Evaluating the Dimensionality of the Michigan English Language Assessment Battery

Hong Jiao
Florida State University

This study evaluates the dimensionality of Form FF, listening and Form EE, grammar/cloze/vocabulary/reading (GCVR) in the Michigan English Language Assessment Battery (MELAB). It further investigates the influences of gender, native language, and proficiency level on the dimensionality of the listening and the GCVR sections in the MELAB. Stout's procedure was employed to test two hypotheses; that the listening items are unidimensional, and the GCVR items are unidimensional. Principle axes factor analysis and principle component analysis both using the tetrachoric correlation matrix were applied for further exploration. The results indicate that both listening and GCVR tests were unidimensional for female and Tagalog/Filipino-speaking groups. Further, the global GCVR test was unidimensional. But for other groups, the results were inconsistent across methods regarding the unidimensionality of both forms.

Validity is an important issue in test development and evaluation according to the *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999), as well as fairness. Validity refers to the degree to which evidence supports the inferences based on test scores (Messick, 1989). Fairness means that all examinees are given comparable opportunities to demonstrate their abilities on the construct a test intends to measure (American Educational Research Association, et al., 1999, p.74). In examining test fairness, the researcher should address questions such as whether the test measures the same construct in all relevant populations (Wang & Witt, 2002). An investigation of the factor structure of a test can provide evidence of validity (Messick, 1995) and fairness of the test.

To make valid and fair comparisons across examinee groups, test items should be constructed to measure the same construct(s). However, test items often measure other traits in addition to the traits they intend to measure (Hambleton & Swaminathan, 1985; Reckase, 1979, 1985; Stout, 1987). Several studies (Birenbaum & Tatsuoka, 1982; Bock, Gibbons, & Muraki, 1988) indicated that item attributes and examinee characteristics could affect the dimensionality of test items. Dimensionality is a property of the test as well as of the examinees (Reckase, 1990). This is also true with language proficiency tests. Oltman and Stricker (1988) and Kok (1992) showed that examinees' English proficiency and ethnic background affected the dimensionality of language proficiency tests. Therefore, when evaluating the dimensionality of a test, it would provide a better picture if the evaluation were done from the perspective of both the test itself and the examinees' characteristics.

The Michigan English Language Assessment Battery (MELAB) is a test developed for college and university admission. It intends to assess the English language competence of adult non-native speakers of English who will apply to study at an English-speaking institution. The MELAB includes Part 1, writing on a prompt, Part 2, a listening comprehension test, Part 3, grammar, cloze, vocabulary, and reading comprehension (GCVR) questions, and an optional speaking test. All the items in the listening and GCVR subtests are scored dichotomously.

The *MELAB Technical Manual* (English Language Institute, University of Michigan, 1996) reported factor analysis results, done at the component score level, of Part 2 and Part 3 in the MELAB. The *Michigan English Language Assessment Battery: Technical Manual 2003* (English Language Institute, University of Michigan, 2003) reported an item factor analysis of the individual items in Part 2 and Part 3 sections of the MELAB, and principle component analysis of the testlet scores. The item-level factor analysis provided more information regarding the construct validity of Part 2 and Part 3 in the MELAB.

The purpose of this study is to evaluate the dimensionality of Part 2, listening comprehension, and Part 3, GCVR, in the MELAB separately, using item-level information. It further investigates the influences of gender, native language, and language proficiency level on the dimensionality of the listening comprehension test and the GCVR test. Two sets of hypotheses were proposed for this research. One set was that the items in Part 2 were unidimensional, globally and across subgroups of examinees. The other set was that the items in Part 3 were also unidimensional, globally and across subgroups of examinees. In short, this study intends to provide a better understanding of the dimensionality of Part 2 and Part 3 in the MELAB and to determine the consistency in dimensionality across all available examinees and the selected subgroups of examinees.

Stout's Nonparametric Analysis of Dimensionality

Stout (1987) proposed the concept of essential unidimensionality. Essential unidimensionality refers to the existence of exactly one dominant dimension. Van Abswoude, van der Ark, and Sijtsma (2004) suggest that DIMTEST can be used to verify unidimensionality when there is only one dominant trait in the data set and only a few items are driven by another trait. DIMTEST is a statistical assessment of whether there is one or more than one dominant dimension. Stout's nonparametric procedure (Nandakumar & Stout, 1993; Stout, 1987) tests two statistical hypotheses. The null hypothesis states that $d = 1$ and the alternative hypothesis is that $d > 1$, where *d* stands for the number of dimensions in a set of test items.

To test the hypothesis that a group of dichotomous items is unidimensional, DIMTEST divides all the items on the test into three subtests, two assessment subtests, and one partitioning subtest. DIMTEST selects M items from N items: the total number of items on the test. These M items are called Assessment Subtest 1, or AT1. These items are dimensionally distinct from the rest of the items and measure the same trait. AT1 items can be selected based on expert opinions or based on factor analysis results. DIMTEST can automatically choose the AT1 items through a factor analysis procedure using the tetrachoric correlation matrix. Then, another group of M items are selected from the remaining items so that the difficulty levels of these items are as similar to those of the AT1 items as possible. They are called Assessment Subtest 2, AT2. AT2 has a similar difficulty distribution as does AT1, and is dimensionally similar to the remaining items. AT2 is constructed to reduce the examinee variability bias and the item difficulty bias, which may result in false rejection of the null hypothesis. The remaining items, n = N - 2M, is the Partitioning Subtest, PT. Examinees are divided into subgroups based on their PT scores. Examinees with the same PT score are assigned into the same PT subgroup. For each PT subgroup, a statistic, t_{LK}, based on the examinees' AT1 subtest scores, and a statistic, t_{BK}, based on the examinees' AT2 subtest scores are calculated (see Nandakumar & Stout, 1993; Stout, 1987, for details). The DIMTEST statistic T is obtained with the following formula:

$$T = \frac{T_L - T_B}{\sqrt{2}}$$

where

$$T_L = \sum_{k=1}^{n-1} t_{Lk} \quad \text{and} \quad T_B = \sum_{k=1}^{n-1} t_{Bk}$$

(k is the number of PT scores, t_{Lk} is the standardized difference between two variance estimates). The first variance estimate is actual observed variance between subgroups k number-correct scores on AT1. The second is the variance between subgroups k number-correct AT1 scores that were predicted under the unidimensional assumption. The first variance estimate will be inflated if the data is multidimensional. The measure of the amount of multidimensionality for subgroup k is t_{Lk}. If unidimensionality holds for subgroup k except for statistical error, the two within-subgroup variance estimates are approximately equal, and $t_{Lk} = 0$. If multidimensionality holds, then $t_{Lk} > 0$. If the test is not long enough, T_L is biased even if unidimensionality holds. Thus, T_B is used to correct the statistical bias in T_L. It is better to apply DIMTEST for tests with the total number of items equal to or larger than 80 items. Van Abswoude, et al. (2004) indicated that DIMTEST has low power for short tests.

Consequently, Stout's statistic, T, is compared with the upper 100(1-α) percentile of the standard normal distribution, Z_a, for a desired level of significance, α. When $T < Z_a$, DIMTEST accepts the unidimensionality hypothesis. When $T > Z_a$, DIMTEST rejects the unidimensionality hypothesis. Nandakumar (1991) modified Stout's more conservative statistic and proposed a more powerful statistic with a slightly higher but acceptable type I error rate. This study presents both Stout's conservative statistic T and Nandakumar's more powerful statistic T'.

Since DIMTEST uses test scores as a conditioning variable, it shows some positive bias even after correcting for the two types of bias using AT2. To further reduce bias and increase the power of the more powerful statistic T', Stout, Goodwin Froelich, and Gao (2001) proposed a new DIMTEST procedure that uses only one AT subtest.

DIMTEST incorporates a FAC procedure that performs an unrotated principle axis factor analysis of the tetrachoric correlation matrix for the dichotomous data set with maximum interitem correlations estimating communalities. A FAC output file containing the second-factor loadings can be utilized as an input file for the ASN program in automatically selecting AT1 items. When the ASN program uses the second-factor loadings from the output of FAC program to automatically choose AT1 items, the number of AT1 items is also determined automatically to optimize the statistical power (Nandakumar & Stout, 1993). The other output file from the FAC program contains the results of the factor analysis. AT1 items can be selected subjectively based on the FAC output. Three sub-programs in DIMTEST are used in this study: FAC, ASN, and SSC. FAC implements a tetrachoric factor analysis, ASN uses the output from the FAC program to select AT1 and AT2 items, and SSC calculates the DIMTEST statistics.

Principle Component Analysis with Tetrachoric Correlations

Principle component analysis has been used by researchers to assess dimensionality of a set of items (Abedi, 1997). If a large amount of variance can be explained by the first component, the set of items can be considered unidimensional. For dichotomous items, principle components analysis uses tetrachoric correlations to reduce items into a small number of principle components accounting for most of the variance in the items. According to Hatcher (1994), multiple criteria can be used to determine the number of components to retain. They are the eigenvalue, the proportion of variance accounted for, and the interpretability criterion. Kaiser (1960) suggests that a component with an eigenvalue larger than one be retained. Hatcher (1994) suggests retaining any component accounting for at least 10% of the total variance. Reckase (1979) suggests that if the first component explains 20% of the variance of a set of items, the item set is unidimensional. In addition, the interpretation of the retained component should make substantive meaning of the constructs.

