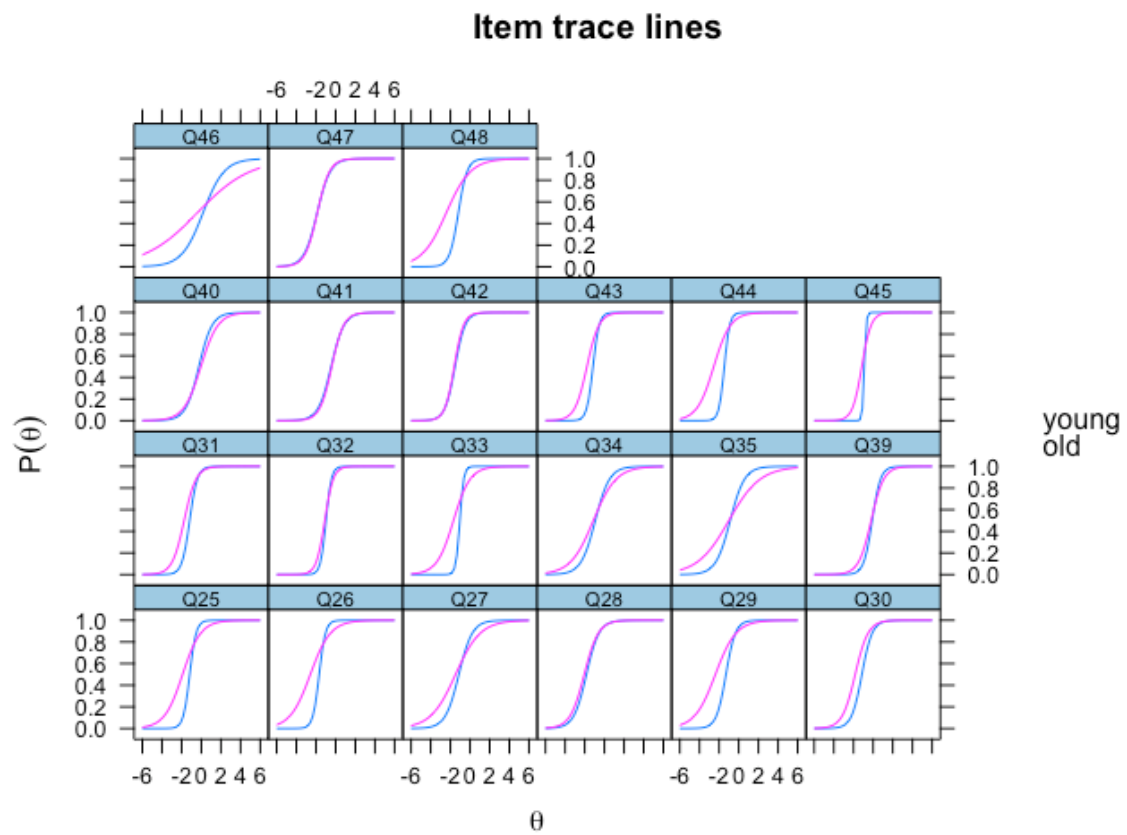


Figure 4

Item Characteristic Curves (ICC) for different gender group