Method

Data

The data used in this study were from examinees who took Form EE of the Part 2 (GCVR) and Form FF of the Part 3 (listening) of the MELAB. Their responses to Part 2 and Part 3, and the information on their gender and native language, were collected. There were 1,031 examinees who took Form EE, and 1,650 examinees who took Form FF. Form EE contains 100 items: Items 1 through 30 are grammar items, items 31 through 50 are cloze passage items, items 51 through 80 measure vocabulary, and items 81 through 100 are the reading comprehension items. For Form FF (listening), items 1 through 15 are the short questions, items 16 through 35 are the short conversations, and items 36 through 50 are radio report comprehension items. Table 1 shows the test composition for Form EE and Form FF.

Table 1. Composition for Form EE and Form FF

Form EE (GCVR)	Item Numbers	Form FF (Listening)	Item Numbers
Grammar	1 to 30	Short questions	1 to 15
Cloze	31 to 50	Short conversations	16 to 35
Vocabulary	51 to 80	Radio reports	36 to 50
Reading	81 to 100		

In this study, two sets of analyses were carried out. The first set of analyses focuses on the global structure of the test items using all available examinee data, and the second set evaluates the local structure of data across subgroups of test takers that differ with respect to gender, native language, and proficiency level. The selected six sub-groups of examinees were female, male, examinees whose native language was Korean, those whose native language was Tagalog/Filipino, high-proficiency examinees for a particular subtest, and low-proficiency examinees for a particular subtest. For both the listening and GCVR tests, high and low proficiency levels were distinguished by the examinee scale scores. For both subtests, examinees with a scale score of 80 or higher were classified as high proficiency examinees, and those with a scale score below 80 were categorized as low proficiency examinees. Due to the limited amount of data, only Tagalog/Filipino and Korean language groups were analyzed. Altogether, seven dichotomous response data sets were set up for each subtest; namely, data sets for all available examinees taking a particular subtest, female examinees, male examinees, Tagalog/Filipino speakers, Korean speakers, high-proficiency examinees, and low-proficiency examinees, resulting in 14 data sets. The number of examinees for the seven groups for each subtest is summarized in Table 2.

Table 2. Number of Examinees for Each Data Set

Listening	Number of Examinees
All examinees	1,650
Female	1,257
Male	393
Tagalog/Filipino	800
Korean	141
High listening proficiency	939
Low listening proficiency	711
GCVR	
All examinees	1,031
Female	787
Male	244
Tagalog/Filipino	527
Korean	123
High GCVR proficiency	528
Low GCVR proficiency	503

Procedure

After the collection of item response data, multiple procedures were adopted to appraise global and local dimensionality of the tests: Stout's DIMTEST procedure, principle axis factoring of tetrachoric correlations, and principle components analysis with LISREL.

To calculate Stout's statistic, test items were split into three subtests: AT1 (assessment subtest 1), AT2 (assessment subtest 2), and PT (partitioning subtest). The items in the AT1 were not specified in advance, but were identified through a principle axis factor analysis of the tetrachoric correlations by the FAC application. The FAC program first ran the tetrachoric factor analysis to calculate the second-factor loadings for the selection of AT1 subtest items set. Only part of the data was used for running FAC, while the rest of the data was used for ASN and SSC runs. The ASN program selected AT1 and AT2 items automatically based on the FAC output, and the SSC program calculated the DIMTEST statistic. SSC assessed the statistical significance of the distinctiveness of the dimensionality between two specified subtests: the Assessment Subtests and the Partitioning Subtest. DIMTSET conservative and more powerful T statistics, and their probabilities, were used as the criteria to evaluate test dimensionality, and $\alpha = 0.05$ was used to determine the significance of the hypothesis test.

Principle axis factoring of tetrachoric correlations was run for each group of examinees. Tetrachoric factor analysis in the DIMTEST was run with the specification of the number of factors. For this study, the number of factors was determined based on the natural groupings of the items. For Form FF, the 50 listening items were divided into three parts, measuring examinee ability to understand short questions, short conversations, and radio reports. For Form EE, the 100 GCVR items were categorized into 4 groups, measuring examinee proficiency in grammar, cloze, vocabulary, and reading comprehension. The resulting number of factors for the tetrachoric factor analysis was determined based on the criteria of the strength of the eigenvalues and the differences between the factor eigenvalues.

To further confirm the results obtained in the principle axis factor analysis and the DIMTEST procedure, LISREL was employed to run a principle component analysis using the tetrachoric correlation matrix. The percentage of variance explained by each factor was employed in determining the number of principle components.

Stout's nonparametric procedure, tetrachoric factor analysis, and principle component analysis using the tetrachoric correlation matrix, were each applied to each of the seven data sets for both test forms. Form EE and Form FF of the MELAB test were analyzed for all available examinees and the six specified subgroups of examinees using DIMTEST, FAC in the DIMTEST, and LISREL. Results based on all the available data and those based on the data from the subgroups were compared to evaluate the global dimensionality and the consistency of local dimensionality across different subgroups of examinees.

Results

Stout's DIMTEST Statistics

Table 3 summarizes the analysis results from Stout's nonparametric procedure to test the unidimensionality of the 14 data sets using DIMTEST. For the listening test, both conservative and the more powerful tests indicated that the test was not unidimensional based on all available examinee responses and for the male subgroup of examinees. However, the listening test was unidimensional at the 0.05 level for the female, Tagalog/Filipino speakers, and both high and low listening proficiency examinee groups. For examinees whose native language was Korean, the listening test was unidimensional based on the conservative statistics, but not unidimensional based on the more powerful statistic.

For the GCVR test, the unidimensionality test was accepted at the 0.05 level for all examinees, females, Tagalog/Filipino speakers, and both high- and low-proficiency subgroups. For the male examinees, the GCVR test was not unidimensional. For the Korean-speaking examinees, the DIMTEST conservative statistic supported unidimensionality, but the more powerful statistic rejected the null hypothesis that the GCVR test was unidimensional.

Table 3. DIMTEST Results

	DIMTEST Statistics			
	Conservative (*T*)		More Powerful (*T*')	
Listening	*T*	P-value	*T*	P-value
All examinees	1.991	0.023	2.254	0.012
Female	0.805	0.210	1.034	0.151
Male	2.625	0.004	3.108	0.001
Tagalog/Filipino	0.529	0.298	0.697	0.243
Korean	1.457	0.073	1.943	0.026
High listening proficiency	0.282	0.389	0.404	0.343
Low listening proficiency	0.325	0.373	0.425	0.335
GCVR				
All examinees	-0.500	0.692	-0.473	0.682
Female	1.088	0.138	1.421	0.078
Male	1.802	0.036	2.148	0.016
Tagalog/Filipino	-3.441	0.9997	-4.159	0.99998
Korean	1.288	0.099	2.176	0.015
High GCVR proficiency	-0.413	0.66	-0.485	0.686
Low GCVR proficiency	0.071	0.472	-0.004	0.502

Eigenvalues and Eigenvalue Differences

The eigenvalues and the eigenvalue differences between factors for the listening test are summarized in Table 4. The eigenvalues for the first three factors were all larger than 1 for all groups. For all examinees, female, male, Tagalog/Filipino, and Korean-speaking examinee groups, the eigenvalues for the first factor were larger than 10, and the difference between the first two factors was around 10. Hattie (1985) suggests using the difference between the first factor and the second factor divided by the difference between the second and the third factor to examine the relative strength of the first factor (dubbed the Factor Difference Ratio Index (FDRI) in Johnson, Yamashiro, & Yu, 2003). If this ratio is larger than 3, the first factor is relatively strong. Based on this criterion, the data for six examinee groups: all examinees, female, male, Tagalog/Filipino speakers, Korean speakers, and low listening proficiency, satisfy this criterion. The first factor was relatively strong for these six groups of examinees. For the examinee group with high listening proficiency, the eigenvalues for the three factors were of similar strength, around 5. This data set did not meet the FDRI criterion suggested by Hattie (1985).

The eigenvalues and the eigenvalue differences between factors for the GCVR data are summarized in Table 5. The eigenvalues for the first four factors were larger than 1 for all groups. The eigenvalues for the first factor was larger than 10 for all groups, but the FDRI was greater than 3 for only all examinees, female, male, Tagalog/Filipino, and low-GCVR-proficiency examinee groups. The examinee group with high GCVR proficiency and the Korean subgroup did not satisfy Hattie’s (1985) FDRI recommendation.

Table 4. Eigenvalues from Tetrachoric Factor Analysis — Listening

Listening	Factor	Eigenvalue	Difference	FDRI
All examinees	1	12.133	10.477	22.68
	2	1.655	0.462	
	3	1.193	0.182	
Female	1	11.994	10.297	23.83
	2	1.698	0.431	
	3	1.266	0.153	
Male	1	12.810	9.917	11.17
	2	2.893	0.888	
	3	2.005	0.306	
Tagalog/Filipino	1	11.914	10.086	20.80
	2	1.828	0.485	
	3	1.343	0.218	
Korean	1	13.903	10.217	17.32
	2	3.685	0.590	
	3	3.095	0.414	
High listening proficiency	1	5.993	1.153	1.63
	2	4.839	0.708	
	3	4.132	0.674	
Low listening proficiency	1	5.602	3.996	26.29
	2	1.606	0.152	
	3	1.454	0.246	

FDRI = factor difference ratio index ((F1-F2)/(F2-F3)).

Table 5. Eigenvalues from Tetrachoric Factor Analysis — GCVR

GCVR	Factor	Eigenvalue	Difference	FDRI
All examinees	1	26.423	20.510	5.79
	2	5.912	3.542	
	3	2.370	0.291	
	4	2.079	0.576	
Female	1	25.147	18.838	5.21
	2	6.308	3.616	
	3	2.692	0.467	
	4	2.225	0.430	
Male	1	30.771	25.005	11.03
	2	5.767	2.267	
	3	3.500	0.807	
	4	2.693	0.171	
Tagalog/Filipino	1	22.959	16.987	16.92
	2	5.972	1.004	
	3	4.968	0.342	
	4	4.626	0.681	

Table 5. (cont.)

GCVR	Factor	Eigenvalue	Difference	FDRI
Korean	1	16.148	6.426	1.40
	2	9.722	4.603	
	3	5.119	0.776	
	4	4.343	0.351	
High GCVR proficiency	1	11.886	3.427	2.69
	2	8.460	1.272	
	3	7.187	2.118	
	4	5.069	0.696	
Low GCVR proficiency	1	11.729	7.176	4.17
	2	4.553	1.719	
	3	2.834	0.180	
	4	2.654	0.726	

FDRI = factor difference ratio index ((F1-F2)/(F2-F3)).

Percentage of Variance Explained

To further check the results from the tetrachoric factor analysis in DIMTEST, principle component analysis using the tetrachoric correlation matrix was run in LISREL. The analysis results from LISREL are summarized in Table 6 for the listening test and Table 7 for the GCVR test. For the eigenvalue, a similar pattern to that based on DIMTEST tetrachoric factor analysis results was observed for both listening and GCVR tests using LISREL. Using Reckase's (1979) suggestion that a set of test items is unidimensional if the first factor accounts for 20% or more of the total variance, for the listening test, the item responses of all examinees, females, males, Tagalog/Filipino speakers, and Korean speakers are unidimensional. However, the first principle component for the high and low listening proficiency groups accounted for much less than 20% of the total variance.

For the GCVR test, the first factor for the examinee groups of all examinees, female, male, and Tagalog/Filipino speakers accounted for more than 20% of the total variance. For the Korean speakers and high- and low-GCVR-proficiency examinee groups, the first principle component accounted for less than 20 % of the total variance.

The results regarding the dimensionality of the data sets for the listening and the GCVR tests in the MELAB are summarized in Table 8. In most cases, different procedures and evaluation criteria led to different conclusions regarding the dimensionality of the test data. Only data sets from 5 out of 14 groups of examinees yielded consistent conclusions. The listening test for female and Tagalog/Filipino-speaking groups, and the GCVR test for female, Tagalog/Filipino speakers, and all examinees were unidimensional consistently across all procedures used in this study.

Summary and Discussion

Regarding the global dimensionality of Form EE (GCVR test) in the MELAB, unidimensionality held. This is consistent with the item-level factor analysis results reported in the MELAB technical manual 2003 for Part 3. On the other hand, inconsistent results were obtained regarding the global unidimensionality of Form FF (listening test).

Table 6. Eigenvalues from LISREL – Listening

Listening		PC 1	PC 2	PC 3
All examinees	Eigenvalue	12.69	2.26	1.80
	% Variance	25.38	4.52	3.60
	Cum. % Var	25.38	29.89	33.49
Female	Eigenvalue	12.55	2.30	1.87
	% Variance	25.10	4.59	3.73
	Cum. % Var	25.10	29.69	33.42
Male	Eigenvalue	13.24	3.03	2.24
	% Variance	26.47	6.07	4.48
	Cum. % Var	26.47	32.54	37.02
Tagalog/Filipino	Eigenvalue	12.45	2.39	1.94
	% Variance	24.90	4.79	3.88
	Cum. % Var	24.90	29.69	33.57
Korean	Eigenvalue	14.15	3.79	3.15
	% Variance	28.30	7.58	6.31
	Cum. % Var	28.30	35.89	42.19
High listening proficiency	Eigenvalue	4.81	4.14	3.46
	% Variance	9.62	8.28	6.39
	Cum. % Var	9.62	17.91	24.83
Low listening proficiency	Eigenvalue	6.18	2.33	2.18
	% Variance	12.36	4.65	4.37
	Cum. % Var	12.36	17.01	21.38

Table 7. Eigenvalues from LISREL — GCVR

GCVR		PC 1	PC 2	PC 3	PC 4
All examinees	Eigenvalue	26.90	6.41	2.84	2.56
	% Variance	26.90	6.41	2.84	2.56
	Cum. % Var	26.90	33.32	36.15	38.72
Female	Eigenvalue	25.61	6.81	3.17	2.78
	% Variance	25.61	6.81	3.17	2.78
	Cum. % Var	25.61	32.42	35.59	38.37
Male	Eigenvalue	31.08	6.13	3.60	3.09
	% Variance	31.08	6.13	3.60	3.09
	Cum. % Var	31.08	37.21	40.81	43.90
Tagalog/Filipino	Eigenvalue	22.03	7.57	6.39	4.35
	% Variance	22.03	7.57	6.39	4.35
	Cum. % Var	22.03	29.60	35.99	40.34

Table 7. (cont.)

GCVR		PC 1	PC 2	PC 3	PC 4
Korean	Eigenvalue	16.49	10.07	5.48	4.76
	% Variance	16.49	10.07	5.48	4.76
	Cum. % Var	16.49	26.56	32.05	36.80
High GCVR proficiency	Eigenvalue	12.35	8.86	6.32	4.73
	% Variance	12.35	8.86	6.32	4.73
	Cum. % Var	12.35	21.21	27.53	32.27
Low GCVR proficiency	Eigenvalue	12.26	5.18	3.50	3.30
	% Variance	12.26	5.18	3.50	3.30
	Cum. % Var	12.26	17.43	20.93	24.23

Table 8. Results Summary

	DIMTEST statistics			
Listening	Conservative	More powerful	Eigenvalue difference	Percentage of variance explained by first factor
All examinees	N	N	U	U
Female	U	U	U	U
Male	N	N	U	U
Tagalog/Filipino	U	U	U	U
Korean	U	N	U	U
High listening proficiency	U	U	N	N
Low listening proficiency	U	U	U	N
GCVR				
All examinees	U	U	U	U
Female	U	U	U	U
Male	N	N	U	U
Tagalog/Filipino	U	U	U	U
Korean	U	N	N	N
High GCVR proficiency	U	U	N	N
Low GCVR proficiency	U	U	U	N

For each of the studied subgroups of examinees, unidimensionality held for both forms for female and Tagalog/Filipino-speaking examinee groups. For other subgroups of examinees, the results regarding the unidimensionality for each of the two forms were inconsistent in terms of the evaluation criteria adopted in this study. Thus, no conclusion can be drawn regarding the dimensionality of the listening and GCVR sections of the test for those groups of examinees. The dimensionality was not consistent across different groups of examinees for each test form.

Several issues need attention regarding the generalizability of the study results. The first issue is related to the sample size in this study. Hatcher (1994) suggested that the minimal sample size should be 5 times the number of variables to be analyzed. Van Abswoude, et al. (2004) suggested that DIMTEST may be more effective for large sample sizes, such as n = 2,000. However, there were only data for 1,031 examinees available for the GCVR test, and 1,650 examinees for the listening test. When the subgroups of examinees were selected from these samples, much smaller samples resulted. For example, for the male and Korean groups, there were fewer than 400 cases. Sample sizes smaller than that desired may affect the analysis results.

Stout's nonparametric procedure requires selection of the AT1 items, which was completed automatically by the program based on the second-factor loadings and other output from the FAC analysis. This study also tried to manually select AT1 items based on the tetrachoric factor analysis results. However, such selection may lead to the failure of the Wilcoxon Rank Sum Test in the ASN program. Thus, expert opinions and the factor loadings from the tetrachoric factor analysis presented in Table A.1 to Table B.7 in Appendices A and B may be combined to come up with a set of AT1 items. This may improve the DIMTEST procedure for assessing dimensionality.

In summary, the results of this study provide more information regarding the dimensionality of Part 2, listening, and Part 3, GCVR, in the MELAB. This study helps to identify the effect of the test items and of the examinees' characteristics on the dimensionality of the MELAB sections.

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Appendix A

Factor Loadings for Form FF-Listening

Table A.1. Factor Loadings for Listening-All Examinees

Item	Factor Loadings		
	1	2	3
1	0.611	-0.078	-0.162
2	0.376	0.056	-0.199
3	0.687	-0.137	-0.122
4	0.433	0.076	0.086
5	0.435	0.024	-0.221
6	0.582	-0.161	-0.218
7	0.645	-0.088	-0.186
8	0.544	0.041	-0.101
9	0.547	0.097	-0.284
10	0.330	-0.051	-0.056
11	0.244	-0.015	-0.149
12	0.566	-0.153	0.063
13	0.386	0.104	-0.146
14	0.407	0.133	-0.080
15	0.555	0.124	-0.111
16	0.579	-0.348	0.041
17	0.686	-0.054	-0.044
18	0.484	-0.096	0.093
19	0.572	-0.153	0.187
20	0.655	-0.002	0.014
21	0.413	-0.052	-0.108
22	0.665	-0.239	0.090
23	0.737	-0.147	-0.058
24	0.530	-0.084	0.141
25	0.326	-0.153	0.219
26	0.576	-0.110	-0.024
27	0.424	0.066	-0.243
28	0.701	-0.192	0.179
29	0.696	-0.226	-0.015
30	0.368	-0.005	-0.226
31	0.481	0.070	-0.022
32	0.513	-0.216	0.134
33	0.485	0.184	-0.091
34	0.512	0.305	-0.113
35	0.312	0.048	0.063
36	0.515	-0.037	0.273
37	0.383	0.279	0.081
38	0.314	0.159	0.011
39	0.098	0.110	0.140
40	0.535	0.054	-0.095
41	0.360	0.240	0.176
42	0.339	0.280	0.145
43	0.449	0.007	0.372
44	0.515	0.163	0.215
45	0.495	0.158	0.322
46	0.259	0.502	0.012
47	0.418	0.243	0.128
48	0.270	0.166	0.118
49	0.260	0.518	-0.072
50	0.332	0.198	0.068

Table A.2. Factor Loadings for Listening-Female

Item	Factor Loadings		
	1	2	3
1	0.620	-0.079	-0.158
2	0.393	0.006	-0.202
3	0.658	-0.176	-0.076
4	0.441	0.056	0.059
5	0.431	-0.009	-0.139
6	0.574	-0.200	-0.221
7	0.668	-0.053	-0.165
8	0.528	0.011	-0.133
9	0.517	0.049	-0.308
10	0.350	0.020	-0.036
11	0.210	-0.121	-0.168
12	0.564	-0.126	-0.011
13	0.390	0.155	-0.175
14	0.399	0.075	-0.100
15	0.547	0.074	-0.143
16	0.580	-0.365	0.122
17	0.678	-0.124	-0.019
18	0.497	-0.087	0.104
19	0.565	-0.132	0.153
20	0.611	-0.009	0.103
21	0.427	-0.004	-0.197
22	0.642	-0.190	0.043
23	0.726	-0.128	-0.064
24	0.531	-0.007	0.128
25	0.352	-0.109	0.202
26	0.605	-0.143	0.035
27	0.388	0.067	-0.248

28	0.704	-0.196	0.200
29	0.706	-0.254	0.005
30	0.375	-0.038	-0.200
31	0.477	0.004	0.017
32	0.510	-0.119	0.095
33	0.499	0.204	-0.147
34	0.507	0.344	-0.187
35	0.320	0.015	0.068
36	0.502	-0.046	0.344
37	0.373	0.286	0.091
38	0.324	0.179	0.052
39	0.112	0.098	0.080
40	0.515	0.107	-0.111
41	0.367	0.214	0.206
42	0.340	0.300	0.189
43	0.460	0.056	0.341
44	0.531	0.162	0.179
45	0.474	0.187	0.323
46	0.221	0.515	-0.023
47	0.410	0.318	0.104
48	0.279	0.191	0.087
49	0.245	0.478	-0.127
50	0.345	0.187	0.052

Table A.3. Factor Loadings for Listening-Male

Item	Factor Loadings		
	1	2	3
1	0.585	0.005	-0.007
2	0.312	0.113	0.268
3	0.780	-0.013	0.004
4	0.402	0.072	0.035
5	0.442	0.148	0.023
6	0.625	0.084	-0.023
7	0.565	-0.047	-0.030
8	0.593	0.139	-0.121
9	0.641	0.149	0.145
10	0.267	-0.056	-0.201
11	0.308	0.862	-0.308
12	0.570	-0.162	-0.219
13	0.380	-0.128	0.084
14	0.440	0.018	0.197
15	0.581	0.097	0.199
16	0.585	-0.958	0.414
17	0.706	0.017	0.097
18	0.431	-0.175	-0.057
19	0.590	-0.056	-0.200
20	0.783	0.099	0.009
21	0.384	-0.286	-0.068
22	0.731	-0.229	-0.393
23	0.773	-0.082	-0.353
24	0.538	-0.378	-0.170
25	0.232	-0.130	-0.181
26	0.479	0.033	0.069
27	0.532	-0.011	0.057
28	0.692	-0.034	-0.112
29	0.645	0.117	-0.253
30	0.339	0.215	0.041
31	0.503	0.193	0.264
32	0.533	-0.279	-0.291
33	0.442	0.024	0.213
34	0.589	-0.316	0.505
35	0.288	0.115	0.106
36	0.569	0.049	0.073
37	0.418	0.238	0.040
38	0.287	0.019	0.110
39	0.049	-0.077	0.008
40	0.610	0.002	-0.178
41	0.340	0.209	0.225
42	0.345	0.149	0.184
43	0.405	-0.024	-0.198
44	0.462	0.099	-0.078
45	0.553	0.151	-0.170
46	0.391	0.218	0.343
47	0.452	0.071	0.036
48	0.247	0.130	0.130
49	0.312	0.416	0.367
50	0.289	0.207	0.151

Table A.4. Factor Loadings for Listening-Tagalog/Filipino

Item	Factor Loadings		
	1	2	3
1	0.598	-0.106	-0.138
2	0.399	-0.001	-0.147
3	0.686	-0.211	-0.053
4	0.452	0.148	0.147
5	0.448	-0.072	-0.267
6	0.556	-0.120	-0.146
7	0.663	-0.048	-0.220
8	0.532	0.061	-0.064
9	0.581	0.177	-0.261
10	0.321	-0.026	-0.043
11	0.216	0.023	-0.143

12	0.515	-0.121	0.122
13	0.376	0.181	-0.101
14	0.418	0.150	0.035
15	0.541	0.114	-0.139
16	0.520	-0.392	-0.020
17	0.712	-0.034	-0.019
18	0.500	-0.115	0.083
19	0.526	-0.294	0.122
20	0.592	0.030	-0.083
21	0.421	0.127	-0.111
22	0.668	-0.152	0.147
23	0.711	-0.160	-0.078
24	0.512	0.004	0.052
25	0.334	-0.291	0.266
26	0.581	-0.133	-0.120
27	0.440	0.188	-0.273
28	0.659	-0.301	0.078
29	0.693	-0.336	-0.049
30	0.345	-0.011	-0.268
31	0.505	0.093	0.087
32	0.539	-0.135	0.104
33	0.459	0.153	-0.163
34	0.514	0.385	-0.170
35	0.316	0.080	0.139
36	0.510	0.004	0.215
37	0.424	0.266	0.092
38	0.353	0.078	-0.036
39	0.097	0.146	0.237
40	0.490	0.085	-0.047
41	0.351	0.178	0.076
42	0.375	0.112	0.158
43	0.444	0.120	0.389
44	0.530	0.114	0.203
45	0.456	0.004	0.337
46	0.211	0.431	0.125
47	0.455	0.312	0.096
48	0.263	0.006	0.286
49	0.249	0.491	-0.025
50	0.376	0.207	0.182

Table A.5. Factor Loadings for Listening-Korean

Item	Factor Loadings		
	1	2	3
1	0.639	-0.044	-0.287
2	0.370	0.242	0.105
3	0.763	0.101	0.041
4	0.473	-0.147	-0.198
5	0.501	0.130	0.163
6	0.574	0.027	-0.159
7	0.715	-0.025	-0.015
8	0.535	-0.013	-0.074
9	0.603	0.228	0.030
10	0.374	0.176	0.017
11	0.455	0.430	0.435
12	0.712	-0.162	-0.080
13	0.664	0.105	-0.206
14	0.351	0.176	0.096
15	0.607	0.096	0.139
16	0.866	-0.167	-0.786
17	0.722	-0.171	-0.110
18	0.747	-0.387	0.334
19	0.675	-0.415	0.381
20	0.719	-0.001	-0.042
21	0.459	-0.116	-0.212
22	0.480	-0.228	0.012
23	0.708	-0.062	0.031
24	0.441	0.055	-0.216
25	0.384	-0.176	0.501
26	0.566	-0.110	-0.064
27	0.001	0.660	0.534
28	0.793	-0.493	0.420
29	0.666	-0.027	0.140
30	0.322	0.128	0.191
31	0.214	0.025	-0.170
32	0.535	0.154	-0.037
33	0.468	0.362	0.157
34	0.461	0.238	-0.063
35	0.431	0.010	0.192
36	0.554	-0.086	-0.097
37	0.412	-0.048	0.010
38	0.481	0.121	-0.470
39	0.145	-0.097	-0.128
40	0.353	0.298	-0.324
41	0.333	0.429	0.339
42	0.288	0.345	0.034
43	0.530	-0.183	-0.145
44	0.507	0.091	0.126
45	0.545	0.188	-0.015
46	0.316	0.332	0.129
47	0.548	0.048	-0.006
48	-0.110	1.029	-0.467
49	0.301	0.363	0.215
50	0.322	0.140	0.024

Table A.6. Factor Loadings for Listening-High Proficiency

Item	Factor Loadings		
	1	2	3
1	0.450	0.054	0.119
2	0.137	0.510	0.170
3	0.462	0.074	0.285
4	0.345	-0.144	-0.315
5	0.314	-0.057	0.407
6	0.477	-0.169	-0.004
7	0.145	0.018	0.139
8	0.128	0.175	0.067
9	0.022	0.169	-0.051
10	0.076	0.060	0.025
11	-0.026	0.586	-0.387
12	0.524	-0.489	-0.373
13	0.199	0.080	0.096
14	0.420	0.072	0.053
15	0.506	0.231	0.010
16	-1.498	0.316	-0.420
17	-0.024	0.056	-0.270
18	0.306	0.368	0.314
19	-0.133	-1.405	-0.043
20	-0.474	0.620	0.317
21	0.152	0.152	0.008
22	-0.346	-0.026	0.138
23	0.695	0.302	-0.493
24	-0.035	0.161	-0.095
25	0.282	-0.135	0.045
26	0.317	0.206	0.331
27	0.381	0.370	0.085
28	-0.179	0.059	1.388
29	0.463	0.380	-0.238
30	0.026	0.193	0.017
31	-0.034	0.459	0.066
32	0.335	-0.134	0.078
33	0.082	0.135	-0.018
34	0.133	0.188	0.188
35	0.128	-0.097	-0.009
36	-0.110	0.422	-0.451
37	-0.086	0.102	-0.008
38	0.022	0.061	-0.098
39	0.013	0.007	-0.028
40	-0.006	0.233	0.146
41	-0.154	-0.127	0.092
42	0.067	0.026	-0.028
43	-0.099	-0.075	0.238
44	-0.023	0.006	0.106
45	0.312	0.330	-0.352
46	0.087	-0.046	-0.010
47	-0.007	0.035	0.065
48	0.341	-0.027	-0.287
49	0.329	-0.109	0.146
50	-0.009	0.024	-0.014

Table A.7. Factor Loadings for Listening-Low Proficiency

Item	Factor Loadings		
	1	2	3
1	0.398	-0.273	-0.173
2	0.056	-0.145	0.212
3	0.575	-0.169	0.204
4	0.133	0.148	-0.068
5	0.143	-0.096	0.262
6	0.425	-0.348	0.079
7	0.444	-0.264	0.009
8	0.269	0.025	0.201
9	0.165	-0.210	0.276
10	0.139	-0.141	-0.153
11	0.142	0.067	0.378
12	0.529	-0.063	-0.179
13	0.085	-0.110	-0.186
14	0.183	0.242	0.189
15	0.266	0.013	0.260
16	0.636	-0.058	0.168
17	0.524	0.036	0.180
18	0.552	0.089	0.080
19	0.473	0.035	-0.052
20	0.449	0.060	0.036
21	0.216	-0.166	-0.314
22	0.579	-0.024	-0.080
23	0.564	-0.090	0.002
24	0.316	0.173	-0.220
25	0.293	0.122	0.017
26	0.405	0.028	0.023
27	0.168	-0.074	0.124
28	0.617	0.064	-0.173
29	0.601	-0.094	0.020
30	0.134	-0.156	0.004
31	0.231	0.079	0.228
32	0.485	-0.046	-0.175
33	0.136	0.000	-0.062
34	0.064	0.093	-0.168
35	0.182	0.113	0.085

36	0.446	0.324	0.071
37	0.011	0.238	-0.032
38	0.088	0.074	0.139
39	-0.037	0.134	-0.004
40	0.139	-0.173	-0.288
41	0.076	0.354	0.125
42	0.056	0.288	-0.071
43	0.361	0.295	-0.325
44	0.234	0.254	-0.227
45	0.322	0.439	0.045
46	-0.066	0.268	0.202
47	0.035	0.247	-0.158
48	0.069	0.105	-0.148
49	-0.190	0.114	0.191
50	0.044	0.139	0.014

Appendix B

Factor Loadings for Form EE-GCVR

Table B.1. Factor Loadings for GCVR -All Examinees

Item	Factor Loadings			
	1	2	3	4
1	0.553	-0.127	0.261	0.107
2	0.598	0.099	-0.012	-0.134
3	0.625	0.076	0.089	-0.002
4	0.629	-0.123	0.138	-0.101
5	0.382	-0.008	0.162	0.106
6	0.699	-0.028	0.186	-0.154
7	0.242	0.290	-0.003	-0.019
8	0.720	-0.033	0.257	0.032
9	0.323	0.281	-0.012	-0.085
10	0.457	0.346	-0.219	-0.177
11	0.649	-0.194	0.168	0.020
12	0.544	0.099	0.245	-0.140
13	0.593	-0.216	0.085	-0.032
14	0.268	0.503	0.060	-0.177
15	0.631	-0.069	-0.104	0.168
16	0.532	0.190	-0.057	-0.262
17	0.068	0.262	0.220	0.202
18	0.316	-0.243	0.343	0.488
19	0.026	0.628	-0.058	-0.091
20	0.203	0.171	-0.075	0.128
21	0.401	0.066	0.160	0.150
22	0.482	0.192	-0.007	-0.077
23	0.718	0.332	0.164	-0.080
24	0.546	0.281	0.022	-0.162
25	0.618	-0.107	0.129	-0.098
26	0.668	-0.161	-0.007	-0.265
27	0.585	0.265	0.371	-0.110
28	0.683	0.090	0.123	-0.017
29	0.559	0.165	0.188	0.015
30	0.492	0.434	-0.189	-0.183
31	0.448	0.406	0.115	-0.254
32	0.477	-0.059	-0.206	-0.055
33	0.228	0.040	0.222	0.088
34	0.545	0.172	0.136	0.001
35	-0.009	0.342	0.242	0.005
36	0.325	0.198	-0.091	0.002
37	-0.144	0.164	0.146	0.060
38	0.476	0.298	0.107	-0.124
39	0.251	0.371	-0.013	-0.249
40	0.585	-0.171	0.092	0.176
41	0.431	0.177	0.031	-0.163
42	0.554	0.017	0.038	-0.045
43	0.319	0.135	0.106	0.133
44	0.343	0.224	0.104	-0.015
45	0.274	0.189	-0.001	-0.052
46	0.365	-0.159	0.038	-0.120
47	0.430	0.309	-0.020	-0.039
48	0.258	0.369	0.130	0.085
49	0.675	-0.010	0.180	-0.164
50	0.277	0.209	0.146	0.111
51	0.716	-0.237	-0.235	-0.138
52	0.580	-0.389	-0.308	-0.088
53	0.567	-0.104	-0.257	-0.062
54	0.607	-0.163	-0.094	-0.102
55	0.478	0.193	-0.377	-0.259
56	0.501	-0.087	-0.085	-0.115
57	0.675	-0.522	0.112	0.030
58	0.641	-0.316	-0.056	0.137
59	0.743	-0.255	0.013	0.006
60	0.554	-0.183	-0.095	-0.186
61	0.637	-0.377	-0.098	-0.113
62	0.470	0.276	0.153	-0.080
63	0.382	0.070	0.046	-0.048
64	0.631	-0.309	-0.304	0.048
65	0.599	-0.145	-0.030	0.019
66	0.435	0.103	-0.153	-0.005
67	0.683	-0.196	-0.182	-0.001
68	0.651	-0.353	0.103	0.027
69	0.444	0.165	0.009	0.077
70	0.736	-0.263	-0.042	-0.106
71	0.610	0.034	-0.046	-0.085
72	0.617	-0.085	0.143	0.009
73	0.642	-0.287	0.172	-0.009
74	0.570	0.001	0.151	0.042
75	0.756	-0.329	-0.020	-0.026
76	0.719	-0.308	-0.178	0.137
77	0.566	-0.175	-0.018	0.077
78	0.633	-0.471	0.192	0.011
79	0.400	0.018	0.130	0.163
80	0.604	-0.126	0.027	-0.007
81	0.436	0.184	-0.038	0.190
82	0.421	0.160	-0.182	0.125

83	0.386	0.213	-0.255	0.319
84	0.351	0.232	-0.228	0.279
85	0.384	0.334	0.023	0.200
86	0.696	-0.169	-0.154	0.019
87	0.393	0.189	-0.087	0.158
88	0.511	0.329	-0.124	0.077
89	0.593	-0.066	-0.155	0.168
90	0.420	0.384	-0.043	0.251
91	0.312	0.268	-0.128	0.261
92	0.406	0.192	-0.067	0.273
93	0.572	-0.038	-0.203	0.240
94	0.407	0.336	-0.079	0.275
95	0.227	0.255	-0.134	0.079
96	0.498	0.197	-0.163	0.116
97	0.084	0.275	-0.155	-0.015
98	0.435	0.085	-0.173	0.040
99	0.372	0.246	-0.198	0.179
100	0.565	0.093	0.002	0.157

Table B.2. Factor Loadings for GCVR-Female

Item	Factor Loadings			
	1	2	3	4
1	0.543	-0.158	-0.281	0.148
2	0.580	0.081	0.003	-0.152
3	0.608	0.068	-0.093	-0.029
4	0.615	-0.124	-0.248	-0.034
5	0.375	-0.005	-0.143	0.131
6	0.665	0.005	-0.252	-0.131
7	0.277	0.327	-0.012	-0.045
8	0.732	-0.106	-0.241	0.092
9	0.332	0.260	-0.001	-0.121
10	0.427	0.373	0.250	-0.219
11	0.612	-0.206	-0.220	0.046
12	0.554	0.101	-0.333	-0.053
13	0.598	-0.229	-0.140	-0.050
14	0.300	0.483	-0.085	-0.155
15	0.603	-0.092	0.091	0.145
16	0.564	0.157	0.035	-0.265
17	0.090	0.236	-0.149	0.255
18	0.343	-0.318	-0.103	0.414
19	0.046	0.615	0.079	-0.101
20	0.206	0.165	0.137	0.150
21	0.412	0.001	-0.065	0.184
22	0.478	0.178	0.095	-0.083
23	0.689	0.328	-0.195	-0.032
24	0.547	0.291	-0.054	-0.114
25	0.602	-0.053	-0.186	-0.007
26	0.704	-0.105	-0.070	-0.238
27	0.605	0.264	-0.407	-0.032
28	0.683	0.071	-0.129	0.020
29	0.549	0.138	-0.192	0.095
30	0.459	0.459	0.194	-0.179
31	0.388	0.470	-0.153	-0.314
32	0.437	-0.027	0.132	-0.131
33	0.188	0.026	-0.207	0.137
34	0.536	0.135	-0.104	0.024
35	0.015	0.316	-0.209	-0.031
36	0.342	0.209	0.136	0.012
37	-0.191	0.117	-0.104	0.049
38	0.436	0.366	-0.171	-0.098
39	0.242	0.462	-0.061	-0.267
40	0.574	-0.213	-0.089	0.140
41	0.447	0.158	-0.048	-0.095
42	0.531	0.026	-0.071	-0.080
43	0.303	0.108	-0.052	0.215
44	0.375	0.227	-0.122	-0.001
45	0.274	0.244	0.004	-0.126
46	0.379	-0.142	-0.063	-0.115
47	0.416	0.334	-0.012	-0.011
48	0.305	0.302	-0.070	0.112
49	0.685	-0.002	-0.209	-0.076
50	0.226	0.172	-0.161	0.156
51	0.691	-0.242	0.276	-0.182
52	0.599	-0.362	0.327	-0.135
53	0.526	-0.042	0.287	-0.155
54	0.566	-0.147	0.168	-0.186
55	0.456	0.227	0.285	-0.192
56	0.492	-0.085	0.101	-0.174
57	0.647	-0.548	-0.084	-0.005
58	0.603	-0.373	0.138	0.073
59	0.708	-0.251	0.012	0.010
60	0.539	-0.132	0.064	-0.253
61	0.671	-0.344	0.078	-0.151
62	0.453	0.241	-0.115	-0.107
63	0.377	0.074	-0.002	-0.072
64	0.596	-0.348	0.428	0.018
65	0.599	-0.181	0.077	-0.005
66	0.454	0.114	0.172	-0.055
67	0.653	-0.170	0.218	-0.088
68	0.606	-0.378	-0.133	-0.018
69	0.455	0.165	0.005	0.051
70	0.712	-0.208	0.046	-0.102
71	0.607	0.040	0.079	-0.034
72	0.594	-0.089	-0.173	0.083

73	0.631	-0.356	-0.205	-0.023
74	0.598	-0.026	-0.091	0.063
75	0.760	-0.346	0.025	-0.052
76	0.668	-0.359	0.299	0.083
77	0.512	-0.224	0.083	0.080
78	0.608	-0.536	-0.213	0.056
79	0.408	-0.007	-0.032	0.187
80	0.623	-0.124	-0.024	0.014
81	0.373	0.203	0.028	0.242
82	0.387	0.182	0.192	0.103
83	0.380	0.227	0.330	0.265
84	0.334	0.222	0.287	0.296
85	0.431	0.304	0.002	0.166
86	0.673	-0.132	0.136	0.061
87	0.407	0.163	0.108	0.153
88	0.456	0.374	0.073	0.052
89	0.558	0.028	0.195	0.243
90	0.393	0.358	0.052	0.284
91	0.244	0.310	0.079	0.253
92	0.354	0.216	0.081	0.266
93	0.510	0.041	0.168	0.262
94	0.347	0.392	0.036	0.261
95	0.179	0.295	0.077	0.065
96	0.464	0.207	0.162	0.041
97	0.122	0.275	0.152	-0.054
98	0.382	0.108	0.142	0.037
99	0.378	0.204	0.218	0.169
100	0.545	0.072	-0.024	0.199

Table B.3. Factor Loadings for GCVR-Male

Item	Factor Loadings			
	1	2	3	4
1	0.587	-0.014	-0.171	0.059
2	0.639	0.170	0.177	-0.106
3	0.676	0.126	-0.038	0.011
4	0.648	-0.103	0.074	-0.046
5	0.408	-0.045	-0.123	-0.035
6	0.786	-0.112	-0.076	-0.079
7	0.157	0.138	-0.116	0.106
8	0.704	0.131	-0.034	-0.123
9	0.289	0.375	0.173	0.091
10	0.541	0.460	-0.363	-0.149
11	0.742	-0.089	0.028	-0.148
12	0.516	0.101	0.115	-0.003
13	0.582	-0.190	0.018	-0.042
14	0.187	0.543	0.192	-0.200
15	0.694	-0.020	0.169	0.157
16	0.450	0.268	0.150	-0.175
17	0.061	0.262	-0.008	-0.090
18	0.384	0.278	-1.207	0.049
19	0.021	0.592	0.203	0.089
20	0.210	0.126	0.192	-0.014
21	0.388	0.245	-0.108	-0.065
22	0.503	0.270	-0.080	-0.315
23	0.819	0.387	-0.224	-0.019
24	0.541	0.259	0.130	-0.138
25	0.644	-0.293	0.118	-0.250
26	0.584	-0.235	0.115	-0.215
27	0.559	0.242	-0.015	-0.300
28	0.687	0.178	0.003	-0.155
29	0.571	0.212	0.365	-0.097
30	0.574	0.431	0.235	-0.149
31	0.645	0.291	-0.317	-0.316
32	0.570	-0.145	0.008	0.225
33	0.355	0.059	-0.095	-0.011
34	0.613	0.205	0.023	-0.068
35	-0.052	0.381	-0.181	0.041
36	0.304	0.094	0.067	-0.087
37	0.010	0.226	-0.072	-0.054
38	0.584	0.056	0.011	0.032
39	0.289	0.038	-0.013	-0.047
40	0.685	-0.154	-0.071	0.227
41	0.400	0.172	0.179	-0.222
42	0.620	0.010	0.048	0.027
43	0.379	0.180	0.248	-0.157
44	0.267	0.094	0.137	0.182
45	0.282	0.050	-0.114	0.089
46	0.320	-0.187	-0.055	-0.054
47	0.474	0.238	0.142	-0.044
48	0.179	0.522	-0.051	0.077
49	0.654	-0.082	0.066	-0.295
50	0.423	0.266	0.147	-0.092
51	0.745	-0.219	0.076	-0.206
52	0.525	-0.410	0.009	-0.008
53	0.643	-0.273	0.080	0.074
54	0.702	-0.179	-0.033	0.059
55	0.552	0.044	0.084	0.022
56	0.530	-0.084	-0.103	0.116
57	0.728	-0.457	-0.201	-0.055
58	0.732	-0.183	-0.056	0.109
59	0.802	-0.239	0.036	-0.074
60	0.581	-0.326	0.006	0.096
61	0.549	-0.473	-0.086	0.045
62	0.526	0.409	-0.117	-0.149
63	0.381	0.139	-0.142	-0.114

64	0.687	-0.175	0.095	-0.120
65	0.605	-0.026	-0.071	0.179
66	0.396	-0.063	0.206	0.137
67	0.735	-0.267	-0.194	0.173
68	0.763	-0.300	-0.091	0.118
69	0.438	0.078	-0.035	0.292
70	0.775	-0.365	0.015	-0.102
71	0.617	0.055	-0.053	-0.231
72	0.697	-0.197	0.127	-0.223
73	0.696	-0.106	0.079	-0.161
74	0.491	0.149	-0.083	-0.079
75	0.748	-0.325	-0.035	0.008
76	0.793	-0.158	0.028	0.006
77	0.676	0.034	0.062	-0.102
78	0.679	-0.322	0.017	-0.066
79	0.411	0.106	-0.456	-0.205
80	0.572	-0.248	0.049	0.031
81	0.602	0.118	0.067	-0.005
82	0.503	0.135	0.028	0.195
83	0.409	0.112	0.051	0.292
84	0.430	0.174	0.261	0.203
85	0.334	0.200	0.335	0.245
86	0.751	-0.254	0.249	0.051
87	0.374	0.190	-0.017	0.301
88	0.686	0.222	-0.259	0.270
89	0.656	-0.230	-0.232	0.034
90	0.504	0.322	0.165	0.154
91	0.471	0.181	-0.005	0.365
92	0.535	0.126	-0.081	0.329
93	0.687	-0.239	0.026	0.297
94	0.575	0.116	-0.073	0.311
95	0.349	0.191	0.069	0.160
96	0.604	0.181	-0.029	0.307
97	0.002	0.236	0.128	0.241
98	0.552	0.123	0.045	0.030
99	0.371	0.336	0.084	0.298
100	0.647	0.060	0.219	0.117

Table B.4. Factor Loadings for GCVR-Tagalog/Filipino

Item	Factor Loadings			
	1	2	3	4
1	0.434	-0.102	0.015	-0.089
2	0.534	-0.047	-0.015	-0.048
3	0.506	-0.203	0.076	-0.051
4	0.503	-0.163	0.161	-0.094
5	0.237	0.083	0.051	-0.037
6	0.611	-0.127	0.059	-0.043
7	0.294	0.032	-0.279	-0.228
8	0.708	-0.062	0.116	-0.087
9	0.384	0.389	-0.033	-0.043
10	0.508	-0.040	-0.193	-0.458
11	0.471	-0.139	0.149	-0.012
12	0.533	-0.099	0.019	-0.054
13	0.471	-0.008	0.146	-0.234
14	0.519	0.336	-0.280	0.032
15	0.521	-0.192	0.011	-0.032
16	0.516	-0.057	-0.029	-0.053
17	0.266	0.208	0.087	0.089
18	0.357	0.066	-0.573	-1.042
19	0.348	0.377	-0.197	0.056
20	0.242	-0.010	0.186	-0.014
21	0.303	-0.004	0.091	-0.078
22	0.356	-0.147	-0.055	-0.176
23	0.927	0.025	-0.084	-0.149
24	0.685	0.183	0.016	0.018
25	0.500	-0.368	-0.345	-0.006
26	0.600	-0.152	0.148	0.052
27	0.611	-0.151	-0.014	-0.031
28	0.732	-0.206	0.111	-0.235
29	0.565	-0.194	0.041	-0.013
30	0.701	-0.055	0.106	-0.230
31	0.708	0.389	0.086	-0.079
32	0.253	-0.195	-0.337	0.371
33	0.123	0.076	-0.396	-0.232
34	0.616	-0.013	-0.045	-0.308
35	0.014	0.605	-0.204	-0.049
36	0.343	0.105	-0.070	0.228
37	-0.200	-0.001	-0.066	-0.003
38	0.594	0.216	-0.092	0.122
39	0.370	0.364	-0.132	0.169
40	0.284	0.006	0.126	0.024
41	0.504	-0.074	0.145	-0.118
42	0.468	0.074	0.032	0.250
43	0.357	0.019	0.043	0.051
44	0.385	0.107	-0.030	0.248
45	0.254	-0.082	0.121	-0.040
46	0.285	-0.201	0.064	-0.032
47	0.456	-0.164	0.075	-0.041
48	0.406	0.270	0.292	-0.234
49	0.600	-0.272	0.105	-0.079
50	0.295	0.061	0.012	0.386
51	0.524	-0.171	-0.175	0.500
52	0.298	-0.309	-0.348	0.115
53	0.351	-0.142	0.022	0.041

54	0.459	0.088	-0.519	0.010
55	0.475	-0.234	0.123	-0.013
56	0.349	0.159	-0.057	-0.183
57	0.654	1.131	-0.367	0.677
58	0.574	-0.103	-0.046	0.291
59	0.550	-0.285	-0.219	0.178
60	0.388	0.013	0.080	-0.152
61	0.363	-0.223	-0.602	0.211
62	0.645	0.211	-0.082	0.028
63	0.310	0.171	0.057	0.100
64	0.133	0.658	1.330	-0.104
65	0.348	0.170	0.208	-0.121
66	0.384	-0.092	0.123	0.101
67	0.510	-0.088	0.291	0.380
68	0.120	-0.047	-0.259	0.436
69	0.494	-0.153	0.071	-0.010
70	0.637	-0.323	0.158	0.073
71	0.635	-0.246	0.107	0.018
72	0.626	-0.211	-0.001	0.156
73	0.462	0.039	0.336	0.448
74	0.531	-0.286	-0.022	-0.113
75	0.485	-0.079	0.202	0.050
76	1.022	0.866	-0.188	-0.471
77	0.410	0.000	-0.012	-0.117
78	0.435	0.092	0.328	-0.355
79	0.312	0.054	-0.101	0.017
80	0.486	-0.148	0.080	0.126
81	0.371	-0.075	-0.005	0.014
82	0.366	-0.097	0.140	0.162
83	0.389	-0.050	0.008	0.154
84	0.320	-0.099	0.047	0.057
85	0.438	-0.139	0.129	0.084
86	0.516	-0.120	0.098	0.108
87	0.449	0.098	0.028	0.108
88	0.502	-0.230	-0.093	0.076
89	0.427	-0.172	0.063	0.014
90	0.689	0.052	-0.326	-0.016
91	0.395	0.072	0.033	-0.005
92	0.365	-0.146	0.053	0.027
93	0.437	-0.202	-0.002	0.145
94	0.500	-0.116	0.077	-0.249
95	0.380	0.389	-0.021	0.059
96	0.575	0.223	0.016	0.210
97	0.204	0.454	-0.076	0.023
98	0.329	-0.212	0.175	0.143
99	0.455	-0.078	0.028	-0.161
100	0.580	-0.105	0.110	0.198

Table B.5. Factor Loadings for GCVR-Korean

Item	Factor Loadings			
	1	2	3	4
1	0.230	0.506	0.165	-0.187
2	0.644	0.022	0.131	0.145
3	0.466	0.184	-0.028	-0.240
4	0.477	0.289	0.031	0.034
5	0.137	-0.048	0.001	0.190
6	0.454	0.316	0.300	-0.020
7	0.309	0.289	-0.035	0.158
8	0.692	0.003	0.488	0.549
9	0.531	-0.053	-0.014	0.175
10	0.588	0.023	-0.101	-0.042
11	0.434	0.617	-0.108	-0.002
12	0.338	0.570	0.118	-0.118
13	0.280	0.276	-0.214	-0.211
14	0.161	0.076	-0.327	0.390
15	0.292	-0.196	0.132	0.164
16	0.354	-0.292	0.101	-0.292
17	0.020	0.084	-0.097	-0.474
18	0.121	-0.167	0.158	0.197
19	0.213	0.017	-0.095	-0.147
20	0.085	-0.517	-0.213	0.289
21	0.278	-0.328	0.037	-0.206
22	0.483	-0.187	-0.065	-0.178
23	0.249	-0.335	-0.069	0.039
24	0.524	-0.246	0.097	-0.135
25	0.316	0.415	0.097	0.055
26	0.532	0.299	0.298	0.338
27	0.307	0.706	0.463	0.149
28	0.330	-0.017	0.290	0.127
29	0.400	-0.154	0.120	-0.070
30	0.610	-0.004	0.215	-0.021
31	0.475	0.831	-0.284	-0.004
32	0.179	0.289	-0.384	0.212
33	-0.025	0.488	-0.075	-0.222
34	0.260	-0.294	0.004	-0.053
35	-0.058	-0.122	0.279	0.303
36	0.214	0.207	-0.228	0.078
37	-0.084	-0.079	-0.030	0.116
38	0.480	0.365	-0.036	-0.074
39	0.361	0.625	0.069	0.110
40	0.303	-0.095	0.019	0.268
41	0.330	0.476	0.046	-0.178
42	0.497	0.212	-0.014	0.104
43	0.252	-0.057	-0.191	0.317

44	0.083	-0.349	0.126	-0.129
45	0.274	0.249	0.172	-0.045
46	0.309	0.521	-0.232	-0.083
47	0.341	0.492	-0.314	0.157
48	0.278	0.146	0.052	0.128
49	0.436	0.773	-0.004	-0.027
50	-0.186	0.228	0.611	-0.212
51	0.588	-0.026	-0.229	-0.449
52	0.625	-0.505	0.101	-0.254
53	0.693	-0.431	-0.072	-0.134
54	0.439	0.246	-0.642	-0.113
55	0.540	-0.072	-0.318	-0.174
56	0.500	-0.304	0.322	-0.355
57	0.560	0.199	0.412	-0.285
58	0.357	-0.514	0.397	-0.155
59	0.454	-0.124	0.075	-0.455
60	0.543	0.078	-0.240	-0.537
61	0.559	0.301	-0.147	0.113
62	0.197	0.163	-0.082	-0.044
63	0.315	0.270	0.036	-0.043
64	0.428	-0.584	-0.188	0.038
65	0.529	-0.092	0.235	-0.098
66	0.451	-0.472	0.050	-0.199
67	0.343	-0.135	0.131	-0.081
68	0.425	-0.159	0.074	-0.095
69	0.204	-0.319	0.444	0.113
70	0.631	-0.095	0.061	0.106
71	0.451	-0.396	-0.096	-0.244
72	-0.175	-0.028	0.187	-0.019
73	0.271	-0.150	0.244	0.302
74	0.357	-0.116	-0.160	0.336
75	0.689	-0.203	0.018	0.174
76	0.365	-0.301	-0.283	0.056
77	0.352	-0.048	-0.295	-0.092
78	0.436	-0.292	0.097	-0.211
79	0.120	-0.284	0.274	-0.134
80	0.433	-0.159	0.389	-0.221
81	0.193	-0.289	-0.050	-0.040
82	0.295	0.139	0.313	0.160
83	0.214	-0.590	-0.325	0.413
84	0.474	-0.221	-0.355	0.031
85	0.233	-0.108	0.274	0.280
86	0.554	-0.202	-0.147	0.101
87	0.338	-0.148	-0.044	0.114
88	0.519	0.109	0.099	0.219
89	0.545	-0.261	-0.113	-0.044
90	0.241	-0.434	-0.272	0.333
91	0.426	-0.043	-0.434	0.217
92	0.531	-0.172	-0.234	0.012
93	0.567	0.033	-0.275	-0.029
94	0.475	0.017	0.233	0.250
95	0.242	0.272	0.148	0.267
96	0.546	-0.089	-0.022	0.170
97	0.214	0.101	-0.029	-0.042
98	0.294	0.061	-0.235	-0.008
99	0.334	-0.303	0.059	0.241
100	0.305	0.287	0.199	0.156

Table B.6. Factor Loadings for GCVR- High Proficiency

Item	Factor Loadings			
	1	2	3	4
1	0.355	0.024	-0.346	-0.145
2	0.303	0.184	-0.123	-0.064
3	0.404	0.128	-0.348	-0.059
4	0.390	-0.307	-0.421	-0.354
5	0.153	0.179	0.133	-0.331
6	0.565	-0.224	-0.269	0.106
7	0.179	0.271	-0.084	0.095
8	0.566	-0.145	0.106	-0.087
9	0.160	0.298	0.029	0.025
10	0.309	0.368	-0.146	0.101
11	0.323	-0.263	-0.028	-0.245
12	0.534	-0.013	-0.016	0.011
13	0.416	-0.227	0.040	-0.130
14	0.359	0.526	-0.130	-0.046
15	0.304	0.141	-0.164	-0.081
16	0.417	0.255	0.348	0.002
17	0.143	0.235	-0.114	-0.075
18	0.216	-0.265	-0.246	-1.134
19	0.118	0.725	0.066	0.049
20	0.101	0.134	0.230	-0.089
21	0.294	0.134	0.101	-0.180
22	0.277	0.270	-0.122	-0.055
23	0.693	0.275	0.303	-0.193
24	0.489	0.209	0.034	-0.013
25	0.385	-0.125	-0.007	-0.208
26	0.391	-0.482	-0.170	0.258
27	0.493	0.192	-0.079	-0.188
28	0.494	-0.022	0.115	-0.057
29	0.391	0.250	0.106	-0.211
30	0.393	0.371	-0.075	0.100
31	0.307	0.372	-0.205	0.169
32	0.182	0.115	-0.279	0.479
33	0.248	0.199	-0.036	-0.182

34	0.457	0.090	0.153	-0.092
35	0.107	0.456	-0.033	-0.154
36	0.176	0.213	-0.102	0.158
37	-0.025	0.257	-0.114	0.007
38	0.390	0.282	-0.115	0.069
39	0.134	0.371	-0.090	0.205
40	0.336	-0.101	0.071	-0.074
41	0.380	0.181	-0.022	0.088
42	0.369	0.053	0.051	0.037
43	0.172	0.148	0.093	-0.060
44	0.310	0.167	0.053	-0.026
45	0.167	0.246	-0.394	0.123
46	0.172	-0.201	-0.079	0.070
47	0.336	0.271	-0.308	0.220
48	0.226	0.376	-0.018	-0.044
49	0.686	-0.219	-0.280	0.210
50	0.167	0.187	-0.061	-0.081
51	0.293	-0.159	-0.215	0.750
52	0.086	-0.534	0.341	0.614
53	0.320	-0.011	-0.176	0.533
54	0.293	0.060	-0.525	-0.024
55	0.137	0.311	0.007	0.118
56	0.269	-0.073	0.154	0.012
57	0.395	-0.562	-0.454	-0.374
58	0.492	-0.469	0.297	-0.195
59	0.532	-0.316	0.150	-0.190
60	0.272	-0.171	0.023	0.180
61	0.348	-0.424	0.135	0.160
62	0.475	0.165	-0.082	-0.177
63	0.324	0.221	-0.293	0.014
64	0.095	-0.211	0.595	0.296
65	0.377	-0.127	-0.438	0.048
66	0.205	-0.006	0.083	0.064
67	0.429	-0.239	0.411	0.445
68	0.389	-0.244	0.107	-0.026
69	0.507	0.108	0.407	0.031
70	0.375	-0.432	0.215	0.193
71	0.473	-0.109	0.250	0.037
72	0.568	-0.304	0.188	-0.053
73	0.565	-0.402	0.170	-0.036
74	0.503	-0.110	0.011	-0.093
75	0.477	-0.564	-0.176	0.122
76	-0.122	0.144	1.653	-0.254
77	0.453	-0.141	-0.319	0.110
78	0.576	-0.615	0.291	-0.027
79	0.326	0.096	0.019	-0.180
80	0.453	-0.141	0.224	0.152
81	0.187	0.298	0.052	-0.209
82	0.157	0.344	-0.292	0.172
83	0.108	0.386	0.180	-0.157
84	0.068	0.400	0.094	0.033
85	0.215	0.339	0.092	0.015
86	0.355	-0.200	0.209	0.093
87	0.213	0.204	0.276	0.078
88	0.283	0.417	0.080	0.071
89	0.144	0.265	0.327	0.545
90	0.304	0.431	0.347	-0.172
91	0.064	0.427	0.098	-0.042
92	0.288	0.282	0.032	-0.048
93	0.229	0.142	0.184	0.044
94	0.130	0.495	0.055	0.074
95	0.109	0.285	-0.038	0.164
96	0.181	0.307	0.110	0.030
97	-0.036	0.299	-0.049	0.154
98	0.204	0.083	0.113	0.158
99	0.206	0.354	0.131	0.021
100	0.411	0.109	0.122	0.002

Table B.7. Factor Loadings for GCVR-Low Proficiency

Item	Factor Loadings			
	1	2	3	4
1	0.407	-0.192	0.202	0.255
2	0.266	0.257	-0.105	0.120
3	0.234	0.053	0.055	0.036
4	0.405	-0.005	0.009	0.312
5	0.184	-0.158	0.119	-0.041
6	0.305	-0.023	-0.164	0.201
7	-0.081	0.194	0.195	0.016
8	0.324	-0.122	0.298	0.333
9	0.013	0.329	-0.060	0.198
10	0.078	0.523	-0.201	-0.040
11	0.518	-0.018	0.007	0.350
12	0.087	-0.080	0.030	0.399
13	0.456	-0.124	-0.042	-0.036
14	-0.157	0.291	-0.190	-0.059
15	0.464	0.147	0.108	0.041
16	0.129	0.262	-0.442	-0.062
17	-0.157	0.020	0.453	0.212
18	0.264	-0.217	0.342	0.005
19	-0.327	0.324	-0.017	0.099
20	-0.026	0.202	0.139	-0.142
21	0.157	-0.065	0.223	0.068
22	0.205	0.299	0.036	0.196
23	-0.104	0.349	-0.287	-0.090

24	0.018	0.356	-0.162	0.047	72	0.244	-0.086	-0.013	0.058
25	0.366	-0.076	-0.173	0.199	73	0.478	-0.280	-0.040	0.039
26	0.441	0.114	-0.238	0.271	74	0.185	-0.055	0.168	-0.003
27	-0.019	0.083	-0.073	0.433	75	0.730	-0.050	-0.043	-0.045
28	0.234	0.232	0.024	0.376	76	0.710	0.034	0.006	-0.154
29	0.120	0.032	-0.018	0.105	77	0.513	0.012	0.162	-0.157
30	-0.049	0.689	-0.133	0.014	78	0.622	-0.363	0.024	-0.057
31	-0.187	0.141	-0.236	0.405	79	0.220	-0.012	0.304	-0.145
32	0.377	0.134	-0.119	-0.023	80	0.432	-0.113	0.059	0.048
33	0.116	-0.195	0.091	0.132	81	0.087	0.151	0.120	-0.033
34	0.105	0.155	0.121	0.160	82	0.197	0.221	0.160	-0.043
35	-0.232	-0.147	0.089	0.024	83	0.126	0.350	0.249	-0.318
36	0.081	0.251	0.124	0.169	84	0.154	0.402	0.325	-0.083
37	-0.190	-0.166	0.076	-0.021	85	-0.032	0.272	0.331	0.125
38	-0.079	0.050	-0.178	0.031	86	0.549	0.058	0.009	-0.149
39	-0.112	0.264	-0.080	0.174	87	0.050	0.203	0.239	0.022
40	0.467	-0.136	0.170	-0.013	88	0.070	0.315	0.093	0.138
41	0.074	0.128	-0.129	-0.011	89	0.468	0.155	0.228	-0.080
42	0.284	0.005	-0.115	0.166	90	-0.061	0.427	0.198	-0.040
43	-0.003	-0.029	0.183	0.099	91	0.041	0.257	0.214	-0.029
44	0.022	0.171	0.190	-0.048	92	0.101	0.073	0.303	-0.301
45	0.039	0.118	0.118	0.009	93	0.437	0.202	0.189	-0.021
46	0.228	-0.171	-0.069	0.134	94	0.021	0.246	0.349	0.044
47	-0.007	0.358	0.033	0.221	95	-0.021	0.216	0.104	0.149
48	-0.154	0.177	0.242	-0.049	96	0.148	0.226	0.173	-0.119
49	0.279	0.042	0.003	0.381	97	-0.126	0.220	-0.049	-0.066
50	-0.022	0.161	0.134	0.329	98	0.126	0.195	-0.112	-0.045
51	0.687	0.158	-0.134	-0.119	99	0.076	0.260	0.100	-0.100
52	0.638	0.084	-0.164	-0.287	100	0.175	0.091	0.151	0.134
53	0.444	0.156	-0.101	-0.257					
54	0.524	0.070	-0.097	-0.003					
55	0.229	0.433	-0.267	-0.010					
56	0.317	0.002	-0.193	-0.159					
57	0.764	-0.358	-0.012	-0.065					
58	0.605	-0.004	0.113	-0.077					
59	0.659	-0.020	-0.028	-0.006					
60	0.495	0.036	-0.101	-0.103					
61	0.678	-0.080	-0.097	0.068					
62	-0.039	0.207	-0.059	0.032					
63	0.132	-0.020	-0.096	0.036					
64	0.673	0.166	-0.094	-0.127					
65	0.518	0.115	0.081	0.062					
66	0.176	0.360	0.092	-0.179					
67	0.578	0.107	-0.004	-0.092					
68	0.719	-0.205	0.012	0.079					
69	-0.030	0.025	0.139	-0.140					
70	0.644	0.006	-0.170	0.094					
71	0.213	0.138	-0.146	-0.209					